DOE/EA-1331

ENVIRONMENTAL ASSESSMENT

REMEDIATION OF SUBSURFACE AND GROUNDWATER CONTAMINATION AT THE ROCK SPRINGS *IN SITU* OIL SHALE RETORT SITE

SWEETWATER COUNTY, WYOMING

July 2000

U.S. DEPARTMENT OF ENERGY

NATIONAL ENERGY TECHNOLOGY LABORATORY

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July 2000

Prepared by:

U.S. Department of Energy
National Energy Technology Laboratory

NEPA COMPLIANCE SUMMARY SHEET

LEAD AGENCY

U.S. Department of Energy (DOE)

TITLE

Environmental Assessment for Remediation of Subsurface and Groundwater Contamination at the Rock Springs *In Situ* Oil Shale Retort Test Site; Sweetwater County Wyoming.

CONTACT

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ABSTRACT

The U.S. Department of Energy (DOE) has prepared this EA to assess environmental and human health issues and to determine potential effects associated with the proposed Rock Springs *In-Situ* Oil Shale Retort Test Site remediation that would be performed at the Rock Springs site in Sweetwater County, Wyoming. The purpose of this action is to implement the 1998 Site Cleanup Agreement (Agreement) between the State of Wyoming Department of Environmental Quality and the U.S. Department of Energy, Federal Energy Technology Center (FETC), now named the National Energy Technology Laboratory (NETL). The Rock Springs site is located approximately 7 miles (mi) (11.3 kilometers [km]) west of Rock Springs, Wyoming and is 340 acres (138 hectares) in size. The land is privately owned.

The Proposed Action identified in the EA is for the DOE to perform air sparging with bioremediation at the Rock Springs site to remove contaminants resulting from oil shale retort tests conducted between 1965 and 1979. The Proposed Action is to perform *in situ* aeration, with features potentially including groundwater pumping and nutrient addition at Retort Sites 4, 7, 9, and 12. Implementation of the Proposed Action would result in the cleanup of benzene and other contaminants dissolved in the groundwater and would ensure that such contaminants in the Tipton Aquifer do not eventually affect the Wasatch Aquifer.

Three alternatives to the Proposed Action were also considered. Alternative 1 would remediate Retort Sites 4,7,9 and 12 by extracting and evaporating groundwater. Evaporation ponds would be lined with clay or suitable synthetic material to prevent leaching into the groundwater. Alternative 2 would remediate Retort Sites 4,7,9 and 12 by chemical oxidation, which would be performed by injecting oxidant solution

(hydrogen peroxide or potassium permanganate) into the groundwater using metering pumps to direct the oxidants into injection wells. Alternative 3 is No Action.

The main issues of concern examined in the Environmental Assessment (EA) were whether:

- Groundwater would act as a source for movement of contaminants off the Site.
- The Proposed Action and alternatives for groundwater remediation would be effective.
- Remediation activities would result in loss of wildlife, wildlife habitat, and forage for livestock and wildlife grazing; and
- Surface disturbance areas could be returned to pre-test conditions in terms of soil productivity and vegetation.

AVAILABILITY

A draft EA was made available for public review at the following public reading rooms:

Sweetwater County Public Library
300 North First East Street
Green River, Wyoming 82935
(307) 875-3615

Wyoming Department of Environmental Quality
122 West 25th Street
Cheyenne, Wyoming 82002
(307) 777-7037

Wyoming Department of Environmental Quality
250 Lincoln Street
Lander, Wyoming 82520
(307) 332-3144

Wyoming State Library
2301 Capitol Avenue
Cheyenne, Wyoming 82002
(307) 777-6333

PUBLIC INVOLVEMENT

DOE encourages public participation in the National Environmental Policy Act (NEPA) process, and public comments were solicited from April 3 through May 5, 2000. Notices of the availability of a Draft EA were published in local newspapers (the *Rock Springs Rocket Miner* and the *Casper Star Tribune*), and copies of the Draft EA were distributed to Federal and state agencies considered to be potentially interested parties. Copies of the Draft EA were also made available to the public at the local libraries or reading rooms indicated above. Four agency comment letters were received during this review period. These comments are briefly summarized below and are included in Appendix B.

On April 19, 2000, the Wyoming Deputy State Historic Preservation Officer (SHPO) noted that the draft environmental assessment included maps that showed the locations of some cultural resource sites. All maps showing cultural resource site locations have since been removed to protect site confidentiality. In the same comment letter, the SHPO also noted that the Union Pacific Railroad and segments of U.S. Highway 30 are historic properties.

The second comment letter was submitted by the State of Wyoming, Office of Federal Land Policy. The Office indicated that it supported the Proposed Action, because it is in keeping with the Fossil Energy Site Cleanup Agreement signed with the State of Wyoming Department of Environmental Quality.

On April 25, 2000, the Wyoming Game and Fish Department commented that the Rock Springs site is located in crucial antelope winter range and that the site is a severe winter relief range for antelope of the Sublette herd. They also indicated that Bitter Creek (on the reach adjacent to the Rock Springs site) supports a number of native and non-native fish species, including the flannelmouth sucker.

The fourth comment, dated May 24, 2000 was also submitted by the Wyoming State Historic Preservation Office. The staff archaeologist recommended that DOE should allow the project to proceed in accordance with Federal and state laws but explained that if any cultural material is discovered during construction, all work must be stopped and notification made to the DOE and SHPO.

