4.0 - AFFECTED ENVIRONMENT

4.1 INTRODUCTION

This chapter provides an analysis of the environmental consequences from implementation of the Proposed Action (Alternative A), Alternative B (No Action Alternative), and Alternative C (Vertical Drilling in the Potential Oil Shale Development Area). ACEPMs and additional Resource Protection Measures that would reduce impacts under Alternative A and/or C have been included in **Chapter 2** of this EA, and the analyses in this chapter assume that those measures would be implemented.

Direct impacts to resources, those that are caused by the action and occur at the same time and/or place (40 CFR 1508.8), in the following analyses are described in terms of initial impacts from construction and development activities. In areas where interim reclamation is implemented, ground cover by herbaceous and woody species could re-establish within 7 to 8 years following seeding of native plant species and diligent weed control efforts. However, it is important to note that recent BLM monitoring has documented that reclamation efforts for oil and gas development have largely been unsuccessful at reestablishing soil stability, vegetation, and subsequent forage for wildlife and livestock due to poor soils and drought. BLM field inspections show that initial impacts may be more accurately portrayed as long-term impacts. All surface disturbance proposed under the alternatives, therefore, could remain as long-term (or even permanent) impacts on the landscape if reclamation efforts are not successful.

4.2 GEOLOGY, MINERALS, AND PALEONTOLOGY

4.2.1 GEOLOGY AND MINERALS

4.2.1.1 Alternative A – Proposed Action

Potential impacts to geologic and mineral resources from the Proposed Action include interference with potential mining of oil shale in the Project Area.

<u>Oil Shale</u>

Development of the Proposed Action could potentially conflict with future oil shale development. As described in **Section 3.2**, OSEC was granted a lease on 160 acres of land within the Project Area in Sections 22 and 23 of T10S, R24E, to conduct a RD&D project to evaluate oil shale extraction technologies on the former site of the White River Corporation Mine. Tests conducted to date reveal that the shale produces about 30 gallons of oil per ton using retort processing. Shale mining in this area could be conducted across a vertical interval of about 58 feet at a depth of about 1,200 feet. If the pilot project proves to be successful, OSEC may be granted an additional 4,960 acres of preferential lease rights within the Project Area for the development of a commercial-scale oil shale facility. The shale would be mined by underground room-and-pillar methods. Surface facilities would include fresh and spent shale stockpiles, roads, water management facilities, maintenance shops, and shale retorts.

Under the Proposed Action, both vertical and directionally-drilled wells would be drilled in the preferential lease rights area, and two well pads would be constructed within the 160-acre RD&D area. Surface disturbance within the RD&D area would be approximately 10 acres. An additional 452 acres of surface disturbance would occur within the preferential lease area. A

maximum of 462 acres, therefore, would be unavailable for surface facilities for oil shale production during the 30-40 year LOP.

Within the preferential lease area, well casings would also present obstacles to underground mining of oil shale, as well as health and safety concerns, especially for directionally-drilled well casings. Vertical well casings could be accommodated within the pillars in a conventional room-and-pillar mining plan, where vertical columns of rock (pillars) are left in place to support the ceilings of the mine. Downhole GPS surveys would be performed to accurately locate all well casings within the preferential lease area. Because of the health and safety concerns associated with the unintentional breaching of a well casing, directionally-drilled wells could preclude oil shale mining in their immediate vicinity.

4.2.1.2 Alternative B – No Action

Potential impacts to geologic and mineral resources from the No Action Alternative are similar in nature to those for the Proposed Action but lesser in magnitude. Because no wells would be developed on Federal lands, interference with potential mining of oil shale in the RD&D and preferential lease areas would be minimal under the No Action Alternative.

Oil Shale

Development of the No Action Alternative would have minimal impacts on future oil shale development. The oil shale RD&D and preferential lease areas are located entirely on Federal lands. One co-located pipeline and access road would cross the preferential lease area under the No Action Alternative, precluding a small area from development of surface facilities. No wells would be drilled in the RD&D or preferential lease area.

4.2.1.3 Alternative C – Vertical Drilling in the Potential Oil Shale Development Area

Potential impacts to geologic and mineral resources from the Alternative C are similar to those for the Proposed Action in nature and include interference with potential mining of oil shale in the Project Area.

Oil Shale

Alternative C has been designed to minimize potential conflicts with future oil shale development. Under Alternative C, no well pads would be located in the oil shale RD&D area and only vertical wells would be drilled in the oil shale preferential lease rights area. Initial surface disturbance for the well pads, access roads, pipelines, and compressor station within the preferential lease rights area under Alternative C would be about 711 acres, or about 14.3 percent of the land surface within the preferential lease area. At least this much of the area would be unavailable for the development of surface facilities for oil shale production during the 30-40 year LOP.

Under Alternative C, vertical well casings could be accommodated within the pillars in a conventional room-and-pillar mining plan, where vertical columns of rock (pillars) are left in place to support the ceilings of the mine. This arrangement would allow for more efficient extraction of shale in this area, and reduce the potential health and safety risks associated with the well casings.

4.2.1.4 Recommended Mitigation Measures

The following mitigation measures are recommended consistent with Utah Administrative Code R649-3-27, R649-3-30, and R649-3-31.

- Operators engaged in oil and gas operations on lands which operators are exploring for and developing mineral resources other than oil and gas should enter into a cooperative agreement with respect to multiple mineral management. The agreement should define such items as:
    - The coordination of access to and development within an area.
    - Mitigation of subsurface impact including but not limited to issues pertaining to the interface in the underground environment of oil shale mining operations and other mineral operations.
    - Exchange of geologic, engineering, and production data.
- On wells that are intentionally deviated from the vertical within potential oil shale areas (i.e., the RD&D or preferential lease area) a directional survey shall be run from a point at least 20 feet below the oil shale section to the surface and shall thereafter be filed with the BLM within 20 days after reaching total depth.
- BLM involvement will be requested when any producing well is approached by oil shale mine workings within a distance of 2,640 feet.
- Any casing set into or through the oil shale section shall be cemented over the entire oil shale section.
- If a well is dry, junked, or abandoned, a cement plug shall be placed across the entire portion of the oil shale section extending 200 feet above and 200 feet below the longitudinal center of the Mahogany Zone. When the casing is cemented, cement plugs 200 feet in length shall be centered across the top and across the base of the Parachute Creek member of the Green River Formation. In the event that the casing is not cemented, the BLM should approve the method and procedure to prevent the migration of oil, gas, and other substances through the wellbore from one formation to another.
- The BLM, with concurrence of the operator, may change the surface location of the proposed well if there appears to be any possibility of interference between the proposed well bore and mine workings.
- The BLM shall approve the adequacy and location of the cement plugs after examining the appropriate logs and drilling and testing records for the well, to ensure that the oil shale section is adequately protected.
- Before commencing a drilling operation for oil and gas on any lands within either the RD&D or preferential lease area, the operator shall furnish a copy of the APD, together with a plat or map, to oil shale owners or their lessees whose interests are within a radius of 2,640 feet of the proposed well. The operator shall furnish a notice of intention to plug and abandon any well in areas where oil shale development could occur to the owners of lessees prior to commencement of plugging operations.

- The Operator shall use generally accepted techniques for vertical and directional drilling and maintain the wellbore within an intact core of any mine pillar, should wells be drilled within an active mining location.

4.2.2 PALEONTOLOGICAL RESOURCES

4.2.2.1 Alternative A – Proposed Action

Potential impacts to paleontological resources under the Proposed Action include the loss of scientifically important fossils due to primary surface-disturbing activities such as well pad and access road excavation and grading, and secondary surface activities, such as vehicular and pedestrian traffic. A total of 249 wells would be drilled from 152 well pads with an initial surface disturbance of 858 acres. Where surface-disturbing activities occur on previously disturbed areas, fossil resources would not be affected. However, where surface disturbance is proposed on undisturbed fossiliferous formations, paleontological resources would be at risk. Where fossils occur on the surface within these areas, they may potentially be broken or destroyed during surface-disturbing activities. Disturbance of bedrock for the construction of reserve pits and access roads also results in the potential for exposing, breaking, and destroying fossils. The magnitude of the potential losses cannot be quantified, as fossils may be unknowingly destroyed. Alternatively, construction of well pads and access roads may uncover scientifically important fossils.

Because of the potential for fossil resources to occur in the Project Area, paleontological surveys would be conducted by a BLM-approved paleontologist prior to any surface disturbance in sandstone bedrock or other sensitive geologic formations under the Proposed Action. If significant fossils are encountered during the survey, the paleontologist would assess and document the discovery and contact the appropriate BLM AO. The BLM AO would determine the need for further monitoring of the area or mitigation of the site during surface-disturbing activities. Also, if fossils are encountered by the project operator during excavation, construction would be suspended, and the appropriate BLM AO would be notified. Construction would not resume until the fossils are assessed by the BLM AO, and appropriate mitigation, monitoring, and/or compliance measures are developed and implemented.

4.2.2.2 Alternative B – No Action

Under the No Action Alternative, new wells would not be allowed on Federal lands in the Project Area. Drilling and production would occur only on State and private lands within the Project Area. A total of 36 wells would be drilled under the No Action Alternative, as compared to 249 wells under the Proposed Action. Surface disturbance under the No Action Alternative would be about 21% of that under the Proposed Action. Therefore, the potential for adverse (or beneficial) impacts to paleontological resources from the No Action Alternative is about one-fifth of that for the Proposed Action.

4.2.2.3 Alternative C – Vertical Drilling in the Potential Oil Shale Development Area

Potential impacts to fossils from Alternative C would be similar to those under the Proposed Action. A total of 240 wells would be drilled under the Alternative C, as compared to 249 wells under the Proposed Action. Surface disturbance under Alternative C would be about 1.3 times that for the Proposed Action. Therefore, the potential for adverse (or beneficial) impacts to paleontological resources from Alternative C is about 1.3 times of that under the Proposed Action.

4.2.2.4 Recommended Mitigation Measures

If vertebrate fossils or noteworthy invertebrate or plant fossils are found, the following steps would be taken to reduce loss of paleontological information and resources as directed by the SMA Authorized Officer:

Sampling. Fossil material would be sampled if needed to determine the significance of the find.

Salvage. Salvage would be required, as directed by the Authorized Officer, if the fossil discovery is of scientific interest and the proposed development would destroy the site, if time- and cost-effective, or if the fossil material is small and can be quickly collected. Often, once the material from a particular site has been collected and properly recorded, the need for further protection ceases.

Rerouting. Rerouting of project facilities would occur, as directed by the Authorized Officer, if critical or significant fossil material is discovered directly on the road or pipeline route or proposed well pad or compressor station site. This option would generally be considered if the fossil locality is scientifically very important and should be left undisturbed for subsequent scientific evaluation.

Relocation. Occasionally, as directed by the Authorized Officer, it would be appropriate to move fossils out of the impact zone and relocate them nearby. This option might apply to poorly-preserved fossils of limited extent.

Monitoring. If field surveys suggest that critical or significant fossil material is likely to be encountered in a certain area, monitoring by a qualified paleontologist during ground-disturbing activities would be required, as directed by the Authorized Officer.

4.3 AIR QUALITY AND CLIMATE

The following sections describe and quantify potential impacts that each Alternative could have on air quality. All dispersion modeling was performed using the AERMOD-Prime model (version 07026). The meteorological data used was from surface and upper air stations developed for the West Tavaputs Draft Environmental Impact Statement (BLM 2008b). AERMET, a sub-program of AERMOD, was used to process the meteorological data. As the Project Area has complex terrain, AERMOD was run with the terrain option using USGS digital elevation maps. Fence lines were set up 100 meters (m) from each source. Receptors were spaced as follows: 25 m apart on fence lines, 100 m apart up to 500 m from the fence lines, 500 m apart up to 1,000 m from the fence lines, and 1,000 m apart up to 5,000 m from the fence lines.

All comparisons with PSD Class II increments are intended only to evaluate potential significance, and do not represent a regulatory PSD increment consumption analysis. PSD increment consumption analyses are typically applied to large industrial sources during permitting, and are solely the responsibility of the State of Utah and the EPA. The maximum modeled concentrations for NO_2 reflects an adjustment by a factor of 0.75, in accordance with standard EPA methodology (60:153 FR 40469, Aug 9, 1995) to convert from the modeled NO_x concentration to NO_2.

4.3.1 ALTERNATIVE A – PROPOSED ACTION

The emission sources associated with the Proposed Action would be those associated with well development and well production. This includes vehicle traffic, construction, drilling, and completion activity during the development phase of the Proposed Action, followed by continuous emissions from condensate storage tanks, dehydration units, compressor engines, and operations traffic. Air pollutants from these sources would include NO_X, CO, PM_{10}, $PM_{2.5}$, and VOCs. Benzene, toluene, ethylbenzene, xylenes, n-hexane, and formaldehyde would be the primary HAPs. Detailed emission calculations for each activity are shown in **Appendix F**.

During the 10-year construction and drilling phase, vehicle tailpipe and road dust emissions would increase within the Project Area. Vehicle emissions would result from work crews commuting to and from the work site and from the transportation and operation of equipment to construct wells pads, access roads, and pipelines. NO_X, SO_2, and CO would be emitted from vehicle tailpipes. Fugitive dust would increase with additional vehicle traffic on unpaved roads and from wind erosion in areas of soil disturbance. Drill and completion rig operations would result mainly in an increase of NO_X and CO emissions, with lesser amounts of SO_2. These emissions would be short-term for the drilling and completion times.

Emission rates were calculated using applicable EPA emission factors and anticipated level of operational activities, such as estimated vehicle trips, load factors, and hours of operation. Development emissions would produce elevated pollutant levels but would be short-term and localized for the duration of the activities.

After construction, NO_x, CO, VOC, and HAP emissions would result from the long-term operation of storage tank vents, well pad separators, dehydration units, and compression engines. Additionally, road dust (PM_{10} and $PM_{2.5}$) and tailpipe emissions would be produced by vehicles serving the wells.

Estimated emissions from the Proposed Action are summarized in **Tables 4.3-1, 4.3-2**, and **4.3-3**. All development-related emission calculations assume a maximum development rate of 35 wells and 21 pads per year. Production emissions are calculated for the full-field development of 249 wells.

Table 4.3-1. Annual Emissions for Development Phases of the Proposed Action

Pollutant	Development Emissions (tons/year)[1]					Total (tons/yr)
	Construction	Wind Erosion	Drilling	Completion	Interim Reclamation	
NO_X	1.1	-	174	27.9	1.0E-02	203
CO	0.4	-	42	36.5	2.8E-02	79
VOC	0.1	-	2.6	0.8	6.1E-03	3.4
SO_2	3.2E-02	-	2.9	0.39	4.3E-04	3.4
PM_{10}	3.8	0.4	67	45	2.2	118
$PM_{2.5}$	0.5	0.2	10	5.5	0.2	16
Benzene	-	-	1.4E-02	2.0E-03	-	1.6E-02
Toluene	-	-	5.2E-03	9.5E-04	-	6.1E-03

Pollutant	Development Emissions (tons/year)[1]					Total (tons/yr)
	Construction	Wind Erosion	Drilling	Completion	Interim Reclamation	
Ethylbenzene	-	-	-	-	-	0
Xylene	-	-	3.6E-03	4.5E-04	-	4.0E-03
n-Hexane	-	-	-	1.6E-01	-	0.2
Formaldehyde	2.6E-02	-	1.5E-03	6.8E-03	-	3.4E-02

[1] Assumes maximum development scenario (35 wells developed in 1 year).

Table 4.3-2. Total Annual Production Emissions from the Proposed Action[1]

Pollutant	Tons/Year					Total (tons/year)
	Separators & Dehy Reboilers	Condensate Tanks	Dehydrators	Operations Vehicle	Compressor Engines	
NO_X	62	-	-	1.2	22	85
CO	52	-	-	6.8	1.9	61
VOC	4.5E-02	1,114	1.0	0.7	3.6	1,119
SO_2	-	-	-	0.1	-	0.1
PM_{10}	4.7	-	-	181	0.5	186
$PM_{2.5}$	4.7	-	-	18	0.5	24
Benzene	1.3E-03	0.4	0.1	-	2.3E-02	0.5
Toluene	2.1E-03	0.4	0.2	-	2.1E-02	0.6
Ethylbenzene	-	0.1	3.6E-02	-	2.1E-03	0.1
Xylene	-	0.1	0.1	-	9.7E-03	0.3
n-Hexane	1.12	4.0	3.6E-02	-	0.1	5.2
Formaldehyde	0.05	-	-	-	0.3	0.3

[1] Emissions include 249 producing wells (including associated operations traffic)

Table 4.3-3. Southam Proposed Action Annual Emissions (tons/year) [1]

Pollutant	Development	Production	Total
NO_x	203	85	288
CO	79	61	140
VOC	3.4	1,119	1,122
SO_2	3.36	0.06	3.4
PM_{10}	118	186	304
$PM_{2.5}$	16	23.0	40
Benzene	2.E-02	0.5	0.6
Toluene	6.E-03	0.6	0.6

Pollutant	Development	Production	Total
Ethylbenzene	-	0.1	0.1
Xylene	4.E-03	0.3	0.3
n-Hexane	0.2	5.2	5.4
Formaldehyde	0.03	0.3	0.4

[1] Emissions include 249 producing wells (including associated operations traffic) and 35 wells being developed in one year.

Detailed emission comparisons are presented in **Tables 4.3-4, 4.3-5**, and **4.3-6** for all alternatives for NO_x, PM_{10}, and $PM_{2.5}$ respectively. Alternatives B and C emissions and impacts are discussed in later sections.

Table 4.3-4. Comparison of NO_x Emissions by Alternative

Oxides of Nitrogen (NOx) Emission Comparison by Alternative Activity/Total	NOx (Tons per Year)		
	Alt A 249 wells	Alt B 36 wells	Alt C 240 wells
Construction	1.12	0.63	1.38
Drilling	174	89	179
Completion	27.9	14	28.7
Total Development	***203***	***104***	***209***
Wellsite Separators	54.5	16	60.4
Operations Traffic	1.19	0.26	1.24
Total Well Production	***64***	***16***	***61.7***
Central Compression Facilities	22	22	22
Total Production	***85***	***38***	***83***
Project Total	**288**	**134**	**293**

Table 4.3-5. Comparison of PM_{10} Emissions by Alternative

Particulate Matter less than 10 microns in diameter (PM_{10}) Emission Comparison by Alternative Activity/Total	PM_{10} (Tons per Year)		
	Alt A 249 wells	Alt B 36 wells	Alt C 240 wells
Construction	3.7	2.2	5.2
Drilling	66	34.1	68
Completion	45	23.1	46
Total Development	***118***	***61***	***122***
Wellsite and Central Separators	4.1	1.2	4.0
Operations Traffic	181	44	188
Total Well Production	***186***	***45***	***192***
Central Compression Facilities	0.5	0.5	0.5
Total Production	***186***	***46***	***192***
Project Total	**304**	**105**	**315**

Table 4.3-6. Comparison of $PM_{2.5}$ Emissions by Alternative

Particulate Matter less than 2.5 microns in diameter ($PM_{2.5}$) Emission Comparison by Alternative Activity/Total	$PM_{2.5}$ (Tons per Year)		
	Alt A 249 wells	**Alt B 36 wells**	**Alt C 240 wells**
Construction	0.5	0.3	0.8
Drilling	10	5.0	10
Completion	5.5	2.8	5.6
Total Development	***16***	***8.1***	***17***
Wellsite Separators	4.1	0.6	4.0
Operations Traffic	18.2	4.5	18.9
Total Well Production	***22***	***5.1***	***23***
Central Compression Facilities	0.5	0.5	0.5
Total Production	***23***	***5.6***	***24***
Project Total	**40**	**14**	**41**

4.3.1.1 Criteria Pollutant Ambient Air Quality Impacts

The predicted criteria pollutant impacts are compared to applicable Utah and NAAQS standards and to prevention of significant deterioration (PSD) Class II increments. All comparisons with PSD Class II increments are intended only to evaluate potential significance, and do not represent a regulatory PSD increment consumption analysis.