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ACRONYMS AND ABBREVIATIONS

ac	acre(s)
ACHP	Advisory Council on Historic Preservation
atm	atmospheres
bgs	below ground surface
BETX	benzene, ethylbenzene, toluene, and xylenes
BLM	Bureau of Land Management
BPT	best practicable technology
BTU	British Thermal Unit
°C	degrees Centigrade
CAA	Clean Air Act
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
cm	centimeter(s)
Corps	U.S. Army Corps of Engineers
CWA	Clean Water Act
DB	decibel
dBA	A-weighted decibel
DOE	Department of Energy
EA	environmental assessment
EG&G	EG&G Technical Services
EIS	Environmental impact statement
EPA	Environmental Protection Agency
ESA	Endangered Species Act
^{o}F	degrees Fahrenheit
FETC	Federal Energy Technology Center
FONSI	Finding of No Significant Impact
fpd	feet per day
ft	feet
FWPCA	Federal Water Pollution Control Act
gal	gallon(s)
gal/sec	gallon(s) per second
gpm	gallon(s) per minute
ha	hectare(s)
HAP	hazardous air pollutants
Harza	Harza Engineering Company, Inc.
I-80	Interstate Highway 80
ID	inside diameter
in	inch
lb	pound
kg	kilogram(s)
km	kilometer(s)

kph	kilometer(s) per hour
kWh	kilowatt-hour
LERC	Laramie Energy Research Center
LETC	Laramie Energy Technology Center
L	liter(s)
LE	Federally listed and endangered species on the verge of extinction.
L/min	liters per minute
L/sec	liters per second
m^3	cubic meter(s)
m	meter(s)
METC	Morgantown Energy Technology Center
µg/L	microgram(s) per liter
$\mu g/m^3$	microgram(s) per cubic meter
mg/L	milligram(s) per liter
mi	mile(s)
mph	mile(s) per hour
msl	mean sea level
NEPA	National Environmental Policy Act
NETL	National Energy Technology Laboratory
NHPA	National Historic Preservation Act
NPDES	National Pollutant Discharge Elimination System
NRHP	National Register of Historic Places
OSHA	Occupational Safety and Health Administration
PCP	pentachlorophenol
PM_{10}	particulate matter 10 microns or less in diameter.
ppb	parts per billion
ppm	parts per million
psig	pounds per square inch gage
PT	Proposed for Federal listing as a threatened species
PVC	polyvinyl chloride
RCRA	Resource Conservation and Recovery Act
SC	State of Wyoming Species of Special Concern
SEA	Site Evaluation Accomplished
SHPO	State Historic Preservation Officer
scfm	standard cubic feet per minute
T	Federally listed threatened species
TDS	total dissolved solids
TCLP	toxicity characteristic leaching procedure
TNT	trinitrotoluene
US-30	US Highway 30
USC	United States Code
USFWS	U.S. Fish and Wildlife Service
VOC	Volatile Organic Compound
WDEQ	Wyoming Department of Environmental Quality
WQA	Water Quality Act
WWCC	Western Wyoming Community College

WYAQD	Wyoming Department of Environmental Quality/Air Quality Division
WYDOT	Wyoming Department of Transportation
WYLQD	Wyoming Department of Environmental Quality/Land Quality Division
WYNDD	Wyoming Natural Diversity Database
WYWQD	Wyoming Department of Environmental Quality/Water Quality Division
yd^3	cubic yard(s)

SECTION 1
PURPOSE AND NEED FOR ACTION

This Environmental Assessment (EA) evaluates a remedial action and three alternatives proposed by the U.S. Department of Energy (DOE) for the Rock Springs *in situ* oil shale Retort Site located in Sweetwater County, Wyoming. This section describes the history of the test site, the purpose and need for the Proposed Action, the decision to be made, and the scope of the environmental analysis process.

1.1 BACKGROUND

1.1.1 Site History

The DOE Laramie Energy Technology Center (LETC) and its predecessor organizations conducted experimental rock fracturing and *in situ* oil shale retorting tests at a site located approximately 7 miles (mi) (11.3 kilometers [km]) west of Rock Springs, Wyoming between 1965 and 1979. The location of the Rock Springs site in relationship to Wyoming is shown in Figure 1.1. A more detailed map of the site is shown in Figure 1.2. The site occupies an area of about 340 acres (ac) or 138 hectares (ha). Only about 10 percent (35 ac or 14 ha) of the site was used for fracturing, retort testing, or associated activities.

In situ oil shale retorting is the process of extracting shale oil from underground shale without mining. In the oil shale retorting tests conducted by LETC at the Rock Springs site, the oil shale formation was fractured and then heated (retorted). Fracturing techniques included explosives, hydraulic, and electrolinking. Liquid nitroglycerin, pelletized trinitrotoluene (TNT), and dynamite were utilized in explosive fracturing. The explosives were placed in boreholes and detonated. Hydraulic fracturing consisted of pumping water or a water-based gel under high pressure into an isolated section of a borehole until the formation began to fracture. High-voltage electricity was used in electrolinking to induce fractures or zones of weakness that would subsequently be fractured either explosively or hydraulically.

For each fracture test, a well or boring field was installed with several shot holes, and several surrounding boreholes were installed to evaluate the results of the fracturing and (if retort tests were conducted) to recover the shale oil. Retorting was generally accomplished by igniting the oil shale rubble or fractured zone with propane and injecting air to maintain combustion. The oil shale was heated to a range of 700 degrees Fahrenheit (°F) (371 degrees Centigrade [°C]) to 1,000 F (538 C) to liberate the shale oil (Dames & Moore, 1996). As the oil shale was heated, the organic solid (kerogen) decomposed into shale oil, retort gas, and residual organic carbon. Recovery of the shale oil resulted in about an equal amount of shale oil and water. Some of this oil, gas, and residual organic carbon were burned to drive the retorting process. The target of these

FIGURE 1.1 GENERAL LOCATION OF THE ROCK SPRINGS SITE

FIGURE 1.2 DETAILED LOCATION OF THE ROCK SPRINGS SITE

FIGURE 1.3 LOCATIONS OF TEST SITES AND RETORTS

experiments was the Tipton shale member of the Green River Formation. The hydrologic units of the Wasatch and Green River formations are described in Section 3.8.1.3. The tests were conducted at depths ranging from 40 feet (ft) (12.2 meters [m]) to 200 ft (60.9 m) below ground surface (bgs) (Dames & Moore, 1996). Fracture tests were conducted at 11 locations designated as Sites 1, 2, 3, 4, 5, 6, 6A, 7, 8, 9, and 12 (Carpenter, 1988). Retort tests were conducted only at Sites 2, 4, 6, 7, 9, and 12. Fracturing and retort experiments were designed for Sites 10 and 11 but were not conducted; therefore, no disturbance occurred at these two sites. The locations of all test sites (fracture and retort) are shown in Figure 1.3.