Development

Dispersion modeling was performed to predict the impacts of pollutant emissions for comparison to NAAQS for $PM_{2.5}$, PM_{10}, NO_2, CO, and SO_2 for the development phase of the Proposed Action. Since development activities are temporary and short-term in nature, comparisons to PSD increments are not appropriate.

Based on a maximum of 35 wells developed per year with two drill rigs, a model with two pad/roads being constructed, two wells being drilled, and two wells being completed was run with the closest six proposed well pads. Each modeled well pad had a 0.24-mile road. A total of 1,106 receptors were evaluated by the model.

Table 4.3-7 shows the maximum predicted air quality impacts compared to the appropriate NAAQS. The predicted impacts would be less than the applicable NAAQS during the development phase. Maximum impacts commonly occurred at fence line receptors, as shown on **Figure 4.3-1**, 24-Hour $PM_{2.5}$ Southam Canyon Predicted Impacts.

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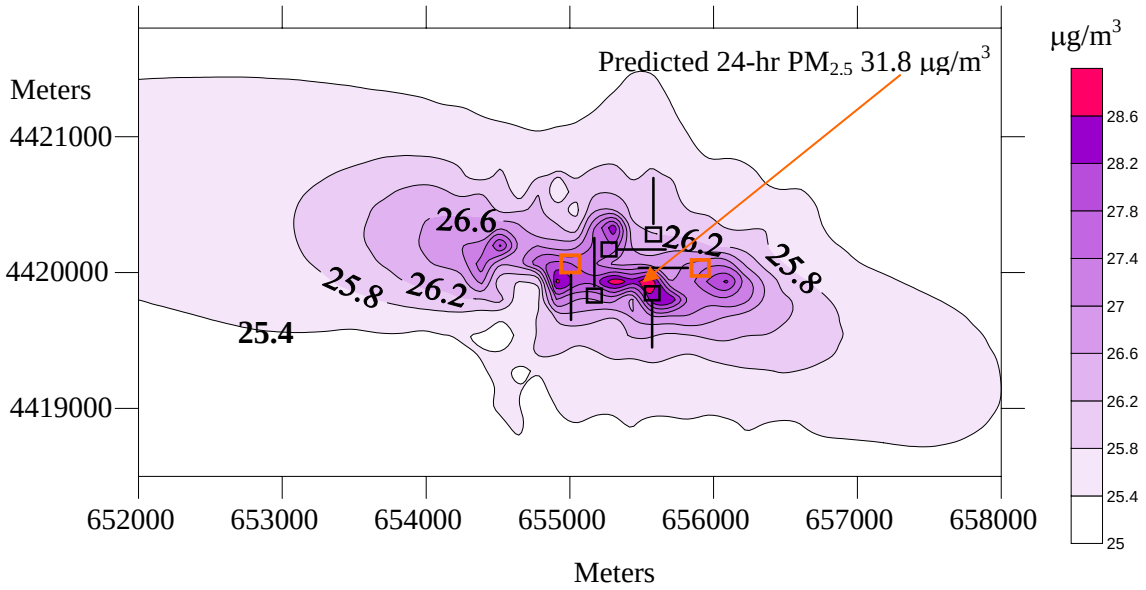
Figure 4.3-1. 24-Hour $PM_{2.5}$ Southam Canyon Predicted Development Impacts



□ = Well Pad being constructed □ = Well Pad —— = Road

Activity by location:			
Construction	Drilling Completion	Completion Drilling	Construction

Background $PM_{2.5}$ = 25 µg/m^3

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Table 4.3-7. Proposed Action Criteria Pollutants Development Ambient Air Maximum Impact Summary

Pollutant	Period	Project Impact (µg/m^3)	Uinta Basin Background Concentration [e] (µg/m^3)	Maximum Project Impact Plus Background (µg/m^3)	National and Utah Ambient Air Quality Standard (µg/m^3)	Percent of NAAQS
$PM_{2.5}$	24-hour Maximum Average [a]	6.8	25	31.8	35	91%
	Annual Mean	2.85 [d]	9	11.85	15	79%
PM_{10}	24-hour Maximum Average [b]	9.19	63.3	72.5	150	48%
NO_2 [c]	Annual Mean	2.72	17	19.7	100	20%
CO	1-hour Maximum	2,681	1,111	3,792	40,000	9%
	8-hour Maximum Average	1,202	1,111	2,313	10,000	23%
SO_2	3-Hour	172	20	192	1300	15%
	24-Hour	42.6	10	52.6	365	14%
	Annual	5.21	5	10.21	80	13%

[a] Concentration estimate represents a 5-year average of the 6th highest 24-hour PM_{10} concentrations
[b] Concentration estimate represents a 3-year average of the 8th highest 24-hour $PM_{2.5}$ concentrations.
[c] Modeled NO_x converted to NO_2 (multiplied by 0.75)
[d] Modeled impact is conservative as activities were modeled 24-hrs per day 365-days per year at the same location. Actual annual impact would be less.
[e] Source: Dave Prey of UDEQ-DAQ June 13th, 2008; the state of Utah currently does not require $PM_{2.5}$ modeling for new sources and does not have an official background. Mr. Prey recommended using the values presented in the table for now.

Operations

Dispersion modeling was performed to predict the impacts of pollutant emissions compared to significance criteria for $PM_{2.5}$, PM_{10}, NO_2, and CO for the operations phase of the Proposed Action. Predicted emissions for SO_2 for operations are less than 1 ton per year (see **Table 4.3-3**) and were not modeled. The compressor station, 6 proposed well sites with 8 proposed wells, and associated roads were modeled. A total of 1,340 receptors were evaluated by the model.

Table 4.3-8 summarizes the criteria pollutant impacts resulting from the Proposed Action operations. All concentrations are predicted to be below the NAAQS and the PSD Class II increments.

Table 4.3-8. Proposed Action Near-Field Operations Predicted Impacts

Pollutant	Averaging Period	Predicted Concentration (µg/m^3)	Percent of PSD Class II Increment	Background [a] (µg/m3)	Project + Background (µg/m3)	Percent of NAAQS (Project + Background)
NO_2	Annual [b]	5.0	20%	17	22	22%
PM_{10}	24-hour [c]	2.7	9%	63	66	44%

Pollutant	Averaging Period	Predicted Concentration (µg/m^3)	Percent of PSD Class II Increment	Background [a] (µg/m3)	Project + Background (µg/m3)	Percent of NAAQS (Project + Background)
$PM_{2.5}$	Annual	0.8	N/A	9	26	74%
$PM_{2.5}$	24-hour [d]	0.3	N/A	25	9.3	62%
CO	1-hour	135	N/A	1,111	1,246	3%
CO	8-hour	28	N/A	1,111	1,139	11%

[a] Source: Dave Prey of UDEQ-DAQ June 13th, 2008; the state of Utah currently does not require $PM_{2.5}$ modeling for new sources and does not have an official background. Mr. Prey recommended using the values presented in the table for $PM_{2.5}$.
[b] Modeled NO_x converted to NO_2 (multiplied by 0.75)
[c] Concentration estimate represents a 5-year average of the 6th highest 24-hour PM_{10} concentrations
[d] Concentration estimate represents a 3-year average of the 8th highest 24-hour $PM_{2.5}$ concentrations.

4.3.1.2 Hazardous Air Pollutant (HAP) Ambient Air Impacts

The primary source of HAPs is from condensate storage tanks, with smaller amounts from other production equipment. Small amounts of HAPs are emitted by construction equipment. However, these emissions are estimated to be less than 1 ton per year, and were not modeled. The central compressor station and the nearest 6 well pads were modeled (8 wells).

Predicted Potential Non-Cancer Health Effects

Modeled HAP concentrations were compared to available dose-response assessment data used by the EPA Office of Air Quality Planning and Standards for risk assessments of HAPs. Short-term impacts from HAP exposure were assessed by comparing maximum 1-hour average impacts to the HAP-specific acute reference exposure level (REL) and annual average impacts to the HAP-specific reference concentration (RfC for continuous inhalation exposure). The REL is the acute concentration at or below which no non-cancer adverse health effects are expected. The RfC is the average concentration (i.e., an annual average) at or below which no long-term, non-cancer adverse health effects are expected. As shown in **Table 4.3-9** the predicted concentrations exceed the acrolein 1-hr REL, all other HAPs are below non-cancer effect risk levels.

Table 4.3-9. Proposed Action Non-Carcinogenic Acute REL and RfC Impacts

HAP	REL [a] (µg/m^3)	Predicted Maximum One-Hour Impact	Percent of REL	RfC[i] (µg/m^3)	Predicted Maximum Annual Impact (µg/m^3)	Percent of RfC
Acrolein	0.19 [a]	1.18	621%	0.02	0.017	85%
Acrolein	69 [b]	1.18	1.71%	0.06 [g]	0.017	28.3%
Acrolein	230 [c]	1.18	0.51%	6.9 [h]	0.2	2.9%
Acrolein	450 [d]	1.18	0.26%	-	-	-
Formaldehyde	94 [a]	5.3	5.6%	9.8	0.08	0.82%
Benzene	1,300 [a,c]	32.3	2.48%	30	2.14	7.13%
Benzene	160,000 [d]	171	0.11%	-	-	-
Toluene	37,000 [a]	156	0.42%	5,000	2.0	0.04%

HAP	REL [a] (µg/m^3)	Predicted Maximum One-Hour Impact	Percent of REL	RfC[i] (µg/m^3)	Predicted Maximum Annual Impact (µg/m^3)	Percent of RfC
Ethylbenzene	350,000 [d]	0.18	0.000%	1,000	0.03	0.003%
Xylenes	22,000 [a]	52.1	0.24%	100	0.67	0.67%
n-Hexane	390,000 [d]	1,759	0.451%	700	21.8	3.11%

[a] California EPA Reference Exposure Level (REL) for no adverse effects EPA Air Toxics Database, Table 2 (EPA 2007)
[b] Acute Exposure Guideline Level (AEGL) for 1-hr and 8-hr exposure with mild effects for once-in-a-lifetime (rare) exposure (for exposure from spills or catastrophic releases), Table 2 (EPA 2007)
[c] Acute Exposure Guideline Level (AEGL) for 1-hr and 8-hr exposure with moderate effects for once-in-a-lifetime (rare) exposure (for exposure from spills or catastrophic releases), Table 2 (EPA 2007)
[d] Immediately Dangerous to Life or Health (IDLH)/10, EPA Air Toxics Database, Table 2 (EPA 2007) since no available REL
[e] REL for benzene is based on a 6-hr exposure (OEHHA 1999), predicted concentration is a 6-hr average.
[f] EPA Air Toxics Database, Table 1 (EPA 2007)
[g] California EPA chronic REL
[h] Mininum risk level for 1-14-day exposure for no adverse effects set by Agency for Toxic Substances and Disease Registry (ATSDR) from Table 2 (EPA 2007) compared to 24-hr predicted concentration
[i] RfC is the reference concentration for no observed adverse effect from chronic inhalation (non-cancer) EPA Air Toxics Database, Table 1 (EPA 2007) http://www.epa.gov/ttn/atw/toxsource/summary.html

The sources of acrolein for the Proposed Action are the compressor engines. Exposure to acrolein would be limited, therefore, primarily to workers in proximity to the well pads and compressor station. **Figure 4.3-2** shows the area of predicted exceedance. Acrolein is a very reactive compound with a half-life in air of 1 day. Exposure to lower levels of acrolein can cause eye, nose, and throat irritation, and can lower breathing rates. Higher levels of acrolein can damage the lungs and cause death (ATSDR 2007 EPA's website documentation for the acrolein RfC indicates EPA has medium confidence in the RfC as it is based on medium quality data (http://www.epa.gov/iris/subst/0364.htm). The exceedence of the REL for no adverse shown in **Table 4.3-9** is not a violation as there is no law or standard for exposure to acrolein. The predicted level of acrolein is 0.26% of the guideline for "Immediately Dangerous to Life or Health" so workers in the area are not expected to be in immediate danger, although sensitive workers may experience eye, nose, and/or throat irritation.

Predicted Potential Cancer Risk

The risk from long-term exposure to carcinogenic HAP emissions is assessed by comparison to the generally acceptable risk range of one additional cancer per one million exposed persons (1 x 10^{-6}) to one additional cancer per 10 thousand exposed persons (1 x 10^{-4}) (40 CFR § 300.430 (e)(2)(i)(A)(2)). Benzene and formaldehyde, the project HAP carcinogens, are evaluated.

Screening level risk assessment involves application of a HAP-specific unit risk factor. The unit risk factor is an upper-bound estimate of the probability of one additional person contracting cancer based on continuous exposure to 1-ug/m^3 of the substance over a 70-year lifetime. Exposure adjustment factors are calculated to adjust for actual exposure times. Cancer risk is estimated for two exposure scenarios: the most likely exposure (MLE) that individuals will experience and the maximally exposed individual (MEI).

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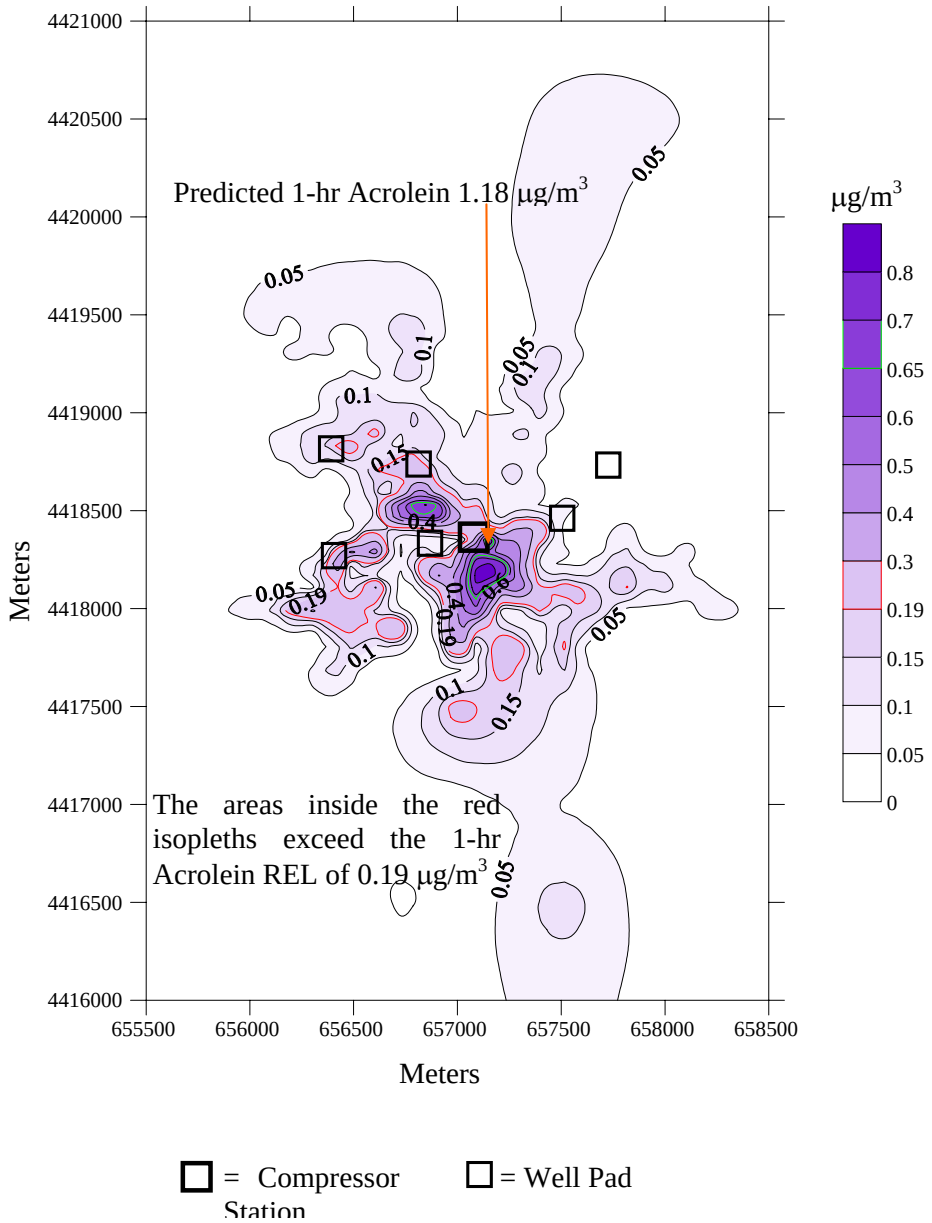
Figure 4.3-2. 1-Hour Acrolein Southam Canyon Predicted Operations Impacts



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The MLE applies to people living in the Project Area. For the MLE exposure adjustment factor, it is assumed a family stays at a residence an average of 9 years and spends 64 percent of the day away from the home (EPA 1997). It is further assumed that households are exposed to one-quarter of the maximum concentration the remaining (36 percent) of the time. This results in an adjustment factor of 0.095 [(9/70)*((0.64*1)+(0.36*0.25))].

An example of an MEI could be an Enduring Resource's pumper that visits well sites daily. For the MEI exposure adjustment factor, exposure is assumed to occur continuously (12 hours per day, 265 days per year) for the life of project (assumed to be 40 years). The calculated adjustment factor is 0.204 [(12/24)*(260/365)*(40/70)].

Table 4.3-10 presents the unit risk factor, exposure adjustment factor, and the estimated cancer risk for the MLE and MEI exposure scenarios for benzene. A range of unit risk factors is available for benzene. Both cancer risk ranges are in the acceptable range of cancer risk.

Table 4.3-10. Proposed Action Carcinogenic HAP Risk

Exposure Scenario	Hazardous Air Pollutant	Unit Risk Factor ($1/\mu g/m^3$)	Exposure Adjustment Factor	Modeled Annual Impact ($\mu g/m^3$)	Cancer Risk
MLE	Benzene	2.2×10^{-6} to 7.8×10^{-6}	0.095	2.14	4.5 in 10 million To 1.6 in a million
	Formaldehyde	1.3×10^{-5}	0.095	0.08	9.9 in 100 million
		MLE Max Total Risk			**1.7 in a million**
MEI	Benzene	2.2×10^{-6} To 7.8×10^{-6}	0.204	26.7	9.6 in 10 million To 3.4 in a million
	Formaldehyde	1.3×10^{-5}	0.204	0.27	2.1 in 10 million
		MEI Max Total Risk			**3.6 in a million**

MEI = maximally exposed individual
MLE = most likely exposure

Individuals are exposed to both pollutants at the same time so the risk could be cumulative. There is uncertainty involved in adding cancer risk estimates together when exposure is to a mixture. Compounds in mixtures can interact synergistically (amplifying effects), antagonistically (reducing the effects), independently (no interaction), or they can have additive effects. The 'Max Total Risk' rows in **Table 4.3-12** represent the sum of the benzene and formaldehyde risk which is likely to be a conservative risk estimate. As a result of the Proposed Action it is possible that 2 additional people out of 1,000,000 people exposed at the most likely exposure level could contract cancer. A maximally exposed individual would have a 3.6 in 1,000,000 increased chance of contracting cancer.

4.3.2 ALTERNATIVE B – NO ACTION

Under the No Action Alternative drilling and production would continue to occur on State of Utah and privately leased land. The sources of air pollutant emissions from the No Action Alternative are similar in nature to those for the Proposed Action. Annual estimated emissions from Alternative B are summarized in **Tables 4.3-11, 4.3-12**, and **4.3-13**. All development-related emission calculations, including well pad and road construction, well drilling, and well completion, assume a maximum development rate of 18 wells and 12 pads per year. Production emissions are calculated for the full-field development of 36 wells.

Table 4.3-11. Annual Emissions for Development Phases of the Southam Canyon Alternative B

Pollutant	Development Emissions (tons/year) [a]					Total (tons/yr)
	Construction	Drilling	Completion	Interim Reclamation	Wind Erosion	
NO_X	0.6	89	14	5.8E-03	-	104
CO	0.2	21	19	0.0	-	40
VOC	0.0	1.3	0.4	3.4E-03	-	1.8
SO_2	1.8E-02	1.5	0.20	2.4E-04	-	1.7
PM_{10}	2.1	34	23	1.1	0.1	61
$PM_{2.5}$	0.3	5	2.8	0.1	4.9E-02	8.3
Benzene	-	7.3E-03	1.0E-03	-	-	8.4E-03
Toluene	-	2.7E-03	4.9E-04	-	-	3.2E-03
Ethylbenzene	-	-	-	-	-	0
Xylene	-	1.8E-03	2.3E-04	-	-	2.1E-03
n-Hexane	-	-	8.1E-02	-	-	0.1
Formaldehyde	1.4E-02	7.5E-04	3.5E-03	-	-	1.9E-02

[a] Assumes maximum development scenario (18 wells developed in 1 year)

Table 4.3-12. Total Annual Production Emissions from the Southam Canyon Alternative B

Pollutant	Tons/Year					Total [1] (tons/year)
	Separators & Dehy Reboilers	Condensate Tanks	Dehydrators	Operations Vehicle	Compressor Engines	
NO_X	16	-	-	0.3	22	38
CO	13	-	-	2.0	1.9	17
VOC	1.1E-02	298	0.3	0.1	3.6	302
SO_2	-	-	-	1.5E-02	-	1.5E-02
PM_{10}	1.2	-	-	44	0.5	46
$PM_{2.5}$	1.2	-	-	4.5	0.5	6.2
Benzene	3.3E-04	0.1	4.7E-02	-	2.3E-02	0.1

Pollutant	Tons/Year					Total [1] (tons/year)
	Separators & Dehy Reboilers	Condensate Tanks	Dehydrators	Operations Vehicle	Compressor Engines	
Toluene	5.4E-04	0.1	0.1	-	2.1E-02	0.2
Ethylbenzene	-	0.1	8.2E-03	-	2.1E-03	7.3E-02
Xylene	-	2.2E-02	4.8E-02	-	9.7E-03	8.0E-02
n-Hexane	0.28	0.6	8.2E-03	-	0.1	0.9
Formaldehyde	0.01	-	-	-	0.3	0.3

[1] Emissions include 36 producing wells

Table 4.3-13. Southam Alternative B Annual Emissions (tons/year)

Pollutant	Development	Production	Total [1]
NO_x	104	38	142
CO	40	17	58
VOC	1.8	302	304
SO_2	1.7	0.02	1.7
PM_{10}	61	46	107
$PM_{2.5}$	8.3	6.2	14
Benzene	8.E-03	0.1	0.1
Toluene	3.E-03	0.2	0.2
Ethylbenzene	0.0E+00	0.1	0.1
Xylene	2.E-03	0.1	0.1
n-Hexane	0.1	0.9	1.0
Formaldehyde	0.02	0.3	0.3

[1] Emissions include 36 producing wells (including associated operations traffic) and development of 18 wells in one year

Dispersion modeling was performed to predict the impacts of pollutant emissions for comparison to NAAQS for $PM_{2.5}$, PM_{10}, NO_2, CO, and SO_2 for the development phase of the No Action Alternative. Since development activities are temporary and short-term in nature, comparisons to PSD increments are not appropriate. Based on a maximum drill rate of 18 wells per year with one drill rig, a model with one well being drilled, one well being completed, and one well pad/road being constructed at the three closest proposed well pads was run. Each pad had an associated road a half a mile long. The model evaluated 1,240 receptors.

Predicted potential impacts for Alternative B are presented in **Table 4.3-14**. The closest proposed well pads for the No Action alternative are closer together than the closest proposed well pads for the Proposed Action. Therefore, predicted impacts for PM_{10} are higher than the predicted impacts for the Proposed Action. Additionally, the length of road per pad that is constructed is longer for the No Action Alternative than the length of road for the Proposed Action. A longer graded length results in more PM_{10} emissions without much increase to $PM_{2.5}$ emissions.

Table 4.3-14. Alternative B Criteria Pollutants Development Ambient Air Maximum Impact Summary

Pollutant	Period	Project Impact (µg/m^3)	Uinta Basin Background Concentration [e] (µg/m^3)	Maximum Project Impact Plus Background (µg/m^3)	National and Utah Ambient Air Quality Standard (µg/m^3)	Percent of NAAQS
$PM_{2.5}$	24-hour Maximum Average [a]	5.16	25	30.2	35	86%
	Annual Mean [b]	2.23	9	11.2	15	75%
PM_{10}	24-hour Maximum Average [c]	49	63.3	112.3	150	75%
NO_2 [d]	Annual Mean	1.20	17	18.2	100	18%
CO	1-hour Maximum	1,357	1,111	2468	40,000	6%
	8-hour Maximum Average	542	1,111	1653	10,000	17%
SO_2	3-Hour	74.9	20	94.9	1300	7%
	24-Hour	21.9	10	31.9	365	9%
	Annual	1.10	5	6.1	80	8%

[a] Concentration estimate represents a 5-year average of the 6th highest 24-hour PM_{10} concentrations
[b] Modeled impact is conservative as activities were modeled 24-hrs per day 365-days per year at the same location. Actual annual impact would be less.
[c] Concentration estimate represents a 3-year average of the 8th highest 24-hour $PM_{2.5}$ concentrations.
[d] Modeled NO_x converted to NO_2 (multiplied by 0.75)
[e] Source: Dave Prey of UDEQ-DAQ June 13th, 2008; the state of Utah currently does not require $PM_{2.5}$ modeling for new sources and does not have an official background. Mr. Prey recommended using the values presented in the table for now.

The maximum impacts from operations occur near the compressor station. The nearest proposed well locations and compressor station are the same for the No Action Alternative as the Proposed Action. Therefore the maximum predicted impacts will be the same for the No Action Alternative as for the Proposed Action, see **Tables 4.3-8** through **4.3-10**.

As HAPs emissions were estimated based upon modeling the central compressor station and the nearest 6 well pads were modeled under the Proposed Action, and the compressor and fewer well pads are proposed under the No Action, impacts are expected to be similar or slightly less than those discussed for Alternative A.

4.3.3 ALTERNATIVE C –VERTICAL DRILLING IN THE POTENTIAL OIL SHALE DEVELOPMENT AREA

The sources of air pollutant emissions from Alternative C are similar in nature to those for the Proposed Action. Annual estimated emissions from Alternative C are summarized in **Tables 4.3-**

15, 4.3-16, and **4.3-17.** All development-related emission calculations, including well pad and road construction, well drilling, and well completion, assume a maximum development rate of 36 wells and 26 pads per year. Production emissions are calculated for the full-field development of 240 wells.

Table 4.3-15. Annual Emissions for Development Phases of the Southam Field Alternative C

Pollutant	Development Emissions (tons/year) [a]					Total (tons/yr)
	Construction	Drilling	Completion	Interim Reclamation	Wind Erosion	
NO_X	1.4	179	28.7	1.3E-02	-	209
CO	0.5	43	37.7	3.5E-02	-	81
VOC	0.1	2.7	0.8	7.6E-03	-	3.6
SO_2	4.0E-02	3.0	0.40	5.3E-04	-	3.5
PM_{10}	4.7	69	47	2.3	0.5	122
$PM_{2.5}$	0.7	10	5.7	0.2	0.2	17
Benzene	-	1.5E-02	2.1E-03	-	-	1.7E-02
Toluene	-	5.3E-03	9.8E-04	-	-	6.3E-03
Ethylbenzene	-	-	-	-	-	0
Xylene	-	3.7E-03	4.6E-04	-	-	4.1E-03
n-Hexane	-	-	1.6E-01	-	-	0.2
Formaldehyde	3.2E-02	1.5E-03	7.0E-03	-	-	4.0E-02

[a] Assumes maximum development scenario (36 wells developed in 1 year)

Table 4.3-16. Total Annual Production Emissions from the Southam Canyon Alternative C [1]

Pollutant	Tons/Year					Total (tons/year)
	Separators & Dehy Reboilers	Condensate Tanks	Dehydrators	Operations Vehicle	Compressor Engines	
NO_X	60.4	-	-	1.24	22	83
CO	50.8	-	-	6.9	1.9	60
VOC	4.4E-02	1,079	0.9	0.69	3.6	1,084
SO_2	-	-	-	0.06	-	0.1
PM_{10}	4.6	-	-	188	0.5	193
$PM_{2.5}$	4.6	-	-	19.0	0.5	24
Benzene	1.3E-03	0.4	0.1	-	2.3E-02	0.5
Toluene	2.1E-03	0.4	0.1	-	2.1E-02	0.6
Ethylbenzene	-	0.1	3.5E-02	-	2.1E-03	0.1
Xylene	-	0.1	0.1	-	9.7E-03	0.3

Pollutant	Tons/Year					Total (tons/year)
	Separators & Dehy Reboilers	Condensate Tanks	Dehydrators	Operations Vehicle	Compressor Engines	
n-Hexane	1.1	3.9	3.5E-02	-	0.1	5.0
Formaldehyde	4.4E-02	-	-	-	0.3	0.3

[1] Emissions include 240 producing wells

Table 4.3-17. Southam Alternative C Annual Emissions (tons/year)

Pollutant	Development	Production	Total [1]
NO_x	209	83	293
CO	81	60	141
VOC	3.6	1,084	1,088
SO_2	3.47	0.1	3.5
PM_{10}	122	193	315
$PM_{2.5}$	17	24	41
Benzene	2.E-02	0.5	0.5
Toluene	6.E-03	0.6	0.6
Ethylbenzene	-	0.1	0.1
Xylene	4.E-03	0.3	0.3
n-Hexane	0.2	5.0	5.2
Formaldehyde	0.04	0.3	0.4

[1] Emissions include development of 36 wells and 240 producing wells. Discrepancies in totals are from rounding errors.

Dispersion modeling was performed to predict the impacts of pollutant emissions for comparison to NAAQS for $PM_{2.5}$, PM_{10}, NO_2, CO, and SO_2 for the development phase of Alternative C. Since development activities are temporary and short-term in nature, comparisons to PSD increments are not appropriate.

Based on a maximum of 36 wells developed per year with two drill rigs, a model with two pad/roads being constructed, two wells being drilled, and two wells being completed was run with the proposed well pads closest together. Each modeled well site had a pad and 0.26-mile road. The model evaluated 1,248 receptors.

Table 4.3-18 shows the predicted development impacts for Alternative C. The predicted impacts would be less than the applicable NAAQS during the development phase of Alternative C. The closest proposed well pads for Alternative C are closer together than the closest proposed well pads for the Proposed Action. Therefore, predicted impacts for PM_{10} are higher than the predicted impacts for the Proposed Action. Additionally, the length of road per pad that is constructed is longer for Alternative C than the length of road for the Proposed Action. A longer graded length results in more PM_{10} emissions without much increase to $PM_{2.5}$ emissions.

The maximum modeled impacts for the Proposed Action occur near the compressor station and well locations near the compressor station are the same for both alternatives. Therefore

operations criteria and HAPs impacts for Alternative C are the same as Alternative A; see **Tables 4.3-8** through **4.3-10.** All predicted concentrations remain below the NAAQS and the PSD Class II increments.

Table 4.3-18. Alternative C Criteria Pollutants Development Ambient Air Maximum Impact Summary

Pollutant	Period	Project Impact ($\mu g/m^3$)	Uinta Basin Background Concentration [e] ($\mu g/m^3$)	Maximum Project Impact Plus Background ($\mu g/m^3$)	National and Utah Ambient Air Quality Standard ($\mu g/m^3$)	Percent of NAAQS
$PM_{2.5}$	24-hour Maximum Average [a]	6.4	25	31.4	35	90%
	Annual Mean	3.05 [b]	9	12.0	15	80%
PM_{10}	24-hour Maximum Average [c]	11.6	63.3	74.9	150	50%
NO_2 [d]	Annual Mean	2.80	17	19.8	100	20%
CO	1-hour Maximum	1,913	1,111	3024	40,000	8%
	8-hour Maximum Average	879	1,111	1990	10,000	20%
SO_2	3-Hour	101	20	121	1300	9%
	24-Hour	39.3	10	49.3	365	14%
	Annual	3.02	5	8.02	80	10%

[a] Concentration estimate represents a 3-year average of the 8th highest 24-hour $PM_{2.5}$ concentrations.
[b] Modeled impact is conservative as activities were modeled 24-hrs per day 365-days per year at the same location. Actual annual impact would be less.
[c] Concentration estimate represents a 5-year average of the 6th highest 24-hour PM_{10} concentrations.
[d] Modeled NO_x converted to NO_2 (multiplied by 0.75).
[e] Source: Dave Prey of UDEQ-DAQ June 13th, 2008; the state of Utah currently does not require $PM_{2.5}$ modeling for new sources and does not have an official background. Mr. Prey recommended using the values presented in the table for now.

4.3.4 RECOMMENDED MITIGATION MEASURES

No additional mitigation is recommended.

4.4 CULTURAL RESOURCES

Ground-disturbing activities, such as well pad and road construction, and secondary surface activities, such as vehicular and pedestrian traffic, can directly and irreversibly damage or destroy sensitive cultural resources. Many of the known archaeological sites – both prehistoric and historic – in the Uinta Basin are shallow and therefore vulnerable to the direct impacts of vegetation clearing, ROW blading, and excavation of soils.

Indirect impacts could include damage or destruction of cultural resources as a result of increased visitation of otherwise remote areas, and as a result of improved public access to these areas provided by Project Area access roads.

4.4.1 ALTERNATIVE A – PROPOSED ACTION

The Proposed Action would include potential initial disturbance of approximately 858 acres, or about 8.1 percent of the land surface in the Project Area. Many of the existing cultural resources surveys within the Project Area were conducted in advance of or in preparation for oil and gas development. Specific potential impacts to cultural resources related to the Proposed Action would not be known until surveys are completed for the proposed 152 well pad locations and ancillary facilities and, if necessary, cultural resource properties are evaluated for eligibility to the NRHP. These surveys and evaluations would be completed at the site-specific application (APD or ROW) stage. Archival record searches identified 33 previously documented archaeological sites within the Project Area.

While the potential for direct impacts to eligible cultural resources is likely to increase with increased well density and associated facilities, those impacts would be mitigated by the preparation and execution of applicant committed environmental protection measures (**Section 2.5**).

The Proposed Action would result in increased human presence in the Project Area during well field development and operations. In addition, proposed well field roads would provide increased motorized access to areas that may contain cultural resources. Vandalism of cultural resources could occur as an indirect effect of the Proposed Action.

4.4.2 ALTERNATIVE B – NO ACTION

Under the No Action Alternative, the potential for impacts to cultural resources would be similar in nature to those described for the Proposed Action; however, they would occur on a much smaller scale, as only 24 well pads would be constructed for an estimated initial disturbance of 181 acres.

4.4.3 ALTERNATIVE C – LIMITED SURFACE DISTURBANCE WITHIN SENSITIVE RESOURCE AREAS

Under Alternative C, 196 well pads would be developed within the Project Area (approximately 1,117 acres of initial disturbance). Impacts to cultural resources would be similar in nature and of slightly greater magnitude to those described under the Proposed Action.

4.4.4 RECOMMENDED MITIGATION MEASURES

No additional mitigation measures beyond those discussed in Chapter 2 are recommended.

4.5 SOILS

Potential impacts to soils in the Project Area from the Proposed Action and alternatives include the removal of vegetation, mixing of soil horizons, soil compaction, increased wind and water erosion, contamination of soils with petroleum products, fuels, or produced water, and loss of topsoil productivity.

4.5.1 ALTERNATIVE A – PROPOSED ACTION

4.5.1.1 Surface Disturbance

A total of approximately 858 acres of soils would initially be disturbed during the construction of 89 single-well and 63 multi-well well pads, the compressor station, 47 miles of surface pipelines, and 36 miles of new or improved access roads under the Proposed Action. This represents about 8.1 percent of the total land surface of about 10,575 acres in the Project Area. Under the Proposed Action, a total of 10.2 acres (including two well pads) would be disturbed in the 160-acre oil shale RD&D area and 462 acres would be disturbed in the 4,960-acre potential oil shale preferential lease area.

Interim reclamation activities described in **Chapter 2**, if successful, would decrease the amount of surface disturbance.

4.5.1.2 Increased Erosion

The primary effect of surface disturbances on soil resources is increased water and wind erosion. Excavation of proposed well pads could initially result in increased erosion of Project Area soils. Increased erosion may also be expected from construction and improvement of access roads and trenching for the installation of pipelines. The erosion hazard of the soils that would be disturbed ranges from slight to high. As discussed in **Section 3.5.2**, most of the soil units that would be disturbed have a water erosion Kw of 0.15 or less. Higher erosion potentials are reported for the Green River-Fluvaquents complex (map unit 90), the Uffens loam (map unit 249), and the Bullpen soils (map unit 260). In addition, all soils on slopes greater than 40 percent and badland areas could be considered to have severe water erosion potentials. Increased erosion of soils can subsequently lead to increased sediment delivery to ephemeral and perennial drainages, increased siltation of livestock ponds, loss of vegetative cover, and increased generation of fugitive dust.

Because the exact routes of the proposed pipelines and access roads are conceptual and subject to change during the APD process, increased erosion in the Project Area was estimated using published estimated erosion rates and the total amount of surface disturbance proposed. The current average erosion rate for soils within the Uinta Basin is reported to be about 1.45 tons per acre per year (tons/acre/year) (BLM 1984). Thus, the existing erosion rate is about 15,334 tons per year for the 10,575-acre Project Area.

Studies concerning the amount of increased erosion associated with the construction of oil and gas facilities in the Uinta Basin have not been completed. However, two studies conducted by the USGS on sediment yield from disturbed surfaces provide some insight into the amount of increased erosion that could be expected from construction of well pads, roads, and other project facilities in the Project Area. Lusby and Toy (1976) reported that yields from reclaimed surface mines were initially 300 percent to 600 percent higher than from undisturbed surfaces. Frickel et al. (1975) found that yields increased to about 2.9 tons/acre/year (about a 100 percent increase) in the Piceance Basin of Colorado after construction of oil shale project facilities. Using these studies as examples, it is assumed that average erosion rates for disturbed soils in the Project Area would initially triple from about 1.45 tons/acre/year to about 4.35 tons/acre/year. This increased erosion rate would generate an additional 2,488 tons of erosion annually from the approximately 858 disturbed acres during and immediately after construction of the proposed project facilities. Using the standard statistical measure used to compare two values called Relative Percent

Difference (RPD), this would represent a theoretical increase of about 14 percent from the existing erosion rate for the Project Area.

These erosion estimates, as is the case for all erosion estimates, are subject to considerable uncertainty. Factors which contribute to the uncertainty include the exact location of the various facilities, the actual road and pipeline gradients, the effectiveness of Best Management Practices (BMPs), and climatic conditions. The BMPs employed would be of two types: non-structural and structural controls. Non-structural controls include proper clearing, grading, and construction practices, including the use of aggregate, surface roughening, and crowning and ditching of roadways. Structural erosion control devices would be used along the proposed access roads, at drilling locations, and at other project facilities to minimize the amount of sediment that reaches any ephemeral drainage in the SCPA, where needed. The erosion control devices used would be specified during the APD process for each project facility, but would include sedimentation basins, vegetated strips, silt fences, and fiber rolls as appropriate. As such, these estimates should be considered to be accurate within the range of +/- 100 percent. However, because these estimates were made using the same set of assumptions for each alternative, they provide a valuable way to compare the potential increased erosion that would result under the various alternatives.

The actual amount of additional sedimentation that would reach the drainages in the Project Area and the White River depends on the effectiveness of the BMPs employed and natural factors, as discussed for Water Resources in **Section 4.6**.

It is also expected that following successful re-vegetation and approximately one to five growing seasons, the erosion rate and potential sedimentation increases would drop to near baseline conditions from well pads and pipeline ROWs, but would remain at elevated levels for the new access roads. That is because portions of the well pads and pipeline ROWs would be reclaimed and re-vegetated, whereas the access road surfaces would continue to be eroded, even in the absence of high traffic volumes.