Only Sites 4 and 9 produced any significant amounts of shale oil (Carpenter, 1988). Approximately 8,000 gallons (gal) (30,236 liters [L]) of oil were recovered from Site 4 (Carpenter, 1972) and 2,500 gal (9,449 L) were recovered from Retort Site 9 (Long, et al., 1977). At Site 2, superheated steam was injected into the fractures, but ignition apparently never occurred and no oil was recovered.

1.1.2 Groundwater Contamination

The retort experiments were conducted below the ground surface; therefore, field investigations were conducted to determine the effect of the experiments on the groundwater system. Soil testing would be performed after groundwater remediation has been completed. During some of the retort experiments, groundwater samples were analyzed, primarily for inorganic constituents. However, beginning in about 1981, the field investigations concentrated on organic constituents. During retort experiments, samples were occasionally collected from some wells and were analyzed for major ions and metals. These studies revealed that organic contaminants were present in the Tipton aquifer. Groundwater samples were collected from monitor wells around the retort sites. The majority of the water quality data was obtained from wells located in and around Retort Site 9 because this area was thought to contain the greatest amount of contamination. The fact that Site 9 had high levels of contamination was later confirmed through pilot testing and groundwater monitoring. Groundwater monitoring events included the following:

- 1981-1983 – Samples collected from 25 monitor wells were analyzed for major ions, trace elements, total sulfur, thiocyanate, thiosulfate, tetrathionate, 13 phenolic compounds, 9 aromatic compounds, and 8 heterocyclic compounds.

- 1988 – Wyoming Department of Environmental Quality (WDEQ) and DOE sampled 10 monitor wells for selected organic and inorganic compounds.

- 1989 – Groundwater samples were collected from 17 new monitor wells and 17 existing monitor wells from March to August. The samples were analyzed for major inorganic constituents, trace metals, sulfur species including thiocyanate, thiosulfate, tetrathionate, total sulfur, and volatile and semi-volatile organic compounds (Linder-Lunsford, et al.,1990).

- 1994-1995 – Groundwater samples were obtained from 29 monitor wells sampled in March, June, and December 1994, and April 1995.

- 1994-1995 – Groundwater samples were collected from 19 new monitor wells and 10 existing monitor wells during four rounds of sampling in March, June, and December 1994, and April 1995. The samples were analyzed for 20 inorganic compounds, 35 volatile constituents, 14 phenolic constituents, and other water quality parameters such as specific conductance, total dissolved solids, pH, and turbidity (Dames & Moore, 1996).

- 1998-present – Remediation treatability and monitoring tests were conducted by EG&G Technical Services (EG&G) and Harza Engineering Company (Harza). Monitoring and testing activities took place at Retort Sites 4, 5, 7, 9, and 12, and included the evaluation of different remediation technologies and tests for benzene and other organic contaminants. To date, this phase of remediation feasibility testing has been conducted over a two-year period.

The organic compounds that were identified as being of particular concern to WDEQ, which could be attributed to the retort experiment, are shown in Table 1.1. The WDEQ was consulted during preparation of this table.

TABLE 1.1
PRIMARY CONTAMINANTS OF CONCERN IN GROUNDWATER

Volatile Constituents	Semi-Volatile Constituents
Acetone	2 – Methylphenol
Benzene	4 – Methylphenol
Toluene	3,4 – Methylphenol
Xylene	2,4 – Dimethylphenol
2-Butanone	2,4,5 – Trichlorophenol
Ethyl-benzene	2,4,6 – Trichlorophenol
	Pentachlorophenol (PCP)

Sources: Lindner-Lunsford, et al., 1990;
Dames & Moore, 1996; and Hoy, 2000.

Acetone and toluene were the most prevalent volatile constituents detected at the site. These constituents were present in the explosives used for the fracturing experiments (toluene is also associated with combustion testing). The concentration of volatile organic compounds (VOCs) is highest in the upper portion of the Tipton aquifer, where the fracturing and retort experiments occurred.

1.1.3 Previous Investigations and Tests

In 1993, a Preliminary Assessment Report was prepared for the DOE, which showed that there were 745 residents within a 4-mi (6. 1 km) radius of the Rock Springs Retort Site. All of these residents were hydraulically up gradient from the site and a majority received drinking water from the Green River. A water well inventory obtained from the

Wyoming State Engineer's Office also showed that there were seven permitted water wells within a 4-mi (6.1 km) radius from the site, and that these wells also were upgradient from the site. No groundwater uses were noted down gradient from the site (TVA, 1993).

The Environmental Protection Agency (EPA) reviewed the Preliminary Assessment Report for the Rock Springs Retort Site, pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The EPA determined that the site should be classified as "Site Evaluation Accomplished" (SEA) under the Federal Superfund program. This meant that a site inspection was not necessary and that EPA would not evaluate the site further for possible inclusion on the National Priorities List.