4.5.1.3 Soil Contamination

Contamination of surface and subsurface soils near gas facilities can occur in oil and gas fields. Sources of potential contamination include leaks or spills of natural gas condensate liquids from wellheads, conveyance pipelines, produced water sumps, condensate storage tanks, and reserve pits. Leaks or spills of saline water, hydrofracturing chemicals, fuels, and lubricants could also result in soil contamination. Of these materials, leaks or spills of natural gas condensate would have the greatest potential environmental impact.

Depending on the size and type of spill, the primary effect on soils would be loss of soil productivity. In addition, petroleum released to surface soils infiltrates the soil and, under the right conditions, can migrate vertically until the water table is encountered, thus contaminating shallow groundwater. Contaminated groundwater could then potentially be discharged by springs or as baseflow into stream channels, leading to surface water contamination.

4.5.1.4 Rangeland Health Standards

Rangeland health standards were adopted by the Utah BLM to assist in the planning process for grazing, recreation, and other activities on BLM lands (BLM 1997). These standards are applicable to the construction of new roads and well pads on BLM lands. Rangeland Health Standard 1 states that “upland soils should exhibit permeability and infiltration rates that sustain

or improve site productivity, considering the soil type, climate, and landform". The Proposed Action would have a minor impact on the attainment of this standard, due to compaction and blending of soils in some locations.

Compaction due to construction activities at the well pads and along access roads would reduce aeration, permeability, and water-holding capacity of the soils. An increase in surface runoff could be expected, potentially causing increased sheet, rill, and gully erosion. In addition, the segregation and reapplication of surface soils would cause the mixing of shallow soil horizons, resulting in a blending of soil characteristics and types. This blending would modify physical characteristics of the soils including structure, texture, and rock content, which could lead to reduced permeability and increased runoff from these areas.

4.5.2 ALTERNATIVE B – NO ACTION

Potential impacts to soils in the Project Area from the No Action Alternative would similar in nature to those described for the Proposed Action, but of much smaller magnitude.

4.5.2.1 Surface Disturbance

Initial surface disturbance under the No Action Alternative would be about 181 acres from the construction of 24 well pads, 17 miles of surface pipelines, and 12 miles of new or improved access roads. This represents about 21 percent of the surface disturbance proposed under the Proposed Action and about 1.7 percent of the 10,575-acre Project Area.

4.5.2.2 Increased Erosion

The estimated increased erosion under the No Action Alternative would be about 525 tons per year from the 181 acres of new surface disturbance, or about one-fifth of that under the Proposed Action. This would represent a theoretical increase of about 3.3 percent from the existing erosion rate for the Project Area.

The actual amount of additional sedimentation that would reach the drainages in the Project Area and the White River depends on the effectiveness of the BMPs employed and natural factors, as discussed for Water Resources in **Section 4.6**.

4.5.2.3 Soil Contamination

Potential impacts under the No Action Alternative related to soil contamination would be similar in nature to those described for the Proposed Action. Because fewer wells would be installed, the probability of a release that causes soil contamination would be about 14 percent of that under the Proposed Action.

4.5.2.4 Rangeland Health Standards

Potential impacts to Rangeland Health Standards under the No Action Alternative would be similar in nature to those for the Proposed Action, but of much smaller magnitude.

4.5.3 ALTERNATIVE C – VERTICAL DRILLING IN THE POTENTIAL OIL SHALE DEVELOPMENT AREA

Under Alternative C, no drilling would be conducted in the oil shale RD&D area and only vertical drilling would be conducted in the potential oil shale preferential lease area.

4.5.3.1 Surface Disturbance

A total of about 1,117 acres of soils would initially be disturbed during the construction of 196 well pads, 61 miles of surface pipelines, and 50 miles of new or improved access roads. Surface disturbance under Alternative C would be about 1.3 times the surface disturbance under the Proposed Action, or about 11 percent of the 10,575-acre Project Area. The additional surface disturbance would be from the use of only vertical, single-well well pads within the potential oil shale preferential lease area, which would increase the total number of well pads to 196. Under Alternative C, a total of 5.4 acres would be disturbed in the 160-acre oil shale RD&D area and 711 acres would be disturbed in the 4,960-acre potential oil shale preferential lease area. No well pads would be constructed in the oil shale RD&D area. Interim reclamation activities would be conducted as described above for the Proposed Action.

4.5.3.2 Increased Erosion

If it is assumed that average erosion rates for soils in the Project Area would initially triple from about 1.45 tons/acre/yr to about 4.35 tons/acre/yr, an additional 3,239 tons of erosion would occur annually during and immediately after construction of the proposed project facilities, or about 1.3 times that under the Proposed Action. This represents a theoretical increase of about 17.4 percent from the existing erosion rate for the Project Area.

The actual amount of additional sedimentation that would reach the drainages in the Project Area and the White River depends on the effectiveness of the BMPs employed and natural factors, as discussed for Water Resources in **Section 4.6**.

It is also expected that following successful re-vegetation and approximately one to five growing seasons, the erosion rate and potential sedimentation increases would drop to near baseline conditions from well pads and pipeline ROWs, but would remain at elevated levels for the new access roads. That is because portions of the well pads and pipeline ROWs would be reclaimed and revegetated, whereas the access road surfaces would continue to be eroded, even in the absence of high traffic volumes.

4.5.3.3 Soil Contamination

Potential impacts related to soil contamination under Alternative C would be similar in nature to those described for the Proposed Action, but would be slightly less in magnitude as 9 fewer wells would be developed.

4.5.3.4 Rangeland Health Standards

Potential impacts to Rangeland Health Standards under Alternative C would be similar in nature to those described for the Proposed Action, but would be slightly higher in magnitude.

4.5.4 RECOMMENDED MITIGATION MEASURES

No mitigation beyond those measures described in **Chapter 2**, along with required standards is recommended.

4.6 WATER RESOURCES

4.6.1 ALTERNATIVE A –PROPOSED ACTION

4.6.1.1 Surface Water

Potential impacts to surface water resources in the Project Area from the Proposed Action include:

- Increased sedimentation and turbidity of surface water as a result of surface disturbance and increased sediment delivery into ephemeral drainage channels, perennial streams, and livestock ponds via runoff;
- Increased sediment loading to the White River, potentially slightly increasing salinity levels in the Colorado River system;
- Adverse effects on surface water quality – i.e., potential contamination of surface water resources from spills or discharges of drilling fluids, petroleum, or other chemicals used for natural gas drilling and production activities;
- Reduction of water flows to livestock ponds by interception of surface water runoff;
- Increased peak stream flows in Evacuation Creek, Southam Canyon, and the White River due to compaction of soils; and
- Impacts to floodplains.

The magnitude of these potential impacts depends on several factors, including the proximity of surface disturbances to ephemeral tributaries of the White River, slope aspect and gradient, soil type, the duration and timing of the construction activity, and the success or failure of reclamation and mitigation measures. The potential for adverse impacts to surface water resources would be greatest during project construction activities and would likely decrease in time due to natural stabilization, interim and final reclamation, and re-vegetation efforts.

<u>Increased Sedimentation and Turbidity</u>

Increased erosion and subsequent increased sediment delivery to perennial streams and ephemeral drainages within the Project Area is likely, especially during the construction of the project facilities. The increased erosion could also potentially lead to an increase in turbidity and salinity in the White River. Both of these effects could have negative impacts on aquatic habitat within affected drainages. In addition, increased sediment delivery to livestock ponds could occur, potentially leading to a reduction of water storage.

Soil loss calculations (presented in **Section 4.5.1.2**) reveal that an estimated 2,488 tons per year of additional erosion could be expected to initially occur annually as a result of the Proposed Action. Over time, short-duration precipitation events and snowmelt could cause soil lost from the proposed facilities to reach the drainages of adjacent ephemeral channels, livestock ponds, Evacuation Creek, Southam Canyon, and the White River.

In sufficient amounts, the additional sediment from construction activities and operational facilities could:

- Clog road culverts and cause road damage;
- Cause accelerated siltation of ephemeral channels and livestock ponds;
- Act as a carrier for other pollutants (trace metals, pesticides, plant nutrients, etc);
- Degrade aquatic habitat by covering stream substrates with fine sediment;
- Increase the turbidity within the White River; and
- Increase salinity levels in the White River (Colorado River system).

Based on data collected at USGS gauging station 09306700 (the median of the calculated sediment loadings in tons/day) on the White River at Asphalt Wash, existing sediment loading in the White River averages about 242,360 tons/year. The highest sediment loading occurs during the months of May and June from snowmelt runoff.

Using the very conservative assumption that all available sediment from the construction of the project facilities would eventually be transported to the White River, development of the Proposed Action could potentially result in maximum increased sediment loadings to the White River equal to the gross additional erosion, which would be an increase of about 1.0 percent over current levels. However, with the proper application and maintenance of BMPs for erosion and runoff control, the actual amount of sediment that would be transported to the ephemeral drainages within the Project Area and on to the White River would be much less.

The amount of additional sediment that would reach the drainages in the Project Area and the White River depends on natural factors and the effectiveness of the BMPs employed. Natural factors which attenuate the transport of sediment into creeks include water available for overland flow, the texture of the eroded material, the amount and kind of ground cover, the slope shape, gradient, and length, and surface roughness (Barfield et al. 1981). The BMPs employed would be of two types: non-structural controls, and structural BMPs to control erosion.

Studies concerning the effectiveness of the BMPs for oil and gas sites have not been conducted. However, several studies conducted in urban settings provide insight into the potential effectiveness of the BMPs that would likely be employed for erosion control in the Project Area. EPA (1999) estimated that the theoretical TSS removal efficiency for retention basins, infiltration basins, and vegetated filter strips are all in the range of 50-80 percent. Actual performance for these BMP types was measured at urban sites and was reported to be 70 percent for retention basins, 89 percent for infiltration basins, and 81 percent for vegetated filter strips. In another study, EPA (2004) reported ranges of TSS removal of 58-78 percent for retention basins, 75 percent for infiltration basins, and 54-84 percent for vegetated filter strips. Using these studies as examples, it is assumed that the BMPs employed would be about 70 percent effective in removing TSS from runoff from the project facilities. Therefore, if the natural factors that affect sediment delivery are ignored, approximately 30 percent of the increased erosion calculated could be expected to eventually be delivered to the White River, or about 746 tons per year. This amount would increase the sediment loading in the White River by about 0.3 percent over current levels. Turbidity and salinity could be expected to increase by similar amounts.

It is important to note that these calculations are approximate. The actual amount of additional sediment loading to the White River is dependent on the natural factors listed above, precipitation amounts and timing, channel conditions, actual BMP efficiency, and reclamation success or failure. In addition, the erosion calculations are also approximate, and should be regarded as accurate only to within +/-100 percent. Nonetheless, these estimates provide a useful way to compare the potential impacts of the various alternatives against each other, in addition to providing estimates of the increased sediment delivery to the White River.

Water Use and Stream Flow Regimes

Approximately 0.75 acre-feet (7,758 barrels) of water would be needed to drill and complete each well. Thus, the total water use for drilling and completion of the proposed 249 wells over the 10-year development period would be about 187.5 acre-feet (18.75 acre-feet per year). In addition, approximately 775 barrels per well pad per year would be used to control dust, or about 15.2 acre-feet per year. Therefore, the estimated total water use for the project would be about 339.5 acre-feet, of 33.95 acre-feet per year.

Water would be obtained from an existing water right (Water Right #49-2279). This water right draws water directly from the White River and is therefore considered to be diversionary. Additional water, if needed would be drawn from permitted sources to be determined as necessary.

Increased Runoff

Soils compacted on existing roads, new access roads, and well pads contribute slightly greater runoff than undisturbed sites. The increased runoff could lead to slightly higher peak flows in the ephemeral channels in the Project Area and the White River, potentially increasing erosion of the channel banks. The increased erosion could lead to slightly increased turbidity in these streams during storm events. However, the natural turbidity in the ephemeral channels within the Project Area during storm events is very high; therefore, the slightly increased turbidity would have no effect on aquatic organisms in the ephemeral channels.

Surface Water Quality

Contamination of surface water can occur in oil and gas fields. Sources of potential contamination include leaks from wellheads, conveyance pipelines, produced water and condensate storage tanks, and tanker trucks. Leaching of contaminants from impacted soils near these facilities also has the potential to contaminate surface water. In addition to leaks from facilities, accidental spills of hydrocarbon products, including fuels and petroleum products produced by the wells, would have the potential to contaminate surface waters if the spills were to occur directly into a stream or when runoff is present. These events could transmit these fluids to the ephemeral channels of the Project Area, and potentially, on to the White River.

Produced water would be temporarily stored in steel tanks at each well site. The contents of the tanks would be pumped out as needed and transported by tanker truck to licensed disposal sites or reused for drilling at other well locations. Therefore, no impacts to surface water resources in and near the Project Area are expected in association with the routine handling of produced water.

An EPA-registered herbicide may be used to control the spread of noxious weeds in some areas, in consultation with the appropriate SMA. Surface water runoff from areas where herbicides are applied would be diverted away from surface water resources through the use of appropriate

BMPs. Although the use of herbicides could result in increased concentrations of these chemicals in surface water runoff, the effect to surface water resources is anticipated to be negligible, based on the proposed storm water runoff controls that would be used at the proposed drilling sites and on new roads, and the small acreage that could potentially require herbicide application.

Hydrofracturing of the Wasatch Formation and Mesaverde Group sandstones for the proposed new wells would be conducted as part of the Proposed Action. Hydrofracturing is commonly used to enhance the recovery of natural gas from relatively impermeable "tight" sandstones, and involves the injection of water or other fluids, which may contain some petroleum constituents, and sand or some other "proppant" into the formation. Hydrofracturing would occur at depths that are at least 8,000 feet or more below the surface. Therefore, because of the great depth to the fractured zone, the potential for impacts to surface water resources from the proposed hydrofracturing is considered to be negligible.

Surface Water Quantity

Currently, surface water in the Project Area is drawn from small ponds and used in limited quantities for livestock watering and industrial purposes. The construction of well pads, pipeline corridors, and access roads could potentially reduce the amount of water that flows to local stock ponds if the existing surface water runoff is intercepted.

4.6.1.2 Groundwater

Potential impacts to groundwater resources from the Proposed Action include contamination with produced water, drilling mud, or petroleum constituents. Groundwater exists in shallow unconsolidated alluvium along Evacuation Creek and the White River, and in deeper bedrock formations beneath the Project Area. Spills of fuels or produced fluids from well pads, pipelines, and compressor stations have the potential to contaminate groundwater resources, especially the shallow alluvial groundwater. Spills from facilities or vehicle accidents near ephemeral channels or the White River would have the greatest potential to contaminate groundwater. However, the Proposed Action has been designed to minimize the placement of facilities near floodplains. No well pads would be located on any floodplains in the area. Therefore, the probability of a spill impacting shallow groundwater has been greatly reduced and is considered to be low.

No produced water would be discharged into surface water drainages or allowed to flow onto the ground surface. There is a slight chance that produced water could be spilled during the loading operations. However, given the BMPs that would be employed to control storm water runoff at each drilling location, there is little chance that produced water would enter and contaminate shallow alluvial aquifers. Accordingly, the potential for contamination of groundwater resources by produced water is considered to be low.

4.6.1.3 Floodplains

Floodplains are protected by Executive Order 11988 which requires that all Federal agencies take action to reduce the risk of flood loss; to minimize the impact of floods on human safety, health, and welfare; and to restore and preserve the natural and beneficial values served by floodplains. Potential impacts to floodplains from the Proposed Action include increased sedimentation, pollution of surface water or shallow groundwater due to accidental spills or loss of containment of petroleum products, fuels and other chemicals, and damage to or loss of riparian vegetation.

Under the Proposed Action, no well pads would be constructed on floodplains in the Project Area. A total of 0.88 mile of surface pipe and 0.15 mile of co-located pipeline and access roads would be constructed on floodplains along Evacuation Creek and Southam Canyon. The total surface disturbance to floodplains would be about 11.3 acres.

4.6.2 ALTERNATIVE B – NO ACTION

Under the No Action Alternative, new wells would not be allowed on Federal lands. However, wells would still be drilled on State of Utah and private lands within the Project Area and reasonable access to these lands would be provided across Federal lands as necessary. A total of 36 wells could be drilled under the No Action Alternative, as compared to 249 wells under the Proposed Action.

4.6.2.1 Surface Water

Increased Sedimentation and Turbidity

Potential impacts related to increased erosion and subsequent increased sedimentation of perennial streams and ephemeral drainages within the Project Area would be similar to those described for the Proposed Action, but of a substantially lesser magnitude.

Soil loss calculations (presented in **Section 4.5.2.2**) reveal that an estimated 525 tons per year of additional erosion could be initially expected to occur under the No Action Alternative, or about 21 percent of that for the Proposed Action. The actual amount of additional sediment that would reach the drainages in the Project Area depends on natural factors and the effectiveness of the BMPs employed, and is estimated to be about 30 percent of the gross erosion, as described above for the Proposed Action. Therefore, the estimated additional sediment delivery to the White River from the No Action Alternative is about 158 tons per year, which would increase sediment loading to the river by about 0.06 percent over current levels. Turbidity and salinity could be expected to increase by similar amounts.

Water Use and Stream Flow Regimes

Water use for each well is estimated to about 0.75 acre-feet (7,758 barrels), as described above for the Proposed Action. For the No Action Alternative, the total water use would be approximately 29.4 acre-feet for the five-year development period, or 5.88 acre-feet per year. Water would be diverted from the White River per Water Right #49-2279.

Increased Runoff

Under the No Action Alternative, potential impacts of increased runoff would be similar in nature to those described for the Proposed Action. The amount of increased runoff would be about one-fifth of that for the Proposed Action.

Surface Water Quality

Impacts to surface water quality under the No Action Alternative would be similar in nature to those described for the Proposed Action. As fewer wells would be developed, the chance of a spill event would be substantially less than that for the Proposed Action or Alternative C.

Surface Water Quantity

Currently, surface water in the Project Area is drawn from small ponds and used in limited quantities for livestock watering and industrial purposes. The construction of well pads, pipeline corridors, and access roads could potentially reduce the amount of water that flows to local stock ponds if the existing surface water runoff is intercepted.

4.6.2.2 Groundwater

Potential impacts to groundwater resources from the No Action Alternative are similar in nature to those for the Proposed Action but of a substantially lesser magnitude because of the fewer numbers of wells that would be developed.

4.6.2.3 Floodplains

Potential impacts to floodplains from the No Action Alternative are similar in nature to those for the Proposed Action but of a substantially lesser magnitude. Under the No Action Alternative, no well pads or other facilities would be constructed on floodplains in the Project Area; therefore, no direct impacts to floodplains would occur. Minor indirect impacts due to increased erosion and sedimentation could occur on the floodplains.

4.6.3 ALTERNATIVE C – VERTICAL DRILLING IN THE POTENTIAL OIL SHALE DEVELOPMENT AREA

Potential impacts to water resources in the Project Area from Alternative C would be similar to those for the Proposed Action but of slightly greater magnitude. Under Alternative C, no drilling would be conducted in the oil shale RD&D area and only vertical drilling would be conducted in the oil shale preferential lease area. A total of 240 wells could be drilled from 196 well pads under the Alternative C, as compared to 249 wells from 152 well pads under the Proposed Action.

4.6.3.1 Surface Water

Increased Sedimentation and Turbidity

Increased erosion and subsequent increased sedimentation of perennial streams and ephemeral drainages within the Project Area under Alternative C would be similar in nature to that described for the Proposed Action but of slightly greater magnitude.

Soil loss calculations (presented in **Section 4.5.3.2**) reveal that an estimated 3,239 tons per year of additional erosion could be expected to initially occur under Alternative C, or about 1.3 times that for the Proposed Action. The actual amount of additional sediment that would reach the ephemeral drainages in the Project Area and the White River depends on natural factors and the effectiveness of the BMPs employed, and is estimated to be about 30 percent of the gross erosion, as described above for the Proposed Action. Therefore, the estimated additional sediment delivery to the White River from Alternative C would be about 972 tons per year, or an increase of about 0.4 percent from current levels. Turbidity and salinity could be expected to increase by similar amounts.

Water Use and Stream Flow Regimes

Water use for each well is estimated to be about 0.75 acre-feet (7,758 barrels). For Alternative C, the total water use would be approximately 396 acre-feet for the ten-year development period, or 39.6 acre-feet per year, as compared to 33.95 acre-feet per year under the Proposed Action. Water would be diverted from the White River per Water Right #49-2279. Additional water, if needed, would be drawn from permitted sources to be determined as necessary.

Increased Runoff

Potential impacts from increased runoff would be similar in nature to those described for the Proposed Action. The amount of increased runoff would be about 1.3 times that under the Proposed Action.

Surface Water Quality

Potential impacts to surface water quality under Alternative C would be similar in nature to those described for the Proposed Action. Because more wells would be developed, the chance of a spill event would be about 1.3 times that for the Proposed Action.

Surface Water Quantity

Currently, surface water in the Project Area is drawn from small ponds and used in limited quantities for livestock watering and industrial purposes. The construction of well pads, pipeline corridors, and access roads could potentially reduce the amount of water that flows to local stock ponds if the existing surface water runoff is intercepted.

4.6.3.2 Groundwater

Potential impacts to groundwater resources from Alternative C would be similar to those for the Proposed Action and include contamination with produced water, drilling mud, or petroleum constituents. Spills of fuels or produced fluids from well pads, pipelines, and compressor stations have the potential to contaminate groundwater resources, especially the shallow alluvial groundwater. Spills from facilities located adjacent to ephemeral channels and the White River would have the greatest potential to contaminate groundwater. However, Alternative C has been designed to minimize the placement of facilities near floodplains. No well pads would be located on any floodplains in the area. Therefore, the probability of a spill impacting shallow groundwater has been greatly reduced and is considered to be low.

4.6.3.3 Floodplains

Potential impacts to floodplains from Alternative C are similar to those for the Proposed Action, and include increased sedimentation, pollution of surface water or shallow groundwater due to accidental spills or loss of containment of petroleum products, fuels and other chemicals, and damage to or loss of riparian vegetation. Under Alternative C, no well pads would be constructed on floodplains. A total of 0.88 mile of surface pipe and 0.22 mile of co-located pipeline and access roads would be constructed on floodplains along Evacuation Creek and Southam Canyon. The total surface disturbance to floodplains would be about 15.7 acres, or about 1.4 times that under the Proposed Action.

4.6.4 RECOMMENDED MITIGATION MEASURES

No additional mitigation beyond regulations, standards, and the measures described in **Chapter 2** are recommended.

4.7 VEGETATION

4.7.1 ALTERNATIVE A - PROPOSED ACTION

Under the Proposed Action, approximately 858 acres of existing vegetation would be removed in the Project Area. **Table 4.7-1** provides a breakdown of disturbance by vegetation community from the Proposed Action.

Table 4.7-1. Surface Disturbance by Vegetation Community for the Proposed Action

Vegetation Community	Acres w/in SCPA	Surface Disturbance (Acres)	Percent Loss of Acres w/in SCPA
Wyoming Big Sagebrush	6,610	601	9.1
Pinyon-Juniper	3,663	256	7.0
Riparian	135	0	0
Black Sagebrush	131	0	0
Desert Shrub	7	0	0
Badlands/Rock Outcrop	1	0	0

Vegetation removal and soil handling associated with the Proposed Action would have both direct and indirect impacts on vegetation resources. Direct impacts would include removal of vegetation, including woodland species, and modification of species composition and structure. Indirect impacts may include increased potential for weed invasion, increased exposure of soils to accelerated erosion, increased potential for fugitive dust, and degradation and loss of topsoil and soil microorganisms.

Specific actions set out under the Proposed Action and ACEPMs, such as revegetation of disturbed areas as described in the Reclamation Plan (**Appendix B**), control of noxious weeds, dust abatement, erosion control, and re-establishing soil conditions, would reduce impacts to vegetation communities in the Project Area.

4.7.1.1 Invasive/Non Native Species

Roads provide a major conduit for the spread of exotic plants into natural areas, particularly in arid and semiarid landscapes of the American West (Gelbard and Belnap 2003). Clearing of vegetation and soils, addition of fill, and grading of roads and well pads could create areas of deep, bare soil that would be susceptible to exotic seed establishment (Trombulak and Frissell 2000). As such, actions associated with the Proposed Action could lead to the transport and establishment of weeds throughout the Project Area. Overall, the Proposed Action could increase establishment of invasive and noxious weeds, such as hoary cress, saltcedar, Russian thistle, halogeton, cheatgrass, and black henbane. Specific negative effects of noxious and invasive

weeds can include: 1) reduction in the overall visual character of an area; 2) competition with, or elimination of native plants; 3) reduction or fragmentation of wildlife and threatened and endangered plant habitats; and 4) increased soil erosion (Gelbard and Belnap 2003).

The potential impacts described above would be reduced based on adherence to ACEPMs and mitigation measures specified in the Vernal ROD and Approved RMP (BLM 2008e). Specifically, Enduring has committed to ACEPMs that include conducting a pre-project weed inventory and controlling and monitoring noxious weeds on disturbed sites. In addition, Enduring Resources and their contractors would be required to power wash construction equipment and vehicles for permitted uses and obtain approval from the AO for a Pesticide Use Proposal prior to pesticide application.

4.7.1.2 Wetlands/Riparian Zones

Under the Proposed Action, the conceptual placement of well pads does show some disturbance in the wetland/riparian zones in the Project Area. As proposed, approximately 1,001 feet of the wetland/riparian linear feature located in Evacuation Creek would be disturbed due to construction of three proposed well pads. However, as feasible surface-disturbing activities would be re-routed away from wetlands/riparian zone during the on-site process.

In addition to direct impacts, construction activities within and near wetlands/riparian zones can have several indirect impacts on these resources including increased sediment deposition, compaction of sensitive riparian vegetation, water quality degradation, and destruction of important and unique wildlife habitat. Additionally, water quality degradation caused by disturbance to these areas could potentially impact wildlife and plant species downstream.

Specific actions under the Proposed Action, including ACEPMs, would minimize impacts to wetlands/riparian zones associated with Evacuation Creek. These include revegetation of disturbed areas as described in the Reclamation Plan (**Appendix B),** implementation of erosion control measures, avoidance of wetland/riparian zones, use of closed-loop systems, and burial of pipelines within floodplains to a depth of 15 feet.

4.7.2 ALTERNATIVE B – NO ACTION ALTERNATIVE

Impacts to vegetation under the No Action Alternative would be similar in nature to those described under the Proposed Action, but lower in magnitude. Under Alternative B, approximately 181 acres of vegetation would be disturbed (a 21 percent reduction from the Proposed Action). As such, direct and indirect impacts to vegetation communities in the Project Area would be correspondingly lower. **Table 4.7-2** provides a breakdown of disturbance by vegetation community from Alternative B.

Table 4.7-2. Surface Disturbance by Vegetation Community for Alternative B

Vegetation Community	Acres w/in SCPA	Surface Disturbance (Acres)	Percent Loss of Acres w/in SCPA
Wyoming Big Sagebrush	6,610	165	2.5
Pinyon-Juniper	3,663	16	0.4
Riparian	135	0	0
Black Sagebrush	131	0	0

Vegetation Community	Acres w/in SCPA	Surface Disturbance (Acres)	Percent Loss of Acres w/in SCPA
Desert Shrub	7	0	0
Badlands/Rock Outcrop	1	0	0

4.7.2.1 Invasive/Non Native Species

Impacts from invasive and noxious weeds under the No Action Alternative would be similar in nature to those described under the Proposed Action. Under Alternative B, approximately 181 acres of vegetation would be disturbed (a 21 percent reduction from the Proposed Action). As such, impacts from invasive and noxious weeds in the Project Area would be correspondingly lower.

4.7.2.2 Wetlands/Riparian Zones

Impacts to wetlands/riparian zones under the No Action Alternative would be similar in nature to those described under the Proposed Action, but lower in magnitude. As proposed, direct impacts to wetlands/riparian zones would occur in Evacuation Creek in the southern portion of the Project Area. Approximately 51 feet of the wetland/riparian linear feature located in Evacuation Creek would be disturbed due to construction of a proposed collocated road and pipeline. However, as feasible surface-disturbing activities would be re-routed away from wetlands/riparian zone during the on-site process

Indirect impacts to these resources, as described under the Proposed Action, would be lower under the No Action Alternative, as only 181 acres of vegetation would be disturbed (a 21 percent reduction from the Proposed Action).

Specific actions under the Proposed Action, including ACEPMs, would minimize impacts to wetlands/riparian zones associated with Evacuation Creek. These include revegetation of disturbed areas as described in the Reclamation Plan (**Appendix B)**, implementation of erosion control measures, avoidance of wetland/riparian zones, use of closed-loop systems, and burial of pipelines within floodplains to a depth of 15 feet.

4.7.3 ALTERNATIVE C – VERTICAL DRILLING ALTERNATIVE

Impacts to vegetation under Alternative C would be similar in nature to those described under the Proposed Action, but higher in magnitude. Under Alternative C, approximately 1,117 acres of vegetation would be disturbed (a 30 percent increase from the Proposed Action). As such, direct and indirect impacts to vegetation communities in the Project Area would be correspondingly higher. **Table 4.7-3** provides a breakdown of disturbance by vegetation community from Alternative C.

Table 4.7-3. Surface Disturbance by Vegetation Community for Alternative C.

Vegetation Community	Acres w/in SCPA	Surface Disturbance (Acres)	Percent Loss of Acres w/in SCPA
Wyoming Big Sagebrush	6,610	734	11.1
Pinyon-Juniper	3,663	384	10.5
Riparian	135	0	0

Vegetation Community	Acres w/in SCPA	Surface Disturbance (Acres)	Percent Loss of Acres w/in SCPA
Black Sagebrush	131	0	0
Desert Shrub	7	0	0
Badlands/Rock Outcrop	1	0	0

4.7.3.1 Invasive/Non Native Species

Impacts from invasive and noxious weeds under Alternative C would be similar in nature to those described under the Proposed Action, but greater in magnitude. Under Alternative C, approximately 1,117 acres of vegetation would be disturbed (a 30 percent increase from the Proposed Action). As such, impacts from invasive and noxious weeds in the Project Area would be correspondingly higher.

4.7.3.2 Wetlands/Riparian Zones

Impacts to wetlands/riparian zones under Alternative C would be similar in nature to those described under the Proposed Action, but higher in magnitude. As a result of the conceptual placement of well pads, roads and pipelines, direct impacts to wetlands/riparian zones would occur in Evacuation Creek in the northeastern portion of the Project Area. As proposed, approximately 769 feet of the wetland/riparian linear feature located in Evacuation Creek would be disturbed due to construction of two well pads and a road/pipeline. However, as feasible surface-disturbing activities would be re-routed away from wetlands/riparian zone during the on-site process.

Indirect impacts to these resources, as described under the Proposed Action, would be higher under Alternative C, as 1,117 acres of vegetation would be disturbed (a 30 percent increase from the Proposed Action).

Specific actions under the Proposed Action would minimize impacts to wetlands/riparian zones associated with Evacuation Creek. These include revegetation of disturbed areas as described in the Reclamation Plan (**Appendix B),** implementation of erosion control measures, avoidance of wetland/riparian zones, use of closed-loop systems, and burial of pipelines within floodplains to a depth of 15 feet.

4.7.4 RECOMMENDED MITIGATION MEASURES

No additional mitigation measures beyond those described in **Chapter 2** are recommended.

4.8 LIVESTOCK GRAZING

4.8.1 ALTERNATIVE A – PROPOSED ACTION

The Proposed Action would result in the removal of approximately 713 usable acres of vegetation (involving 87 livestock AUMs) in grazing allotments in the Project Area. **Table 4.8-1** provides a breakdown of the estimated loss of livestock AUMs by grazing allotment. As shown, activities under the Proposed Action would result in the reduction of approximately 0 to 8.9 percent of usable acres and/or AUMs in these grazing allotments.

Table 4.8-1. Estimated Livestock AUMs Affected by the Proposed Action

Allotment Name	Acres		AUMs		Percent of UseableAcres Lost Due to Proposed Action
	Usable[1] Allotment Acres w/in Project Area	Loss of Usable[1] Acres w/in Project Area	AUMs[2] w/in Project Area	Loss of AUMs w/in Project Area	
Hells Hole	6,556	584	862	77	8.9
Little Emma	1	0	0	0	0
Southam Canyon	1,176	78	112	7	6.6
Watson	626	51	31	3	8.1
White River Bottoms	15	0	1	0	0
Total	**8,374**	**713**	**1,005**	**87**	

Source: BLM 2007, Rangeland Administration System
[1] Usable land is defined as BLM land that has a slope lower than or equal to 40 percent.
[2] Allotment AUMs within the Project Area were calculated using total active AUMs and total acreage for each grazing allotment

Indirect effects to livestock grazing could include reduced forage quality due to potential weed infestations; increased development-related traffic; and potential traffic delays to ranchers accessing the Project Area during construction and drilling phases.

Certain actions under the Proposed Action, including ACEPMs, would reduce impacts to disturbed grazing areas. Actions under the Proposed Action include revegetation of disturbed areas and implementation of noxious weed control and monitoring. In addition, any livestock facilities (e.g. fences, cattle guards, gates, drift fences and natural barriers) that are damaged by the Proposed Action would be repaired or replaced. Additional cattleguards or gates would also be installed, as needed, and maintained for the life of the project.

Adherence to the above-mentioned measures would reduce the anticipated impacts to livestock, forage, and existing livestock facilities within the Project Area.

4.8.2 ALTERNATIVE B – NO ACTION ALTERNATIVE

Impacts to livestock grazing under the No Action Alternative would be similar in nature to those described above under the Proposed Action, but would be smaller in magnitude. Under Alternative B, approximately 49 usable acres, involving 6 AUMs, would be disturbed (a 7 percent reduction from the Proposed Action). As such, the potential for ground-disturbing activities to impact grazing allotments in the Project Area would be correspondingly lower. **Table 4.8-2** provides a breakdown of the estimated loss of livestock AUMs by grazing allotment.

Table 4.8-2. Estimated Livestock AUMs Affected by Alternative B.

Allotment Name	Acres		AUMs		Percent of Useable Acres Lost Due to Alt. B
	Usable[1] Allotment Acres w/in Project Area	Loss of Usable Acres w/in Project Area	AUMs[2] w/in Project Area	Loss of AUMs w/in Project Area	
Hells Hole	6,556	42	862	6	0.6
Little Emma	1	0	0	0	0
Southam Canyon	1,176	2	112	<1	0.2
Watson	626	5	31	<1	0.8
White River Bottoms	15	0	1	0	0

Allotment Name	Acres		AUMs		Percent of Useable Acres Lost Due to Alt. B
	Usable[1] Allotment Acres w/in Project Area	Loss of Usable Acres w/in Project Area	AUMs[2] w/in Project Area	Loss of AUMs w/in Project Area	
Total	**8,374**	**49**	**1,005**	**6**	

Source: BLM 2007, Rangeland Administration System
[1] Usable land is defined as BLM land that has a slope lower than or equal to 40 percent.
[2] Allotment AUMs within the Project Area were calculated using total active AUMs and total acreage for each grazing allotment

4.8.3 ALTERNATIVE C – VERTICAL DRILLING ALTERNATIVE

Under Alternative C, impacts to livestock grazing would be similar in nature to those described under the Proposed Action, but would be greater in magnitude. Under Alternative C, approximately 952 usable acres, involving 118 AUMs, would be disturbed (a 34 percent increase from the Proposed Action). As such, the potential for ground-disturbing activities to impact grazing allotments in the Project Area would be correspondingly greater. **Table 4.8-3** provides a breakdown of the estimated loss of livestock AUMs by grazing allotment.

Table 4.8-3. Estimated Livestock AUMs Affected by Alternative C

Allotment Name	Acres		AUMs		Percent of Useable Acres Lost Due to Alt. C
	Usable[1] Allotment Acres w/in Project Area	Loss of Usable Acres w/in Project Area	AUMs[2] w/in Project Area	Loss of AUMs w/in Project Area	
Hells Hole	6,556	819	862	108	12.5
Little Emma	1	0	0	0	0
Southam Canyon	1,176	83	112	8	7.1
Watson	626	50	31	2	8
White River Bottoms	15	0	1	0	0
Total	**8,374**	**952**	**1,005**	**118**	

Source: BLM 2007, Rangeland Administration System
[1] Usable land is defined as BLM land that has a slope lower than or equal to 40 percent.
[2] Allotment AUMs within the Project Area were calculated using total active AUMs and total acreage for each grazing allotment

4.8.4 RECOMMENDED MITIGATION MEASURES

No additional mitigation measures beyond those described in **Chapter 2** are recommended.

4.9 WILDLIFE AND FISHERIES

4.9.1 ALTERNATIVE A – PROPOSED ACTION

4.9.1.1 General Wildlife

Implementation of the Proposed Action would increase the existing level of functional habitat loss and habitat fragmentation within the SCPA. The estimated surface disturbance of approximately 858 acres of wildlife habitat associated with the construction of well pads, roads, pipelines, compressor station, and related infrastructure would reduce habitat availability and relative habitat values for a variety of common wildlife species. This reduction in habitat would be expected to have a minor to moderate impact on the general wildlife species discussed in **Section 3.9.1** because many of these species are considered habitat generalists, meaning they are

not tightly restricted to specific habitat types (e.g., cottontail rabbits, coyotes, ravens, rodents, and snakes).

Visual and noise disturbances from increased traffic levels and construction, drilling, completion, and production activities, including use of the proposed compressor station, could displace wildlife from habitats in areas of human activity. Construction, drilling, and completion activities could result in displacement from affected habitats in specific, localized areas during the entire construction period for wells, roads, or pipelines (typically a period of several weeks in the vicinity of a well pad). However, production activities could result in displacement only during well visits (generally one, 30 minute visit per day), or for the life of the project for some species if animals are disturbed due to noise from the proposed compressor station. If displaced, individual animals could move into less suitable habitats, which could potentially cause deteriorated physical condition, decreased productivity, and increased general distress.

Overall, the severity of impacts to general wildlife species under the Proposed Action would depend on the seasonal and daily timing of traffic and project-related activities, site-specific topography and vegetation, species' sensitivity to human disturbance, and the availability of suitable habitat within and adjacent to the SCPA.

4.9.1.2 Big Game

Many of the impacts associated with the Proposed Action would be similar among all big game species (i.e., mule deer, elk, Rocky Mountain bighorn sheep, and bison) utilizing habitats in the SCPA. These potential impacts include:

- Decreased habitat values and reduced habitat use within and/or near disturbed areas due to direct habitat loss and fragmentation of habitat;
- Decreased reproductive success and nutritional condition from increased energy expenditure as a physical response to disturbance;
- Increased stress and increased intra- and inter-specific competition for resources due to increased animal densities in adjoining or unsuitable habitats;
- Increased potential for collisions between vehicles and big game; and
- Increased harassment and/or poaching of big game species.

Species-specific habitat losses for UDWR-designated big game ranges associated with the Proposed Action are listed below in **Table 4.9-1**.

Table 4.9-1. Surface Disturbance of Big Game Ranges under the Proposed Action

Big Game Ranges	Mule Deer		Elk		Rocky Mountain Bighorn Sheep		Bison	
	Acres	Percentage of Range in the SCPA	Acres	Percentage of Range in the SCPA	Acres	Percentage of Range in the SCPA	Acres	Percentage of Range in the SCPA
UDWR Crucial Value, Year-long	7[1]	1.1	-	-	110	4.8	858	8.2
UDWR Crucial	187	10.7	-	-	-	-	-	-

Big Game Ranges	Mule Deer		Elk		Rocky Mountain Bighorn Sheep		Bison	
	Acres	Percentage of Range in the SCPA	Acres	Percentage of Range in the SCPA	Acres	Percentage of Range in the SCPA	Acres	Percentage of Range in the SCPA
Value, Winter								
UDWR Substantial Value, Winter	636	8.5	282	7.6	-	-	-	-

[1]UDWR crucial value, year-long habitat for mule deer in the SCPA is considered fawning habitat.