Subsequently, a remedial action alternative study was performed at the Rock Springs *in situ* oil shale retort site (Dames & Moore, 1996). This study showed that the Rock Springs site was neither on the National Priority List regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) nor the Resource Conservation and Recovery Act (RCRA). The study was performed to provide technical support to the decision-making process at Rock Springs. The study evaluated the following four remediation alternatives:

- Groundwater Monitoring and Well Permit Restrictions
- Hydraulic Containment with Above-Ground Treatment
- Pump and Treat with Above-Ground Bioreactor
- *In situ* Bioremediation of Source Area

A human health risk assessment was conducted as part of the 1996 remedial action alternative study. The risk assessment concluded the Rock Springs site does not pose a risk to human health or the environment currently or in the future, due to the lack of a complete exposure pathway. The findings of this study were therefore consistent with the conclusions reached in the 1993 Preliminary Assessment Report. Based upon these findings, the protection of human health and the criteria that deal with effectiveness of treatment and reducing contaminant concentrations were not weighed as heavily as the criteria of implementability and cost. Therefore, groundwater monitoring, well permit restrictions, and pump and treat were rated the highest in terms of cost effectiveness, followed by *in situ* bioremediation of source area and hydraulic containment with aboveground treatment (in that order).

The potential contaminants of concern that were identified from the risk assessment are presented in Table 1.1. The risk assessment assumed a future residential receptor at the Rock Springs site ingesting and using groundwater. This assumption was conservative, because there are no residents at or near the site; and the closest resident is over 2 mi to the east. There are no drinking water or livestock wells on or near the site, and there are no known plans for residential development at or near the site. The closest residents are located approximately 2.2 mi (3.5 km) east of the site. These residents obtain drinking water from the City of Rock Springs.

Harza has been performing pilot testing for aeration and bioremediation at Retort Sites 9 and 12. Pilot testing was started in February 1999 at Retort Site 9 and May 1999 at Retort Site 12. Pilot testing is ongoing, but would be discontinued if the EA and FONSI are approved and a groundwater remediation treatment program is implemented. Testing at these two sites evaluated the effectiveness of *in situ* bioremediation and developed techniques that can be used for full-scale design. Results through September 1999 indicated that *in situ* aeration provides enough dissolved oxygen to stimulate the growth of micro-organisms, which degrades benzene and other volatile organic compounds.

Since July 1998, EG&G has performed pilot tests at Sites 4 and 7 for BETEX (benzene, toluene, ethylbenzene and xylenes). Pilot testing consists of high-rate *in situ* air sparging under different air injection flow rates, pressures, and duration. Results through September 1999 indicated that high-rate *in situ* air sparging provides air at sufficient levels for volatilization and subsequent transport of vapors to the air.

1.2 PURPOSE FOR ACTION

The purpose of this action is to implement the 1998 Site Cleanup Agreement (Agreement) between the State of Wyoming Department of Environmental Quality and the U.S. Department of Energy, Federal Energy Technology Center (FETC), now named the National Energy Technology Laboratory (NETL). A copy of the Agreement is provided in Appendix A. This Agreement would ensure that "environmental impacts associated with past and present activities are thoroughly investigated and that cleanup and restoration (including groundwater) actions approved by the State of Wyoming are taken to protect the health, safety and welfare, and the environment and waters of the State." The Agreement also established a procedure and framework for monitoring the results of cleanup and restoration actions.

1.3 NEED FOR ACTION

The WDEQ requires the DOE to show that best practicable technologies (BPT) would be used to remediate contaminants of concern in the groundwater. BPT is defined by the WDEQ as being appropriate given the nature of the contamination. Wyoming statutes indicate the primary restoration goal for groundwater is achieving background water quality, with a secondary standard of Class of Use, if background cannot be achieved through BPT. Groundwater remediation technologies have been selected based on overall effectiveness in reducing contaminant concentrations, permanence of remediation, and ease of implementation. Remediation would also ensure that contaminated groundwater does not ultimately affect the Wasatch Aquifer, located beneath the Tipton Aquifer.

Surface area reclamation is necessary to return the site to pre-test soil productivity and vegetative cover. Site revegetation would be achieved using WDEQ approved seed mixtures, which would return the land to its former uses (livestock grazing and wildlife habitat). Restoration would begin following completion of groundwater remediation.

1.4 DECISION TO BE MADE

Based on this EA, the DOE will make a decision to either:

- Proceed with the Proposed Action or one of the alternatives, based on a Finding of No Significant Impact (FONSI);

- Prepare an Environmental Impact Statement (EIS) to further evaluate any significant impacts before deciding on a remediation method; or,

- Select the No Action alternative.

1.5 SCOPE OF THE ENVIRONMENTAL ANALYSIS

This EA was prepared in compliance with:

- The requirements of the National Environmental Policy Act of 1969 (NEPA).

- The President's Council on Environmental Quality (CEQ, 1991) regulations for implementing the procedural provisions of NEPA, which are contained in Title 40 of the Code of Federal Regulations (CFR), Parts 1500-1508.

- DOE's NEPA Implementing Procedures (10 CFR 1021)

Issues pertaining to site contamination and remediation were identified through consultations with the State of Wyoming, Bureau of Land Management (BLM), Wyoming Division of Cultural Resources, Wyoming Nature Conservancy, Wyoming Game and Fish Department, U.S. Fish and Wildlife Service (USFWS), and Rock Springs Grazing Association. Correspondence from the Wyoming Game and Fish Department, the USFWS, the SHPO and other organizations are provided in Appendix B.

The issues that were identified are:

- Whether groundwater would act as a source for movement of contaminants off the site.

- Effectiveness of groundwater remediation.

- Whether remediation activities would result in loss of wildlife, wildlife habitat, or forage for livestock and wildlife grazing.

- Whether the surface disturbance could be returned to pre-test conditions in terms of soil productivity and vegetation.