Indirect habitat loss (e.g., avoidance of or displacement from well pads and roads), caused by habitat fragmentation of the remaining habitat, could be substantially larger than the direct habitat losses shown below. Habitat loss and displacement are not limited to actual areas of vegetation removed by surface-disturbing activities. Studies have shown that mule deer will generally avoid human-related activities, and therefore, the amount of suitable habitat loss will be greater than the acreage that is eventually developed (D'Eon and Serrouya 2005; Sawyer et al. 2006). Such studies, while useful, are not necessarily characteristic of all populations. For example, Easterly et al. (1991) found some evidence that mule deer acclimated to human activity associated with construction and production of oil fields. The conflicting results of the studies described above show that habitat selection varies based on factors such as species, topography, landscape, climate, season, and intensity of development. As such, impacts related to habitat fragmentation in the SCPA cannot easily be predicted or quantified, but for the purposes of analysis, it is assumed that disturbance on big game ranges would exceed that listed in **Table 4.9-1**.

As previously discussed, population estimates for the Book Cliffs mule deer herd unit (Herd Unit #10) and the Bitter Creek subunit of the Book Cliffs elk herd unit (Herd Unit #10) are currently below their UDWR-designated population objectives (refer to **Section 3.9.2.1**). As such, the above-mentioned impacts could potentially contribute to other factors already affecting these herds (e.g., existing habitat fragmentation, drought conditions, etc.). However, it should be noted that impacts to mule deer would be reduced in portions of the SCPA as Enduring Resources would adhere to BLM seasonal restrictions for crucial fawning and crucial winter habitats. Similar to mule deer and elk, the above-mentioned impacts would also be expected to affect Rocky Mountain bighorn sheep that occupy the Evacuation Creek and White River corridors and bison reintroduced to the area. As surface disturbance associated with the Proposed Action would continue to fragment previously fragmented big game ranges in the SCPA, impacts associated with the Proposed Action would likely decrease relative habitat values for these populations, but would not likely alter the current herd units on a population level basis.

4.9.1.3 Migratory Birds

Impacts to migratory birds under the Proposed Action would be similar in nature for all migratory bird species, but would vary in intensity depending on the timing, location, and amount of surface-disturbing activities and the species' sensitivities to these actions. If construction and drilling of the proposed well pads and wells were completed in the late summer months (i.e., August – September), many of the migratory species would have left the SCPA for southern wintering grounds, or at least would have fledged SCPCA nests. Disturbance during this time would not likely have a measurable impact on migratory bird populations as a whole or on individual species. If the proposed well construction and drilling were to occur during the nesting months in spring/summer, the Proposed Action could result in some displacement of birds and

destruction of nesting habitat. This would have a greater impact on high-priority migratory bird species due to their smaller population size and limited distribution found in these species.

Proposed surface disturbance estimates for vegetative communities under the Proposed Action, which provide habitat for migratory birds, are summarized in **Section 3.9.3**, and the location of these disturbances is displayed in **Figure 2-1**. Migratory birds utilizing Wyoming big sagebrush and pinyon-juniper vegetation would most likely be impacted greatest by the direct removal of habitat and increased habitat fragmentation in the SCPA. Habitat fragmentation and associated edge avoidance by migratory birds has been documented as leading to lower levels in productivity (Renfrew et al. 2005). As such, in addition to direct loss of habitat, habitat fragmentation and associated noise and increased human presence could cause displacement from foraging and nesting habitats. If displaced, birds could move to less suitable habitats which could cause an increase in competition and deteriorated physical condition.

Due to the extent of Wyoming big sagebrush and pinyon-juniper vegetation within the SCPA (approximately 10,274 total acres), as compared to the total proposed disturbance in these areas (i.e., approximately 858 acres or 8.4 percent), the above-mentioned impacts would most likely be minimal to moderate, with more moderate impacts expected for those birds occupying habitats within the 100-year floodplains for Evacuation Creek and Southam Canyon. Under the Proposed Action, approximately 0.24 mile of pipeline and approximately 0.04 mile of co-located road and pipeline are proposed within Wyoming big sagebrush vegetation in the 100-year floodplain for Evacuation Creek. Additionally, approximately 0.64 mile of pipeline and 0.11 mile of co-located road and pipeline are proposed within pinyon-juniper vegetation in the 100-year floodplain for Southam Canyon.

The presence of reserve pits in oil and gas fields allows for potential exposure of migratory birds to contaminants. Migratory birds mistake these structures for natural bodies of water, and contact with petroleum products in the reserve pit could result in mortality due to loss of thermoregulatory capability or from ingestion of contaminated water during preening. Birds that ingest sub-lethal doses of oil could also experience impaired reproduction. Those birds returning to their nests may inadvertently apply oil to their eggs, which is extremely toxic to developing bird embryos. These impacts would be minimized under the Proposed Action, as Enduring Resources has committed to using deterrents (e.g., netting or bird balls) on open reserve pits, as directed by the AO.

Specific actions under the Proposed Action, including ACEPMs for intensive reclamation and weed control, would reduce both direct and indirect impacts to migratory birds. Successful reclamation, in conjunction with implementation of a weed control plan, would reestablish migratory bird habitat over time.

4.9.1.4 Raptors

Implementation of the Proposed Action could affect nesting and breeding raptors that utilize the SCPA. Direct and indirect impacts to raptors may include temporary displacement from suitable habitats during the breeding season due to increased noise levels and visual disturbances on the landscape, and a reduction in habitat for prey species caused by direct habitat loss and fragmentation.

Surface-disturbing activities or areas with concentrated human activity in close proximity (e.g., ½ mile) of an active raptor nest could lead to temporary displacement from nesting sites, avoidance of affected areas, and deterrence from establishing or utilizing other nesting sites. Displacement

could lead to nest failure or nest abandonment, thereby affecting the breeding pair and its annual productivity. Steidl and Anthony (2000) suggest that the greatest energetic costs from disturbance occur in nestlings, potentially decreasing overall reproductive success. Displacement could also lead to increased use of adjacent habitats, which could lead to increased inter- and intra-specific competition for resources. However, as increased noise levels and visual disturbances associated with construction, drilling, and completion activities would be relatively short-term as compared to the life of the project, displacement to adjacent habitats from these activities would likely be temporary in nature and thus would not likely alter the productivity of current raptor populations within the SCPA. In addition, although human activity has been shown to adversely impact breeding raptors, some evidence of raptor habituation to human-induced disturbances has also been documented (Anderson et al. 1989; Steidl and Anthony 2000; Rodriguez-Estrella et al. 1998). It should be noted that displacement to adjacent habitats caused by avoidance of noise pollution from the proposed compressor station not likely be temporary in nature and could exist for the life of the project.

In addition to reducing suitable nesting habitat, surface disturbances associated with the Proposed Action would result in the direct loss of approximately 858 acres of habitat for raptor prey species such as mammals, songbirds, and reptiles. Rodriguez-Estrella et al. (1998) identify loss or fragmentation of habitat of prey species as a contributor to raptor population declines.

Specific actions under the Proposed Action, including ACEPMs listed below, would reduce both direct and indirect impacts to raptors. Raptor management would be guided by "*Best Management Practices for Raptors and Their Associated Habitats in Utah*" (see Appendix A of the Vernal ROD and Approved RMP) (BLM 2008e). As such, prior to any surface-disturbing activities during the breeding season, a BLM-approved contractor would survey all areas within 1 mile of proposed surface disturbance for the presence of raptor nests. If occupied/active raptor nests are found, construction would not occur during the nesting season for that species within a species-specific buffer described in the "*Guidelines*" above. In addition, as specified in these "*Guidelines*", and as determined by the AO of the appropriate SMA, modifications of these spatial and seasonal buffers for BLM-authorized actions would be permitted, so long as protection of nesting raptors is ensured (BLM 2008e). Furthermore, successful reclamation, in conjunction with implementation of a weed control plan, could reestablish raptor and prey species habitat over time.

4.9.1.5 Upland Game Birds

Impacts to chukar populations under the Proposed Action would be similar in nature to those described above for migratory birds, in that impacts would vary in intensity depending on the timing, location, and amount of surface-disturbing activities. The Proposed Action would result in the direct loss of approximately 496 acres of substantial value, year-long chukar habitat. If construction and drilling of the proposed well pads and wells were completed in spring or early summer (i.e., mid-March through May), chukar could be displaced from breeding or nesting sites, or become vulnerable to ground and aerial predators. Increased access and human presence (e.g., at well sites and project facilities) within the SCPA could also increase the potential for poaching and harassment of chukar, as well as increase hunter access and success. In contrast to these impacts, surface-disturbing activities in the SCPA, primarily along area roads, could increase the presence of cheatgrass, which is an important winter food source for chukar.

Specific actions set out under the Proposed Action, including ACEPMs for intensive reclamation and weed control, would reduce both direct and indirect impacts to chukar related to habitat loss. Successful reclamation, in conjunction with implementation of a weed control plan, would

reestablish chukar habitat over time, but would decrease the presence of cheatgrass, and thus available winter forage, in the SCPA.

4.9.1.6 Fisheries

As previously discussed, the proposed project would utilize water for two main purposes: 1) drilling and completion activities and 2) dust suppression. Total estimated water use during the 10-year development phase would be approximately 340 acre-feet. During the production phase, water use would be approximately 0.1 acre-feet per well pad per year, or a maximum of 15.2 acre-feet per year. Depletions can reduce the ability of the White and Green Rivers to create and maintain their physical and biological environments for fisheries. Water depletions can also contribute to alterations in flow regimes that favor non-native fish species.

Although no ground-disturbing activities would directly occur in the White River corridor as a result of the Proposed Action, fisheries in and downstream of the SCPA could be impacted by water depletion activities, increased siltation due to increased soil erosion, the potential for exposure to hazardous substances in the case of an accidental spill or leak. Degradation of habitat related to increased erosion and sedimentation would be minimized by certain actions set out under the Proposed Action, including ACEPMs which include provisions to implement interim reclamation and utilize approved erosion control measures. Additionally, impacts related to the increased potential for exposure to hazardous substances could be minimized by compliance with SPCC regulations. Furthermore, impacts to fisheries within the White River could be reduced if recommended mitigation measures to avoid entrainment are implemented (see **Section 4.9.4**).

4.9.2 ALTERNATIVE B – NO ACTION

4.9.2.1 General Wildlife

Under Alternative B, impacts to general wildlife species and their habitats within the SCPA would be similar in nature to those described above under the Proposed Action. However, these impacts would be less under Alternative B as approximately 180 acres of surface disturbance (or about 79 percent less disturbance) would occur in the SCPA. In addition, noise disturbances to general wildlife species would be less under Alternative B as well development would only occur on State of Utah and private leases. Overall, as compared to the Proposed Action, Alternative B would result in fewer adverse impacts to general wildlife species associated with functional habitat loss, habitat fragmentation, and displacement within the SCPA.

4.9.2.2 Big Game

Under Alternative B, impacts to big game would be similar in nature, but less in extent as less construction would occur in the SCPA. Species-specific habitat losses for UDWR-designated big game ranges associated with Alternative B are listed below in **Table 4.9-2**.

Table 4.9-2. Surface Disturbance of Big Game Ranges under the No Action Alternative

Big Game Ranges	Mule Deer		Elk		Rocky Mountain Bighorn Sheep		Bison	
	Acres	Percentage of Range in the SCPA	Acres	Percentage of in the SCPA	Acres	Percentage of Range in the SCPA	Bison Acres	Percentage of Range in the SCPA

Big Game Ranges	Mule Deer		Elk		Rocky Mountain Bighorn Sheep		Bison	
	Acres	Percentage of Range in the SCPA	Acres	Percentage of in the SCPA	Acres	Percentage of Range in the SCPA	Bison Acres	Percentage of Range in the SCPA
UDWR Crucial Value, Year-long	-	-	-	-	47	2.0	181	1.7
UDWR Crucial Value, Winter	60	3.4	-	-	-	-	-	-
UDWR Substantial Value, Winter	121	6.9	48	1.3	-	-	-	-

As previously discussed, population estimates for the Book Cliffs mule deer herd unit (Herd Unit #10) and the Bitter Creek subunit of the Book Cliffs elk herd unit (Herd Unit #10) are currently below their UDWR-designated population objectives (refer to **Section 3.9.2.1**). As such, the above-mentioned impacts could potentially contribute to other factors already affecting these herds (e.g., existing habitat fragmentation, drought conditions, etc.). However, it should be noted that impacts to mule deer on BLM-administered lands would be reduced in portions of the SCPA as Enduring Resources would adhere to BLM seasonal restrictions for crucial winter habitats. Similar to mule deer and elk, the above-mentioned impacts would also be expected to affect Rocky Mountain bighorn sheep that occupy the Evacuation Creek and White River corridors and bison transplanted to the area. As surface disturbance associated with the No Action Alternative would continue to fragment previously fragmented big game ranges in the SCPA, and estimated surface disturbances would be minimal, impacts associated with the No Action Alternative would likely decrease relative habitat values for these populations, but would not likely alter the current herd units on a population level basis.

4.9.2.3 Migratory Birds

Under Alternative B, impacts to migratory bird species would be similar in nature to those described under the Proposed Action. However, these impacts would be less under Alternative B as approximately 181 acres of surface disturbance (or about 79 percent less disturbance) would occur in the SCPA. Additionally, it should be noted that no construction (e.g., pipelines or co-located roads and pipelines) would occur in the 100-year floodplains for Evacuation Creek or Southam Canyon.

Specific actions set out under the No Action Alternative, including ACEPMs for intensive reclamation and weed control, would reduce both direct and indirect impacts to migratory birds occupying areas on or near access ROWs on Federal lands. Successful reclamation, in conjunction with implementation of a weed control plan, would reestablish migratory bird habitat over time.

4.9.2.4 Raptors

Under Alternative B, impacts to raptors would be similar in nature to those described above under the Proposed Action. However, these impacts would be less under Alternative B as approximately 181 acres of surface disturbance (or about 79 percent less disturbance) would occur in the SCPA. The loss of raptor nesting and foraging habitats would be correspondingly less under Alternative B as compared to the Proposed Action.

Specific actions under the No Action Alternative, including ACEPMs listed below, would reduce both direct and indirect impacts to raptors occupying areas on or near access ROWs on Federal lands. On BLM-administered lands, raptor management would be guided by "*Best Management Practices for Raptors and Their Associated Habitats in Utah*" (see Appendix A of the Vernal ROD and Approved RMP) (BLM 2008e). As such, prior to any surface-disturbing activities during the breeding season, a BLM-approved contractor would survey all areas within 1 mile of proposed surface disturbance for the presence of raptor nests. If occupied/active raptor nests are found, construction would not occur during the nesting season for that species within a species-specific buffer described in the "*Guidelines*" above. In addition, as specified in these "*Guidelines*", and as determined by the AO, modifications of these spatial and seasonal buffers for BLM-authorized actions would be permitted, so long as protection of nesting raptors is ensured (BLM 2008e). Furthermore, successful reclamation, in conjunction with implementation of a weed control plan, could reestablish raptor and prey species habitat over time.

4.9.2.5 Upland Game Birds

Under Alternative B, impacts to chukar populations would be similar in nature to those described above under the Proposed Action. However, these impacts would be less under Alternative B as approximately 97 acres of surface disturbance (or about 80 percent less disturbance) would occur in substantial value, year-long chukar habitat.

Specific actions set out under the No Action Alternative, including ACEPMs for intensive reclamation and weed control, would reduce both direct and indirect impacts to chukar related to habitat loss on or near access ROWs on Federal lands. Successful reclamation, in conjunction with implementation of a weed control plan, would reestablish chukar habitat over time, but would decrease the presence of cheatgrass, and thus available winter forage, in the SCPA.

4.9.2.6 Fisheries

Under Alternative B, impacts to fisheries in the White and Green Rivers would be similar in nature to those described under the Proposed Action. However, these impacts would be less under Alternative B as approximately 181 acres of surface disturbance (or about 79 percent less disturbance) would occur in the SCPA, and thus less water would be used. Total water usage for the 5-year development phase would be expected to be approximately 29.4 acre-feet, or about 91 percent less than the Proposed Action's 10-year development phase. Degradation of habitat related to increased erosion and sedimentation would be minimized for Federal access ROWs by certain actions set out under Alternative B, including ACEPMs which include provisions to implement interim reclamation, and utilize approved erosion control measures. Additionally, impacts related to the increased potential for exposure to hazardous substances could be minimized by compliance with SPCC regulations. Furthermore, impacts to fisheries within the White River could be minimized if recommended mitigation measures to avoid entrainment are implemented (see **Section 4.9.4**).

4.9.3 ALTERNATIVE C – VERTICAL DRILLING WITHIN THE POTENTIAL OIL SHALE DEVELOPMENT AREA

4.9.3.1 General Wildlife

Under Alternative C, impacts to general wildlife species and their habitats within the SCPA would be similar in nature to those described above under the Proposed Action. However, these impacts would be greater under Alternative C as approximately 1,117 acres of surface disturbance (or about 30 percent more disturbance) would occur in the SCPA to accommodate vertical drilling within the potential oil shale development area. Specifically, habitat loss and associated habitat fragmentation would be greatest in the oil shale development area where wells would be vertically drilled. Overall, as compared to the Proposed Action, Alternative C would result in greater adverse impacts to general wildlife species associated with functional habitat loss, habitat fragmentation, and displacement within the SCPA.

4.9.3.2 Big Game

Under Alternative C, impacts to big game would be similar in nature, but greater in extent as more construction would occur in the SCPA to accommodate vertical drilling within the potential oil shale development area. Vertical drilling would have the greatest effect on UDWR ranges for elk, Rocky Mountain bighorn sheep, bison, and select mule deer ranges (only UDWR substantial value, winter range for mule deer). Impacts to other mule deer ranges in the SCPA (i.e., UDWR crucial value, year-long and UDWR crucial value, winter ranges) would be essentially identical to those expected under the Proposed Action. Species-specific habitat losses for all UDWR-designated big game ranges associated with Alternative C are listed below in **Table 4.9-3**.

Table 4.9-3. Surface Disturbance of Big Game Ranges under Alternative C

Big Game Ranges	Mule Deer		Elk		Rocky Mountain Bighorn Sheep		Bison	
	Acres	Percentage of Range in the SCPA	Acres	Percentage of Range in the SCPA	Acres	Percentage of Range in the SCPA	Acres	Percentage of Range in the SCPA
UDWR Crucial Value, Year-long	7[1]	1.1	-	-	136	5.9	1,117	10.6
UDWR Crucial Value, Winter	188	10.7	-	-	-	-	-	-
UDWR Substantial Value, Winter	859	11.5	382	10.3	-	-	-	-

[1]UDWR crucial value, year-long habitat for mule deer in the SCPA is considered fawning habitat.

As previously discussed, population estimates for the Book Cliffs mule deer herd unit (Herd Unit #10) and the Bitter Creek subunit of the Book Cliffs elk herd unit (Herd Unit #10) are currently below their UDWR-designated population objectives (refer to **Section 3.9.2.1**). As such, the above-mentioned impacts could potentially contribute to other factors already affecting these

herds (e.g., existing habitat fragmentation, drought conditions, etc.). However, it should be noted that impacts to mule deer would be reduced in portions of the SCPA as Enduring Resources would adhere to BLM seasonal restrictions for crucial fawning and crucial winter habitats. Similar to mule deer and elk, the above-mentioned impacts would also be expected to affect Rocky Mountain bighorn sheep that occupy the Evacuation Creek and White River corridors and bison transplanted to the area. As surface disturbance associated with Alternative C would continue to fragment previously fragmented big game ranges in the SCPA, impacts associated with Alternative C would likely decrease relative habitat values for these populations, but would not likely alter the current herd units on a population level basis.