1.6 PUBLIC INVOLVEMENT

Information describing the Proposed Action and opportunities to comment were provided to the public by placing a public notice requesting comments on a Draft EA in the *Rock Springs Rocket Miner* and the *Casper Star Tribune* Newspapers. In addition, copies of the Draft EA were placed in the Sweetwater County Public Library (Green River), the Wyoming Department of Environmental Quality offices (Lander and Cheyenne), and the Wyoming State Library (Cheyenne). Four agency comment letters were received during this review period. These comments are briefly summarized below and are included in Appendix B.

On April 19, 2000, the Wyoming Deputy State Historic Preservation Officer (SHPO) noted that the draft environmental assessment included maps that showed the locations of some cultural resource sites. All maps showing cultural resource site locations have since been removed to protect site confidentiality. In the same comment letter, the SHPO also noted that the Union Pacific Railroad and segments of U.S. Highway 30 are historic properties.

The second comment letter was submitted by the State of Wyoming, Office of Federal Land Policy. The Office indicated that it supported the Proposed Action, because it is in keeping with the Fossil Energy Site Cleanup Agreement signed with the State of Wyoming Department of Environmental Quality.

On April 25, 2000, the Wyoming Game and Fish Department (Department) commented that the Rock Springs site is located in crucial antelope winter range and that the site is a severe winter relief range for antelope of the Sublette herd. The Department also indicated that Bitter Creek (on the reach adjacent to the Rock Springs site) supports a number of native and non-native fish species, including the flannelmouth sucker.

The fourth comment, dated May 24, 2000 was also submitted by the Wyoming State Historic Preservation Office. The staff archaeologist recommended that DOE allow the project to proceed in accordance with Federal and state laws, but explained that if any cultural material is discovered during construction, all work must stop and notification made to the DOE and SHPO.

SECTION 2

DESCRIPTION OF ALTERNATIVES INCLUDING THE PROPOSED ACTION

This section describes the Proposed Action and three alternatives to the Proposed Action. The No Action alternative is described and establishes the basis for comparison of the Proposed Action and its alternatives. The past remedial investigations formed the basis for selecting the Proposed Action and remedial alternatives that are evaluated in this EA.

2.1 PROPOSED ACTION

The Proposed Action for DOE is to perform *in situ* aeration, with features potentially including groundwater pumping and nutrient addition at Retort Sites 4, 7, 9, and 12. It would result in the cleanup of benzene and other contaminants dissolved in the groundwater and would ensure that such contaminants in the Tipton Aquifer do not eventually affect the Wasatch Aquifer. Those contaminants are identified in Table 1.1. If a need to remediate other retort sites is identified in the future, DOE would prepare a supplemental environmental analysis to determine the appropriate remediation method.

Treatability testing is currently being performed at Retort Sites 4, 7, 9, and 12. These sites were selected for testing and remediation because groundwater contamination levels were particularly high, compared to other test sites. These tests were established to define the design basis parameters, including air and water, if appropriate, flow rates and well spacing. Equipment used during the treatability study would be incorporated into the remedial design wherever possible and appropriate.

No active remediation is currently proposed for Sites 1, 2, 3, 5, 6, 6A, 8, and areas outside of historic retort sites (Figure 1.3). The low concentrations of contaminants found in wells in these areas are considered to be localized or originating from Retort Sites 4, 9, and 12. The effectiveness of the Proposed Action on the reduction of the low levels of contaminants in the wells found in Sites 2, 5, 6, and 6A, and the areas outside of historic retort sites would be evaluated through future groundwater monitoring. Monitoring is not proposed at Sites 1, 3, and 8 because those sites were never retorted and are not located near retort sites. The WDEQ has not required monitoring at Sites, 1, 3, and 8.

Groundwater remediation would consist of some combination of air sparging (high-rate air injection) in conjunction with low-rate air injection. The mass transfer of air via sparging would reduce benzene concentrations in the groundwater through volatilization and transport in the vapor phase to the air, either through vent wells or through rock fractures and porous shallow surface soil. The mass transfer of air would increase the dissolved oxygen content in the groundwater under either high-rate or low-rate air injection. The dissolved oxygen would enhance the effectiveness of natural bio-degradation taking place in the saturated regions of the retort zones.

Low-rate groundwater pumping would enhance (through hydraulic control), the distribution of dissolved oxygen, thereby improving coverage of the targeted retort zones. High-rate groundwater pumping may also be performed to dewater the targeted retort zones during air sparging and enhance direct transfer of contamination from solid phase to air, thereby improving contaminant reduction efficiencies.

The initial results of the treatability studies performed at Retort Sites 9 and 12 indicated that sufficient natural nutrients exist in the groundwater for bioremediation to occur. However, the groundwater treatment system would be implemented with the flexibility of providing for nutrient addition, through injection of ammonium chloride and potassium phosphate, if needed to support biological activity during Proposed Action operation. From treatability study results, dosage of nutrients in the injection stream, if required, would be expected to be approximately 25 milligrams per liter (mg/L) (25 parts per million [ppm]) of ammonium chloride and 5 mg/L (5 ppm) of potassium phosphate.

The proposed system for remediation at Retort Sites 4, 7, 9, and 12 could include injection/extraction/vent/monitoring wells, connecting piping, valves, compressor(s), desiccant dryer(s), flow measurement devices, controls, treatment buildings, and if implemented, equipment and tanks for a nutrient addition system, and groundwater pump(s). The proposed flow diagram of the Proposed Action is shown on Figure 2.1.

Table 2.1 summarizes the approximate number of new wells expected to be required and their screened intervals for each of Retort Sites 4, 7, 9, and 12. The actual number of wells may be somewhat greater or less than these estimates. This includes wells for both injection and groundwater monitoring. Though preliminary at this time, the number of wells in Table 2.1 was based on the results from the Retort Sites 4, 9, and 12 treatability study data and on available data describing the areal extent of the retort cavities and groundwater contamination. The areal extent of the retorting activities was estimated by more recent site studies performed at the site. The exact number of wells and well placement would be determined during the design phase of the Proposed Action. In addition, some existing wells would be incorporated into the final design.

The wells may be connected to the treatment system injection (and extraction) equipment with piping. The piping would be protected from freezing, either with heat tracing or through burial below the frost line depth. Vent wells would release to the atmosphere. Selected wells would be designed to serve as monitoring wells in addition to injection, extraction, and/or vent wells.

The compressor(s) would be capable of supplying an air flow ranging from as low as 1 to 2 liters/min (L/min) (8.8×10^{-3} gal/sec) with 50 pounds per square inch gage (psig) (3.4 atmospheres [atm]) pressure for low-rate air injection up to 100 standard cubic foot per minute (scfm) (4.72 L/sec) with 100 psig (6.8 atm) pressure for air sparging. The compressor(s) would be housed in a treatment building with controls. The controls, at a minimum, would be programmed for automatic operation, emergency shutoff, and on-off timer control of the compressor(s).

FIGURE 2.1 FLOW DIAGRAM FOR *IN SITU* AERATION

TABLE 2.1
ANTICIPATED NUMBER OF NEW WELLS FOR PROPOSED ACTION

Retort Site	Approximate Number of New Wells [a]	Approximate Screened Interval (ft bgs)	(m bgs)
Site 4	8-10	60 – 95	18 -29
Site 7	2-3	60 - 95	18 -29
Site 9	30-35	80 – 200	24 - 61
Site 12	10-12	150 – 260	46 - 79

Source: Harza Engineering Company, 2000(a)

(a) The projected number of new wells is approximate and may later vary.

If implemented, submerged water pumps with variable frequency drives designed for continuous service may be used for groundwater pumping. The submerged pumps would be capable of pumping from as low as 1 gallon per minute (gpm) (0.6 L/sec) for hydraulic control up to 20 gpm (1.3 L/sec) or higher for dewatering the retort zone. Small quantities of groundwater may be re-injected for hydraulic control. This amount would be less than one gpm (0.06 L/sec), and injection, if used, would be authorized by the Wyoming Underground Injection Control Permit (No. 98-337), dated January 8, 1999. Groundwater purge stream, whether from hydraulic control or dewatering, would be collected for on-site evaporation or off-site disposal.

A cyclic air-delivery approach evaluated in the Site 9 pilot-testing program showed enhanced benzene degradation compared to a continuous sparging approach. Therefore, some air-delivery cycle periods would be developed for implementation of air injection at Retort Sites 4, 7, 9, and 12. The periods of air supply and rest may be adjusted during the Proposed Action duration based on testing results.

Groundwater monitoring during the Proposed Action would occur at Retort Sites 4, 7, 9, and 12. For evaluation purposes it was assumed that a total of 30 wells would be monitored. Only two additional monitoring wells would probably be needed at Site 7. The total purge water produced per sampling round would be 7,250 gal (27,401 L) based on thirty 4- to 6-in (10.2 cm to 15.2 cm) ID wells, 100 ft (30.5 m) of saturated thickness, three well volumes, and four sampling events per year.

Additional wells would also be sampled as part of the Rock Springs long-term monitoring plan. The current long-term monitoring plan includes a total of 34 wells. The total purge water volume produced per sampling round is approximately 6,500 gal (24,567 L). Currently, there are two sampling events per year.

The total volume of purge water produced annually from the Proposed Action and long-term monitoring would be approximately 29,000 gal (109,605 L) and 13,000 gal (49,133 L), respectively. This water would be collected and either evaporated on-site or trucked to the Sweetwater County Landfill. This landfill can accept the water for fugitive dust spray suppression and control. The landfill currently accepts wastewater from the

Rock Springs pilot-testing program, pursuant to the conditions of the “Waste Disposal Permit for Production Water/Drilling Fluids” (permit number 9811002.00), dated November 23, 1998 and issued to the FETC by Sweetwater County Solid Waste Disposal District Number 1.

The bioremediation program is expected to operate for about 5 years. However, remediation would continue until requirements set forth by the WDEQ are satisfied. As described in Section 1.3 of this EA, the WDEQ requires the DOE to show that best practicable technologies (BPT) would be used to remediate contaminants of concern in the groundwater. The WDEQ defines BPT as:

> “A technology based process justifiable in terms of existing performance and achievability in relationship to health and safety, which minimizes to the extent safe and practicable, disturbances and adverse impacts of the operation on human or animal life, fish, wildlife, plant life and related environmental values.”

Wyoming regulations indicate the primary restoration goal for groundwater is achieving background water quality, with a secondary standard of Class of Use, if background cannot be achieved through BPT. Groundwater remediation technologies are selected based on overall effectiveness in reducing contaminant concentrations, permanence of remediation, and ease of implementation.

Surface area reclamation would be necessary to return the site to pre-test soil productivity and vegetative cover. Site revegetation would be achieved using WDEQ approved seed mixtures, which would return the land to its former uses (livestock grazing and wildlife habitat). Restoration would begin after completion of groundwater remediation.

Construction of project facilities (process and monitor wells, three treatment buildings, pipeline, evaporation ponds, and roads) would disturb approximately 5 ac (2.0 ha). Each treatment building would contain an air compressor, switches, and a workspace to mix nutrients or take groundwater samples. Approximately 8,000 cubic yards (yd^3) (6,103 cubic meters [m^3]) of topsoil would be salvaged from these areas. The topsoil would be stockpiled for post-reclamation activities. The topsoil piles would be identified by a sign, temporarily seeded with a mixture of grasses, and protected from wind and water erosion with a straw mulch and silt fences, as deemed necessary.