4.9.3.3 Migratory Birds

Under Alternative C, impacts to migratory bird species would be similar in nature to those described under the Proposed Action. However, these impacts would be greater under Alternative C as approximately 1,117 acres of surface disturbance (or about 30 percent more disturbance) would occur in the SCPA to accommodate vertical drilling within the potential oil shale development area. Additionally, it should be noted that construction of pipelines and co-located roads and pipelines in the 100-year floodplains for Evacuation Creek and Southam Canyon would be identical to that described above under the Proposed Action, with the exception of the proposed co-located road and pipelines in the 100-year floodplain for Evacuation Creek (approximately 0.11 miles). Surface-disturbing activities in these floodplains, and other proposed development activities throughout the SCPA, would increase habitat fragmentation in the SCPA.

Specific actions set out under Alternative C, including ACEPMs for intensive reclamation and weed control, would reduce both direct and indirect impacts to migratory birds. Successful reclamation, in conjunction with implementation of a weed control plan, would reestablish migratory bird habitat over time.

4.9.3.4 Raptors

Under Alternative C, impacts to raptors would be similar in nature to those described above under the Proposed Action. However, these impacts would be greater under Alternative C as approximately 1,117 acres of surface disturbance (or about 30 percent more disturbance) would occur in the SCPA to accommodate vertical drilling within the potential oil shale development area. The loss of raptor nesting and foraging habitats would be correspondingly greater under Alternative C as compared to the Proposed Action.

Specific actions under Alternative C, including ACEPMs listed below, would reduce both direct and indirect impacts to raptors. Raptor management would be guided by "*Best Management Practices for Raptors and Their Associated Habitats in Utah*" (see Appendix A of the Vernal ROD and Approved RMP) (BLM 2008e). Prior to any surface-disturbing activities during the breeding season, a BLM-approved contractor would survey all areas within 1 mile of proposed surface disturbance for the presence of raptor nests. If occupied/active raptor nests are found, construction would not occur during the nesting season for that species within a species-specific buffer described in the "*Guidelines*" above. In addition, as specified in these "*Guidelines*", and as determined by the AO, modifications of these spatial and seasonal buffers for BLM-authorized actions would be permitted, so long as protection of nesting raptors is ensured (BLM 2008e). Furthermore, successful reclamation, in conjunction with implementation of a weed control plan, could reestablish raptor and prey species habitat over time.

4.9.3.5 Upland Game Birds

Under Alternative C, impacts to chukar populations would be similar in nature to those described above under the Proposed Action. However, these impacts would be greater under Alternative C as approximately 605 acres of surface disturbance (or about 22 percent more disturbance) would occur in substantial value, year-long chukar habitat.

Specific actions set out under Alternative C, including ACEPMs for intensive reclamation and weed control, would reduce both direct and indirect impacts to chukar related to habitat loss on or near access ROWs on Federal lands. Successful reclamation, in conjunction with implementation of a weed control plan, would reestablish chukar habitat over time, but would decrease the presence of cheatgrass, and thus available winter forage, in the SCPA.

4.9.3.6 Fisheries

Under Alternative C, impacts to fisheries in the White and Green Rivers would be similar in nature to those described under the Proposed Action. However, these impacts would be greater under Alternative C as approximately 1,117 acres of surface disturbance (or about 30 percent more disturbance) would occur in the SCPA, and thus more total water would be used for the project. Total water usage for the 10-year development phase would be expected to be approximately 396 acre-feet, or about 16 percent more than the Proposed Action's 10-year development phase. Degradation of habitat related to increased erosion and sedimentation would be minimized by certain actions set out under Alternative C, including ACEPMs which include provisions to implement interim reclamation, and utilize approved erosion control measures. Additionally, impacts related to the increased potential for exposure to hazardous substances could be minimized by compliance with SPCC regulations. Furthermore, impacts to fisheries within the White River could be minimized if recommended mitigation measures to avoid entrainment are implemented (see **Section 4.9.4**).

4.9.4 RECOMMENDED MITIGATION MEASURES

To avoid entrainment, water would be pumped from an off-channel location – one that does not connect to the river during high spring flows. An infiltration gallery constructed in a BLM and USFWS-approved location would be best.

If the pump head is located in the river channel where larval fish are known to occur, the following measures should be followed: 1) the pump should not be situated in a low-flow or no-flow area, as these habitats tend to concentrate larval fishes; 2) the amount of pumping should be limited, to the greatest extent possible, during that period of the year when larval fish may be present; and 3) the amount of pumping should be limited to the greatest extent possible – during the pre-dawn hours, as larval drift studies indicate that this is a period of greatest daily activity.

All pump intakes should be screened with ¼-inch mesh material. Any fish impinged on the intake screen would be reported to the USFWS (801-975-3330) and the UDWR.

4.10 SPECIAL STATUS WILDLIFE AND FISHERY SPECIES

4.10.1 ALTERNATIVE A – PROPOSED ACTION

4.10.1.1 Mexican Spotted Owl

Although MSO would not likely nest in the SCPA due to the lack of preferred nesting habitat (i.e., steep-walled forested canyons), the Proposed Action would result in the loss of approximately 858 acres of potential foraging habitat for MSO prey species such as small mammals, songbirds, and reptiles. This would constitute an approximately eight percent reduction in foraging habitat for prey species across the entire 10,575 acre SCPA. This could affect MSO potentially occupying "fair" habitat northeast, but outside of the SCPA. However, based on MSO surveys conducted in 2007 and 2008, it was inferred that MSO were absent in the surveyed area at the time the surveys were conducted (B&A 2007; B&A 2008). It is therefore unlikely that MSO would be affected by the estimated loss of prey species within the SCPA.

Given the short-term nature of construction and drilling activities, that no MSO have been documented in the SCPA, and specific actions set out under the Proposed Action, including ACEPMs that include provisions to implement interim reclamation and adhere to mitigation measures in the Vernal ROD and Approved RMP (BLM 2008e), the Proposed Action "***may affect, not likely adversely affect***" the MSO.

4.10.1.2 Yellow-billed Cuckoo

The yellow-billed cuckoo is an obligate riparian species that feeds in cottonwood groves and nests in willow thickets. The Proposed Action would not cause direct loss or fragmentation to pockets of riparian habitat during the construction of well pads, roads, or pipelines, as no development would occur in the 100-year floodplain of the White River. However, activities that increase erosion and sedimentation to area drainages could degrade water quality, which could indirectly reduce the proper functioning level of riparian habitats along the White River corridor. Further, construction activities and increased traffic in the SCPA would likely introduce or spread weed species within riparian habitats near or adjacent to disturbed areas. The presence of exotic plant species has been documented as decreasing the habitat sustainability of remaining riparian habitats for the cuckoo (Wiggins 2005). Such impacts could reduce the overall habitat suitability for yellow-billed cuckoo potentially nesting, breeding, or foraging in the area. However, these impacts would be minimized by specific actions set out under the Proposed Action, including ACEPMs that include provisions to implement interim reclamation, utilize proper erosion protection and silt retention, and implement and adhere to a weed control plan.

Overall, the Proposed Action may indirectly affect potential habitat for the yellow-billed cuckoo along the White River corridor, but as no direct loss/removal of riparian vegetation would occur and no yellow-billed cuckoo have been documented in or near the SCPA, the Proposed Action would not likely result in a trend towards Federal listing of this species.

4.10.1.3 Bald Eagle

Given that no known bald eagle roosting sites have been identified along the White River corridor either in or within ½ mile of the SCPA boundary, it is inferred that wintering bald eagles are unlikely to take shelter in the SCPA from early November through late March. Bald eagles may, however, search for prey items along the White River corridor, including the portion of the White

River that flows through the SCPA. As such, increased human presence, traffic, and associated noise levels during the winter could deter bald eagles from these activities within or near the SCPA, particularly in construction areas in close proximity to the White River. In addition, increased traffic in the SCPA could also increase the potential for vehicle collisions with carrion-feeding eagles.

Specific actions set out under the Proposed Action, including ACEPMs to contact the UDWR regarding the presence of carrion on roadways, shoulders, and ROWs would minimize the potential for vehicle collisions with carrion-feeding eagles. Additionally, ACEPMs that include measures to prohibit construction or surface-disturbing activities within ½ mile bald eagle roost sites and limit daily times for work-related activities during the winter (November 1 through March 31), could minimize or eliminate many potential project-related disturbances to bald eagle behavior (e.g., temporary displacement and loss of prey species habitat) should roost sites become established along the White River corridor.

Based upon the analysis above, the Proposed Action could reduce the relative habitat value of potential bald eagle roosting and foraging habitats, but would not likely result in a trend towards Federal re-listing of this species given the current absence of winter roosting sites in and within ½ mile of the SCPA.

4.10.1.4 Golden Eagle

Under the Proposed Action, potential impacts to golden eagles in the SCPA include the following:

- Direct loss of nesting habitats due to construction activities;
- Temporary loss of potential foraging habitat loss due to changes in vegetation structure;
- Temporary displacement or avoidance of nesting sites caused by increased human activity, traffic, and noise levels; and
- Increased potential for collisions with vehicles when foraging on carrion (a primary winter food source for golden eagles).

Although interim reclamation efforts could restore potential habitat for the golden eagle over time, it is important to note that behavioral changes (e.g., temporary displacement or avoidance of territories) would be similar in nature to those discussed in the general raptor discussion (refer to **Section 4.9.1.4**). Therefore, as discussed previously for other raptor species, specific actions set out under the Proposed Action, including ACEPMs, would reduce both direct and indirect impacts to golden eagles. Raptor management would be guided by "*Best Management Practices for Raptors and Their Associated Habitats in Utah*" (see Appendix A of the Vernal ROD and Approved RMP) (BLM 2008e). As such, prior to any surface-disturbing activities during the breeding season, a BLM-approved contractor would survey all areas within 1 mile of proposed surface disturbance for the presence of raptor nests. If occupied/active golden eagle nests are found, construction would not occur during the nesting season within a species-specific buffer described in the "*Guidelines*" above. In addition, as specified in these "*Guidelines*", and as determined by the AO, modifications of these spatial and seasonal buffers for BLM-authorized actions would be permitted, so long as protection of nesting raptors is ensured (BLM 2008e). Furthermore, ACEPMs to contact the UDWR regarding the presence of carrion on roadways, shoulders, and ROWs could minimize the potential for vehicle collisions with carrion-feeding eagles.

Based on the analysis above, the Proposed Action could reduce the relative value of golden eagle habitat, but would not likely result in a trend towards Federal listing of this species.

4.10.1.5 Greater Sage-grouse

Sage-grouse are a sagebrush-obligate species, and rely almost exclusively on contiguous sagebrush ecosystems for leks, nesting sites, feeding sites, rearing sites, protection, and wintering grounds. Sagebrush habitats in the SCPA are primarily contiguous; however, existing roads have already somewhat fragmented these habitats. Additional development across the SCPA would continue to fragment existing sagebrush vegetation and may deter sage-grouse from utilizing certain portions of the SCPA. Surface disturbance associated with the Proposed Action would result in the direct loss of approximately 602 acres of Wyoming big sagebrush, primarily in the northern portion of the SCPA and east of Evacuation Creek.

According to UDWR data, sage-grouse do not currently utilize sagebrush habitats in the SCPA for breeding or nesting purposes; however, contiguous sagebrush parks in the SCPA may be used for brooding areas or winter cover. Numerous studies have determined that sage-grouse are affected by human activity (Lyon and Anderson 2003; Remington and Braun 1991; Braun 1986). The primary effect of the Proposed Action on sage-grouse would be displacement or abandonment of these areas due to increased disturbance from human activity, increased traffic, and noise associated with construction and drilling activities. Lyon and Anderson (2003) determined that traffic disturbance of 1 to 12 vehicles per day during the breeding season may reduce nest-initiation rates and increase distances from leks during lek-site selection. In addition, Ingelfinger (2001) determined that sagebrush obligate bird densities were reduced within 100 meters of a road, regardless of traffic volumes. Noise from construction activities would also affect sage-grouse during the period those activities are taking place at a given location. Sage-grouse may be temporarily displaced by this noise and other human activities until construction activities were completed. Sage-grouse could also experience increased general distress due to project-related noise impacts (e.g., increased traffic near brooding areas or winter habitat) that would occur in the SCPA throughout the life of the project.

Based on the above information, implementation of the Proposed Action may impact individual sage-grouse or could cause overall habitat value in the SCPA to be altered. However, specific actions set out under the Proposed Action, including ACPEMs that include provisions to implement interim reclamation, and implement and adhere to a weed control plan, would minimize the above-mentioned impacts to sage-grouse in the SCPA. As such, the Proposed Action could reduce the relative value of sage-grouse brooding areas and winter habitat, but would not likely result in a trend towards Federal listing of this species.

4.10.1.6 Endangered Colorado River Fish

Based on the similarity of their affected habitats within the White and Green Rivers, and potential impacts associated with the Proposed Action, impact analyses for the bonytail, Colorado pikeminnow, humpback chub, and razorback sucker (collectively known as the endangered Colorado River fish) are discussed together within this EA.

As previously discussed, the proposed project would utilize water for two main purposes: 1) drilling and completion activities and 2) dust suppression. Total estimated water use during the 10-year development phase would be approximately 340 acre-feet. During the production phase, water use would be approximately 0.1 acre-foot per well pad per year, or a maximum of 15.2

acre-feet per year. Depletions can reduce the ability of the White and Green Rivers to create and maintain the physical habitat (areas inhabited or potentially habitable to the Colorado River fish for spawning, development of fish larvae, or feeding, or serving as corridors between these areas) and the biological environment. Water depletions can also contribute to alterations in flow regimes that favor non-native fish species.

In order to address depletion (and other) impacts on the endangered Colorado River fish, a Recovery Implementation Program for Endangered Fish Species in the Upper Colorado River Basin (Recovery Program) was initiated on January 22, 1988. Under the 1988 Recovery Program, any water depletions from tributary waters within the Colorado River drainage are considered to *"jeopardize the continued existence"* of these fish. In order to further define and clarify the recovery processes in the Recovery Program, a Section 7 agreement was implemented on October 15, 1993, by Recovery Program participants. Incorporated into this agreement is a Recovery Implementation Program Recovery Action Plan (RIPRAP). The RIPRAP identifies actions currently required to recover the endangered fish species in the most expeditious manner. Included in the RIPRAP was the requirement that a one-time depletion fee would be paid to help support the Recovery Program for all non-historic water depletions (i.e., occurring after January 1988) from the Upper Colorado River Basin. The depletion fees ($17.79 per acre-foot as of October 1, 2007) were intended to be the reasonable and prudent alternative to avoid jeopardy to the endangered fishes by depletions to the Upper Colorado River Basin (USFWS 2007b). In 1995, the USFWS eliminated these water depletion fees for non-historical water depletions (permitted after January 1988) from the Upper Colorado River Basin of 100 acre-feet or less (USFWS 1995). For analysis purposes in this EA, it is assumed that all water depletions would be considered non-historical. As such, Enduring would be responsible for paying a one-time depletion fee to the Recovery Program. Furthermore, other impacts to the Colorado River fish related to obtaining water from the White River could be reduced if recommended mitigation measures to avoid entrainment are implemented (see **Section 4.10.4**).

Implementation of the Proposed Action could also degrade USFWS-designated critical habitat for the Colorado River fish in the White and Green Rivers by increasing erosion, sediment yield, and the potential for exposure to hazardous substances in the case of an accidental spill. However, degradation of habitat related to increased erosion and sedimentation would be minimized by certain actions set out under the Proposed Action, including ACEPMs which include provisions to implement interim reclamation, and utilize approved erosion control measures. Additionally, impacts related to the increased potential for exposure to hazardous substances could be minimized by compliance with SPCC regulations.

Based on the estimated non-historic water depletion to the Upper Colorado River Basin, the Proposed Action ***"may affect, is likely to adversely affect"*** the Colorado River fish and their USFWS-designated critical habitats in the White and Green Rivers. As such, Section 7 consultation with the USFWS would be required to evaluate impacts to the Colorado River fish and their critical habitats.

4.10.1.7 Bluehead Sucker, Flannelmouth Sucker, and Roundtail Chub

Although no ground-disturbing activities would directly occur in aquatic habitat for the bluehead sucker, flannelmouth sucker, or roundtail chub as a result of the Proposed Action, these fish could be impacted by water depletion activities, increased siltation due to increased soil erosion, and hazardous substances in the case of an accidental spill or leak. Impacts to these fish species would be similar in nature and intensity to those described above for the endangered Colorado River fish. Degradation of habitat related to increased erosion and sedimentation would be

minimized by certain actions set out under the Proposed Action, including ACEPMs which include provisions to implement interim reclamation, and utilize approved erosion control measures. Additionally, impacts related to the increased potential for exposure to hazardous substances could be minimized by compliance with SPCC regulations.

Based on the analysis above, the Proposed Action would reduce the relative value of fish habitat downstream of the SCPA in the Green River, but would not likely result in a trend towards Federal listing of these species.

4.10.2 ALTERNATIVE B – NO ACTION

4.10.2.1 Mexican Spotted Owl

Under Alternative B, impacts to the MSO would be similar in nature to those described under the Proposed Action. However, these impacts would be less under Alternative B as approximately 181 acres of surface disturbance (or about 79 percent less disturbance) would occur in the SCPA. This would constitute a two percent reduction in foraging habitat for prey species across the entire 10,575 acre SCPA.

Given the short-term nature of construction and drilling activities, that no MSO have been documented in the SCPA, and specific actions set out under the No Action Alternative, including ACEPMs that include provisions to implement interim reclamation and adhere to mitigation measures in the Vernal ROD and Approved RMP (BLM 2008e) on Federal lands, the No Action Alternative "***may affect, not likely to adversely affect***" the MSO.

4.10.2.2 Yellow-billed Cuckoo

Similar to the Proposed Action, the No Action Alternative would not cause direct loss or fragmentation to pockets of riparian habitat during the construction of well pads, roads, or pipelines, as no development would occur in the 100-year floodplain of the White River. Indirect impacts to the yellow-billed cuckoo would be similar in nature to those described above under the Proposed Action. However, these impacts would be less under Alternative B as approximately 181 acres of surface disturbance (or about 79 percent less disturbance) would occur in the SCPA. For access ROWs, these impacts would be minimized on Federal lands by specific actions set out under Alternative B, including ACEPMs that include provisions to implement interim reclamation, utilize erosion protection and silt retention, and implement and adhere to a weed control plan.

Overall, Alternative B may indirectly affect potential habitat for the yellow-billed cuckoo along the White River corridor, but as no direct loss/removal of riparian vegetation would occur and no yellow-billed cuckoo have been documented in or near the SCPA, the No Action Alternative would not likely result in a trend towards Federal listing of this species.

4.10.2.3 Bald Eagle

Under Alternative B, impacts to bald eagles would be similar in nature to those described under the Proposed Action. However, these impacts would be less under Alternative B as approximately 181 acres of surface disturbance (or about 79 percent less disturbance) would occur in the SCPA. This would constitute a two percent reduction in foraging habitat for prey species across the entire 10,575 acre SCPA.

Given the absence of winter roosting sites in and within ½-mile of the SCPA, and specific actions set out under the No Action Alternative for Federal access ROWs, including ACEPMs that include provisions to contact the UDWR regarding the presence of carrion and seasonally prohibit surface-disturbing activities within ½-mile of bald eagle roosting sites, the No Action Alternative would not likely result in a trend towards Federal re-listing of this species.

4.10.2.4 Golden Eagle

Under Alternative B, impacts to golden eagles would be similar in nature to those described under the Proposed Action. However, these impacts would be less under Alternative B as approximately 181 acres of surface disturbance (or about 79 percent less disturbance) would occur in the SCPA. Impacts to golden eagles would be minimized for Federal access ROWs by specific actions under Alternative B, including ACEPMs that include provisions to conduct raptor nest inventories prior to surface-disturbing activities, adhere to seasonal restrictions for nesting raptors, and contact the UDWR regarding the presence of carrion.