During the construction and remediation phase, disturbed soils may be subject to wind and water erosion. Wind erosion would be prevented or reduced by using water or chemicals to stabilize the soil surface. Water erosion would be controlled by minimizing the amount of soil disturbance, and by placing sediment control structures around the storage areas. Reducing traffic speeds would also mitigate fugitive dust from dirt roads.

Approximately 62 yd^3 (47.3 m^3) of soil generated from drilling wells for the retort sites would be stockpiled in a common spoil area. This process would include stripping and stockpiling the topsoil, installing a plastic liner, and spreading the drill cuttings on the liner to volatilize the organic compounds. Drill cuttings would be sampled and tested to determine proper disposal requirements. Sediment fences or erosion control berms would be placed around the topsoil stockpile area to prevent sedimentation and movement of contaminants off-site. Site reclamation of the spoil area would consist of removal of the plastic liner, replacing the topsoil, and revegetating the disturbed areas. The common spoil area would therefore include both topsoil and drill cuttings.

At project completion, the three treatment buildings and associated treatment equipment would be removed. Various air injection wells would be retained for post-reclamation monitoring. The remainder of the wells would be properly abandoned according to WDEQ regulations and the surface disturbance reclaimed as described below.

The abandoned wells would have a minimum of 2 ft (0.6 m) of soil cover over the PVC stub plug. Abandoned well refuse and drill cuttings would be disposed as a non-hazardous solid waste in the Sweetwater County Landfill, following State of Wyoming and County Landfill Guidelines.

Reclamation activities would consist of spreading topsoil on the areas stripped prior to remediation activities. Areas covered with topsoil would be seeded with a mixture of native grasses approved by the WDEQ. Seeding would preferably take place in late fall before the soil freezes but when temperatures are cool enough to prevent germination. Seeded areas would be covered with straw mulch or other suitable material to protect against loss of soil moisture, and wind and water erosion until established.

The success of the reclamation activities would be evaluated by the WDEQ. The Agreement between the DOE and the State of Wyoming may be extended if remediation goals are not met within the period identified in the original Agreement. The Agreement, which established procedures for DOE to clean up the site and to verify effectiveness of the remediation, is also summarized in Section 1.2 of this EA. The DOE expects to maintain a limited groundwater-monitoring program at the site for several years following any action in consultation with the WDEQ.

2.2 ALTERNATIVES TO THE PROPOSED ACTION

Three alternatives to the Proposed Action were considered. Alternative 1 would remediate the sites by relying principally on extracting contaminated groundwater from the retort areas and evaporating it by storing the water in surface holding ponds. Evaporation ponds would be lined with clay or suitable synthetic material to prevent leaching into the groundwater. Alternative 2 would remediate the sites by chemical oxidation, which would be performed by injecting oxidant solution (hydrogen peroxide or potassium permanganate) into the groundwater using metering pumps to direct the oxidants into injection wells. Alternative 3 is No Action.

2.2.1 Alternative 1 – Groundwater Pump and Treat

Under Alternative 1, groundwater pumping and treatment would be performed at Retort Sites 4, 7, 9, and 12. Groundwater pumping would be conducted using pumps placed in discrete extraction wells, and treatment would most likely consist of natural volatilization via engineered evaporation ponds. Discharge to evaporation ponds would be required because the high level of naturally occurring total dissolved solids (TDS) in the groundwater would eliminate the possibility of discharge to surface waters based on surface water quality regulations applicable to Bitter Creek, the nearest surface water drainage. Evaporation rates exceed average annual rainfall by a wide margin (Sweetwater County receives less than 9 in (22.9 cm) of precipitation annually). Like the Proposed Action, this alternative would address the high concentration areas of contaminants dissolved in the groundwater at Retort Sites 4, 7, 9, and 12. No active remediation would be performed in other areas.

Several aquifer tests were performed over the past several years in various wells at Retort Sites 4, 7, 9, and 12 (Dames & Moore, 1997; and Harza, 1998 and 2000a). Results of these pump tests were typical of flow draw down in fracture areas. Sustained yield flow rates were approximately 0.5 gpm (0.03 L/sec) for Retort Site 4 and 1 gpm (0.06 L/sec) for Retort Sites 9 and 12.

Groundwater treatment using groundwater extraction would be difficult because of process characteristics. The process relies on the physical mechanism of desorption of contaminants from surfaces of the retorted zone into the groundwater as it passes. Desorption would occur through the creation of a concentration gradient from the more concentrated surface to the less concentrated groundwater. Treatability tests (Dames & Moore, 1997) suggested that the desorption rate for one contaminant, benzene, ranged from 1 to 10 micrograms per liter (μg/L) (1 to 10 ppb) per day.

The remediation facilities for this alternative would include extraction wells, monitoring wells, connecting piping, valves, groundwater pump(s), *ex situ* treatment equipment, flow measurement devices, controls, treatment buildings, and evaporation pond(s). The proposed flow diagram of the groundwater pump and treat alternative is shown on Figure 2.2.

The number of new wells necessary for adequate coverage was assumed to be similar to the Proposed Action. Like the Proposed Action, the number of wells was based on the preliminary results from Retort Sites 4, 9, and 12 treatability studies and the assumed extent of each of the three Retort Sites. It was also assumed that some existing wells would be incorporated into the final design. The connecting piping would be installed in similar fashion to that described in Section 2.1.

Submerged pump(s) would be installed with variable frequency drives designed for continuous service. The submerged pumps would be capable of pumping approximately 1 gpm (0.0g L/sec). The controls, at a minimum, would be programmed for automatic operation, emergency shutoff, and on-off timer control.