Based on the analysis above, Alternative B could reduce the relative value of golden eagle habitat, but would not likely result in a trend towards Federal listing of this species.

4.10.2.5 Greater Sage-grouse

Under Alternative B, impacts to sage-grouse would be similar in nature to those described under the Proposed Action. However, these impacts would be less under Alternative B as approximately 165 acres of surface disturbance in Wyoming big sagebrush (or about 72 percent less disturbance) would occur in the SCPA. Impacts to sage-grouse would be minimized for Federal access ROWs by specific actions set out under Alternative B, including ACEPMs that include provisions to implement interim reclamation, and implement and adhere to a weed control plan. As such, Alternative B could reduce the relative value of sage-grouse brooding areas and winter habitat, but would not likely result in a trend towards Federal listing of this species.

4.10.2.6 Endangered Colorado River Fish

Under Alternative B, impacts to the endangered Colorado River fish would be similar in nature to those described under the Proposed Action. However, these impacts would be less under Alternative B as approximately 181 acres of surface disturbance (or about 79 percent less disturbance) would occur in the SCPA, and thus less water would be used. Total water usage for the 5-year development phase would be expected to be approximately 29.4 acre-feet, or about 91 percent less than the Proposed Action's 10-year development phase. Degradation of habitat related to increased erosion and sedimentation would be minimized for Federal access ROWs by certain actions set out under Alternative B, including ACEPMs which include provisions to implement interim reclamation, and utilize approved erosion control measures. Additionally, impacts related to the increased potential for exposure to hazardous substances could be minimized by compliance with SPCC regulations. Furthermore, impacts to the Colorado River fish related to obtaining water from the White River could be reduced if recommended mitigation measures to avoid entrainment are implemented (see **Section 4.10.4**).

Based on the estimated non-historic water depletion to the Upper Colorado River Basin, Alternative B ***"may affect, is likely to adversely affect"*** the Colorado River fish and their USFWS-designated critical habitats in the White and Green Rivers. As such, Section 7 consultation with the USFWS would be required to evaluate impacts to the Colorado River fish and their critical habitats.

4.10.2.7 Bluehead Sucker, Flannelmouth Sucker, and Roundtail Chub

Under Alternative B, impacts to the bluehead sucker, flannelmouth sucker, and roundtail chub would be similar in nature and intensity to those described above for the endangered Colorado River fish. Degradation of habitat related to increased erosion and sedimentation would be minimized for Federal access ROWs by certain actions set out under the Proposed Action, including ACEPMs which include provisions to implement interim reclamation, and utilize approved erosion control measures. Additionally, impacts related to the increased potential for exposure to hazardous substances could be minimized by compliance with SPCC regulations.

Based on the analysis above, Alternative B would reduce the relative value of fish habitat downstream of the SCPA in the Green River, but would not likely result in a trend towards Federal listing of these species.

4.10.3 ALTERNATIVE C – VERTICAL DRILLING WITHIN THE POTENTIAL OIL SHALE DEVELOPMENT AREA

4.10.3.1 Mexican Spotted Owl

Under Alternative C, impacts to the MSO would be similar in nature to those described under the Proposed Action. However, these impacts would be greater under Alternative C as approximately 1,117 acres of surface disturbance (or about 30 percent more disturbance) would occur in the SCPA to accommodate vertical drilling within the potential oil shale development area. This would constitute an approximately 11 percent reduction in foraging habitat for prey species across the entire 10,575 acre SCPA.

Given the short-term nature of construction and drilling activities, that no MSO have been documented in the SCPA, and specific actions set out under Alternative C including ACEPMs that include provisions to implement interim reclamation and adhere to mitigation measures in the Vernal ROD and Approved RMP (BLM 2008e), Alternative C "***may affect, not likely to adversely affect***" the MSO.

4.10.3.2 Yellow-billed Cuckoo

Similar to the Proposed Action, Alternative C would not cause direct loss or fragmentation to pockets of riparian habitat during the construction of well pads, roads, or pipelines, as no development would occur in the 100-year floodplain of the White River. Indirect impacts to the yellow-billed cuckoo would be similar in nature to those described above under the Proposed Action. However, these impacts would be greater under Alternative C as approximately 1,117 acres of surface disturbance (or about 30 percent more disturbance) would occur in the SCPA to accommodate vertical drilling within the potential oil shale development area. These impacts would be minimized by specific actions set out under Alternative C, including ACEPMs that include provisions to implement interim reclamation, utilize erosion protection and silt retention, and implement and adhere to a weed control plan.

Overall, Alternative C may indirectly affect potential habitat for the yellow-billed cuckoo along the White River corridor, but as no direct loss/removal of riparian vegetation would occur and no yellow-billed cuckoo have been documented in or near the SCPA, Alternative C would not likely result in a trend towards Federal listing of this species.

4.10.3.3 Bald Eagle

Under Alternative C, impacts to bald eagles would be similar in nature to those described under the Proposed Action. However, these impacts would be greater under Alternative C as approximately 1,117 acres of surface disturbance (or about 30 percent more disturbance) would occur in the SCPA to accommodate vertical drilling within the potential oil shale development area. This would constitute an approximately 11 percent reduction in foraging habitat for prey species across the entire 10,575 acre SCPA.

Given the absence of winter roosting sites in and within ½-mile of the SCPA, and specific actions set out under Alternative C, including ACEPMs that include provisions to contact the UDWR regarding the presence of carrion and seasonally prohibit surface-disturbing activities within ½-mile of bald eagle roosting sites, Alternative C would not likely result in a trend towards Federal re-listing of this species.

4.10.3.4 Golden Eagle

Under Alternative C, impacts to golden eagles would be similar in nature to those described under the Proposed Action. However, these impacts would be greater under Alternative C as approximately 1,117 acres of surface disturbance (or about 30 percent more disturbance) would occur in the SCPA to accommodate vertical drilling within the potential oil shale development area. Impacts to golden eagles would be minimized by specific actions set out under Alternative C, including ACEPMs that include provisions to conduct raptor nest inventories prior to surface-disturbing activities, adhere to seasonal restrictions for nesting raptors, and contact the UDWR regarding the presence of carrion.

Based on the analysis above, Alternative C could reduce the relative value of golden eagle habitat, but would not likely result in a trend towards Federal listing of this species.

4.10.3.5 Greater Sage-grouse

Under Alternative C, impacts to sage-grouse would be similar in nature to those described under the Proposed Action. However, these impacts would be greater under Alternative C as approximately 734 acres of surface disturbance in Wyoming big sagebrush (or about 30 percent more disturbance) would occur in the SCPA to accommodate vertical drilling within the potential oil shale development area. Impacts to sage-grouse would be minimized by specific actions set out under Alternative C, including ACEPMs that include provisions to implement interim reclamation, and implement and adhere to a weed control plan. As such, Alternative C could reduce the relative value of sage-grouse brooding areas and winter habitat, but would not likely result in a trend towards Federal listing of this species.

4.10.3.6 Endangered Colorado River Fish

Under Alternative C, impacts to the endangered Colorado River fish would be similar in nature to those described under the Proposed Action. However, these impacts would be greater under Alternative C as approximately 1,117 acres of surface disturbance (or about 30 percent greater disturbance) would occur in the SCPA, and thus more water would be used. Total water usage for the 10-year development phase would be expected to be approximately 396 acre-feet, or about 16 percent more than the Proposed Action's 10-year development phase. Degradation of habitat related to increased erosion and sedimentation would be minimized by certain actions set out under Alternative C, including ACEPMs which include provisions to implement interim

reclamation, and utilize approved erosion control measures. Additionally, impacts related to the increased potential for exposure to hazardous substances could be minimized by compliance with SPCC regulations. Furthermore, impacts to the Colorado River fish related to obtaining water from the White River could be reduced if recommended mitigation measures to avoid entrainment are implemented (see **Section 4.10.4**).

Based on the estimated non-historic water depletion to the Upper Colorado River Basin, Alternative C ***"may affect, is likely to adversely affect"*** the Colorado River fish and their USFWS-designated critical habitats in the White and Green Rivers. As such, Section 7 consultation with the USFWS would be required to evaluate impacts to the Colorado River fish and their critical habitats.

4.10.3.7 Bluehead Sucker, Flannelmouth Sucker, and Roundtail Chub

Under Alternative C, impacts to the bluehead sucker, flannelmouth sucker, and roundtail chub would be similar in nature and intensity to those described above for the endangered Colorado River fish. Degradation of habitat related to increased erosion and sedimentation would be minimized by certain actions set out under Alternative C, including ACEPMs which include provisions to implement interim reclamation, and utilize approved erosion control measures. Additionally, impacts related to the increased potential for exposure to hazardous substances could be minimized by compliance with SPCC regulations.

Based on the analysis above, Alternative C would reduce the relative value of fish habitat downstream of the SCPA in the Green River, but would not likely result in a trend towards Federal listing of these species.

4.10.4 MITIGATION MEASURES

To avoid entrainment, water would be pumped from an off-channel location – one that does not connect to the river during high spring flows. An infiltration gallery constructed in a BLM and USFWS-approved location would be best.

If the pump head is located in the river channel where larval fish are known to occur, the following measures should be followed: 1) the pump should not be situated in a low-flow or no-flow area, as these habitats tend to concentrate larval fishes; 2) the amount of pumping should be limited, to the greatest extent possible, during that period of the year when larval fish may be present; and 3) the amount of pumping should be limited to the greatest extent possible – during the pre-dawn hours, as larval drift studies indicate that this is a period of greatest daily activity.

All pump intakes should be screened with ¼-inch mesh material. Any fish impinged on the intake screen would be reported to the USFWS (801-975-3330) and the UDWR.

4.11 RECREATION

The potential adverse impacts to recreation from natural gas development in the SCPA would consist primarily of lost recreational opportunities or diminished recreational experience within and near the Project Area.

4.11.1 ALTERNATIVE A - PROPOSED ACTION

Under the Proposed Action, 152 well pads, 47 miles of pipeline, and 36 miles of new or upgraded access roads would be constructed within the Project Area. Surface disturbance associated with the new well pads, associated facilities, roads, and pipelines (approximately 858 acres) would be visible to recreational users throughout much of the Project Area. The shift to an even more industrialized landscape, in combination with an increase in noise and traffic associated with construction, drilling, and completion activities would diminish the recreation experience of visitors seeking a more primitive environment.

Increased noise and human activity, from construction, drilling, and operations, as well as noise from the compressor, would likely result in displacement of game species from portions of the SCPA, which would impact hunting, especially for those seeking a more primitive hunting experience. Conversely, the 36 miles of new and upgraded access roads proposed within the Project Area would provide increased access to broader portions of the area, some of which were previously not accessible by vehicle. This increased access could expand trail-related recreational opportunities (such as OHV use and hunting).

River Recreation: If the Proposed Action were implemented, eight well pads and associated facilities have the potential to be seen from the White River (the nearest of which is proposed approximately ¼ mile from the River). Of those eight wellpads, only two fall within one half mile of the White River. These wells would be developed on leases that predated the VFO Approved RMP. The proposed wells may or may not be drilled during the primary recreational season. If wells were drilled during the recreation season, river recreationists may be able to see drill rigs and/or production facilities and activities on the well pads closest to the river, and could possibly see fugitive dust plumes along access roads. Each drilling rig would be operational for up to 20 days, 24 hours a day per well. Night lighting would be visible for long distances. Following drilling, completion rigs could also be visible for another 10 days. Visible development activities would diminish the recreational experience of some visitors seeking a natural setting devoid of human influence.

4.11.2 ALTERNATIVE B - NO ACTION ALTERNATIVE

Effects of surface disturbance on recreational activities and experiences in the SCPA would similar in nature to that described for the Proposed Action, but would be lower in magnitude due to the reduced level of development. There would be no wells within the viewshed of the river.

4.11.3 ALTERNATIVE C – VERTICAL DRILLING IN THE POTENTIAL OIL SHALE DEVELOPMENT AREA

Under Alternative C, 196 wells pads and associated facilities (50 miles of collocated road and pipeline and an additional 11 miles of pipeline) would be constructed within the Project Area for a total of 1,117 acres of surface disturbance. Effects of surface disturbance on recreational activities and experiences in the area would be nearly identical, but slightly greater, to that described for the Proposed Action. Additionally, 11 well pads (3 more than the Proposed Action) would likely be visible from the White River. Of the 11 well pads visible from the river, three lie within one half mile of the river, the nearest being approximately ¼ mile away. These wells would be developed on leases that predated the VFO Approved RMP.

4.11.4 MITIGATION

The following additional mitigation measures are recommended:

- No drilling would be allowed within sight of the river during the high use recreation season (April 1 through August 15).
- Lighting from drill rigs would be down shielded unless human health and safety would be adversely affected.
- Low profile production facilities would be used on well pads within the view shed of the river as directed by the AO.
- Facilities would be painted to blend with the environment as directed by the AO, with the exception of those facilities having OSHA requirements.

4.12 VISUAL RESOURCES

4.12.1 ALTERNATIVE A – PROPOSED ACTION

Short-term visual impacts due to construction, drilling, and completion activities would occur as a result of the Proposed Action. The landscape would be changed by the introduction of visual modifications within the landscape in the form of new lines, colors, forms, and textures. New well pads, facilities, roads, and pipelines would increase visual contrasts created by gas well construction and production activities (e.g., dozers, drilling rigs, truck traffic, heavy equipment, dust, lights, etc.) within the Project Area. Construction, drilling, and completion would take place over a four to six year period and would generally occur in clusters. Drilling activity typically occurs 24-hours per day, therefore, visual impacts during drilling activities would include lighting of drilling rigs during nighttime hours.

Long-term visual impacts of the Proposed Action would consist of reduced visual harmony within the overall landscape due to the introduction of additional long-term visual modification that creates contrasts. Long-term landscape contrasts would result from well pad facilities, pipelines, and roads, yielding a more industrialized visual setting.

Most of the proposed wells, pipelines, and roads (approximately 575 acres of surface disturbance) are expected within VRM Class III areas, in which the landscape should partially retain the existing character and changes to the landscape should be moderate. Approximately 134 acres of surface disturbance on Federal lands from the development of well pads, roads, and pipelines would occur in VRM Class IV areas and approximately 17 acres in VRM Class II areas. As mentioned in **Section 3.15**, VRM Class II areas allow for management activities to be seen, but those activities should not attract the attention of a casual viewer. The class II areas within the SCPA lie near the White River and in the southwestern corner of the Project Area.

Through implementation of mitigation measures Enduring would attempt to minimize the impact of development activities in the visual corridor of the White River and within Class II areas by locating and designing well pads so that they would be screened from viewers on the river by topographic features. In addition, all operating equipment would be painted a flat non-reflective color that is compatible with the surrounding landscape as specified by the BLM. Based upon commitment to these mitigation measures, the Proposed Action would be in compliance with the VRM Class II objectives.

4.12.2 ALTERNATIVE B – PROPOSED ACTION

Under Alternative B, development would be limited to State and private lands on which VRM guidelines do not apply.

4.12.3 ALTERNATIVE C – VERTICAL DRILLING IN THE POTENTIAL OIL SHALE DEVELOPMENT AREA

General visual impacts due to construction, drilling, and completion activities would be identical in nature to those described in **Section 4.14.1** for the Proposed Action. Specific differences are described below.

As with the Proposed Action, the majority of the development would fall within VRM Class III areas (approximately 711 acres) which would conform with VRM management objectives. Approximately 239 acres of surface disturbance would occur on VRM Class IV areas and 36 acres of disturbance are expected on VRM Class II Federal lands as a result of well pad, road, and pipeline construction.

Through implementation of mitigation measures Enduring would attempt to minimize the impact of development activities in the visual corridor of the White River and within Class II areas by locating and designing well pads so that they would be hidden by topographic features. In addition, all operating equipment would be painted a flat non-reflective color that is compatible with the surrounding landscape as specified by the BLM. Based upon commitment to these mitigation measures, the Proposed Action would be in compliance with the VRM Class II objectives.

4.12.4 RECOMMENDED MITIGATION MEASURES

The following mitigation measures are recommended for VRM Class II areas to reduce visibility from key observation points:

- The edges of well pads would be feathered to blend with the natural surroundings;
- Low profile tanks would be installed as directed by the AO; and
- Tank batteries would be centralized as directed by the AO;
- Topographic and vegetative screening would be utilized as directed by the AO.
- Engines placed in VRM II areas would be muffled with hospital mufflers as directed by the AO so as not to draw the attention of visitors to the area.

4.13 LAND USE AUTHORIZATIONS

4.13.1 ALTERNATIVE A - PROPOSED ACTION

Under the Proposed Action there would be approximately 858 acres of surface disturbance within the SCPA. Of the 858 acres, approximately 726 acres, or 85 percent would occur on Federal lands administered by the BLM.

In addition to the aforementioned impacts, implementation of the Proposed Action could result in potential conflicts with other pending or authorized land uses as described in the sections below.

4.13.1.1 Rights-of-Way

If the Proposed Action were implemented approximately three well pads would be constructed on Federal lands within the ROW for the White River Dam. If construction of the dam were to occur, these well pads and associated roads and pipelines would be located in an area that could potentially inundated. Lease number UTU 66422 contains a no surface occupancy stipulation for the Dam. However, as previously discussed in **Section 3.13.1**, although the State of Utah has never relinquished the ROW for this water facility, neither the State Of Utah's Water Plan (Utah Division of Water Resources 2001) or the Uintah Basin's Water Plan (Utah Division of Water Resources 1999) give any indication that the White River Dam will be constructed in the reasonably foreseeable future.

4.13.1.2 Mineral Development

Development of the Proposed Action could potential conflict with future oil shale development in both the 160-acre RD&D area and (if the pilot oil shale project is successful) within the 4,960-acre preferential lease area. Additional information on potential mineral conflicts can be found in **Section 4.2.1.1**.

If mitigation measures contained in **Section 4.2.1.4** were implemented, oil shale extraction activities and conventional oil and gas development within the preferential lease area would be able to occur concurrently and interference could be minimized.

4.13.2 ALTERNATIVE B - NO ACTION ALTERNATIVE

If Alternative B were selected the Proposed Action would not be implemented and no development would be approved on Federal lands. Nonetheless, drilling and production would continue to occur on State of Utah and private lands within the Project Area.

Construction of four well pads on State of Utah lands and 20 well pads private lands which would accommodate a total of 36 wells would result in approximately 181 acres of surface disturbance.

The BLM would be required to grant ROWs for roads and pipelines across Federal lands to access the leases on the State and private lands. Therefore, of the 181 acres, approximately 49 acres or 27 percent would occur on Federal lands administered by the BLM.

4.13.2.1 Rights-of-Way

Under the No Action alternative there would be no development within the White River Dam ROW; therefore, there it is not anticipated that there would be any long-term conflicts with pending or authorized ROWs.

4.13.3 ALTERNATIVE C – VERTICAL DRILLING IN THE POTENTIAL OIL SHALE DEVELOPMENT AREA

Under Alternative C there would be approximately 1,117 acres of surface disturbance within the SCPA. Of the 1,117 acres, approximately 985 acres, or 88 percent would occur on Federal lands administered by the BLM.

4.13.3.1 Rights-of-Way

If the Proposed Action were implemented approximately three well pads would be constructed on Federal lands within the ROW for the White River Dam. Therefore, impacts would be similar to those discussed under the Proposed Action.

4.13.3.2 Mineral Development

In order to reduce land use conflicts between oil shale and natural gas development, under the Alternative C, no development would occur within the oil shale RD&D area. In addition, each of the 124 wells proposed within the preferential lease area would be drilled vertically. Vertical well bores can be mapped more accurately than directional bores which would reduce the potential for conflict with oil shale development in the future. Additional information on potential mineral conflicts can be found in **Section 4.2.1.3**.

If mitigation measures contained in **Section 4.2.1.4** were implemented, oil shale extraction activities and conventional oil and gas development would be able to occur concurrently within the preferential lease area and unintentional interference with these activities could be essentially avoided.

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