Based on an assumed average pumping rate of 3 gpm (0.19 L/sec) (1 gpm [0.06 L/sec] per retort site), a total of approximately 1,580,000 gal (5,972,400 L) of groundwater would be treated annually. Treatment would be conducted by discharging water to the evaporation ponds, where natural volatilization would occur.

Based on the annual treatment volume, the total area required for evaporation ponds would be about 9 ac (3.6 ha), assuming a conservative net evaporation rate of 0.58 ft (0.17 m) per year during spring, summer, and early fall months. Three evaporation ponds would be constructed with each approximately 3 ac (1.2 ha) in area and 6 ft (2.4 m) in depth (for freeboard and solids build-up). The evaporation ponds would be constructed with berms and lined with clay or plastic, and a leak detection system would be installed.

FIGURE 2.2 LOW DIAGRAM FOR GROUNDWATER PUMP AND TREAT

Maintenance associated with the groundwater pump and treat alternative would be difficult, because the groundwater, high in dissolved solids, would adversely affect operation of the evaporation ponds and would likely clog effluent nozzles.

Monitoring of the groundwater would continue on a semi-annual basis for the duration of the pump and treat alternative. Purge volumes would be similar to those for the Proposed Action. The purge water would be treated and discharged into the groundwater treatment system and subsequent evaporation ponds.

The pump and treat alternative would continue for a period agreed upon between the WDEQ and DOE, but would be expected to continue for 10 to 20 years. When completed, equipment would be removed and the site would be reclaimed as described in Section 2.1.

2.2.2 Alternative 2 - *In situ* Chemical Oxidation

Alternative 2, *in situ* chemical oxidation, would be performed at Retort Sites 4, 7, 9, and 12. Chemical oxidation is a process of removing benzene and other contaminants by breaking them down into components of carbon dioxide and water. It is generally an effective treatment method for reducing levels of organic compounds. However, bench-scale treatability testing on groundwater from sites 9 and 12 did not support its effectiveness at the Rock Springs site.

Chemical oxidation would be performed by injecting oxidant solution (hydrogen peroxide or potassium permanganate) into the groundwater using metering pumps to direct the oxidants into injection wells. Groundwater extraction would also be performed in conjunction with oxidant injection to provide a source of solution water and for hydraulic control. Like the Proposed Action, this alternative would address the high-level sources of VOCs dissolved in the groundwater. No active remediation would be performed in other areas.

Groundwater treatment using chemical oxidation would be difficult due to the characteristics of the natural environment at Rock Springs. The process relies on the adequate distribution of the oxidant in the fracture zone. Bench-scale treatability test results were inconclusive due to problems with oxidant dosage, reduction efficiency, and time required for treatment. In addition, test results suggested that the required potassium permanganate dosages may form a precipitant, thereby potentially clogging well screens and the surrounding formation. Finally, the high natural pH and alkalinity of the groundwater would limit oxidant effectiveness.

The proposed system for the four retort sites would include oxidant injection and groundwater extraction wells, monitoring wells, connecting piping, valves, injection metering pump(s), oxidant storage and mixing tanks, flow measurement devices, groundwater extraction pump(s), controls, and treatment buildings. The chemical *in situ* treatment would not take place inside the treatment buildings. Facilities inside these structures would include control equipment, switching devices, an area for oxidant mixing, and an area to conduct monitoring during inclement weather. The proposed flow diagram of the *in situ* chemical oxidation alternative is shown on Figure 2.3.

FIGURE 2.3 LOW DIAGRAM FOR *IN SITU* CHEMICAL AERATION

The approximate number of new wells necessary for adequate coverage would be similar to the Proposed Action. Some existing wells would be incorporated into the final design. Injection wells would be installed with minimum 1 in (2.5 cm) ID PVC at nested depths, and extraction wells would be installed with minimum 4 in (10.2 cm) ID PVC. The connecting piping would be installed in similar fashion to that described in Section 2.1.

Hydrogen peroxide would be delivered as a liquid, while potassium permanganate would be delivered in a granular form. Either oxidant would be stored and mixed in above-ground storage tanks located in the treatment buildings. Bench-scale results suggested that dosages as high as 3,000 mg/L to 5,000 mg/L (3,000 ppm to 5,000 ppm) or higher would be required. Controls would be installed to monitor injection dosage and metering pump(s) operations.

Monitoring of the groundwater would continue on a semi-annual basis for as long as the chemical oxidation treatment alternative was in effect. Purge volumes are assumed to be similar as described for the Proposed Action. The purge water would be disposed as described in Section 2.1.

In situ chemical oxidation would continue for a period of time agreed upon between the WDEQ and DOE, but would be expected to continue for 5 years. When completed, equipment would be removed, and the site would be reclaimed as described in Section 2.1.

2.2.3 No Action Alternative

Under the No Action alternative, no remedial action to treat the groundwater or subsurface material would be performed. Natural degradation processes would be relied upon to eliminate or reduce groundwater contaminant concentrations. However, no detailed monitoring would be performed to demonstrate the effectiveness of these natural processes. Existing treatability study equipment and any surface piping would be removed, and areas that were disturbed during treatability study testing would be seeded with native grasses to restore the native vegetation.

Adoption of the No Action alternative may have legal consequences, because it would place DOE in violation of the 1993 and 1998 agreements with the WDEQ. It is possible that Notices of Violation would be issued from various state agencies.

This alternative would require some form of institutional controls, such as placing a notice on the plat maps located in Cheyenne, Wyoming, to notify other parties interested in the property that there would be a potential for groundwater contamination. The institutional controls would be identified by the Wyoming State Engineer’s Office and the form and substance of such proposed controls would be resolved with the WDEQ.

Groundwater would be periodically sampled to measure contaminant levels and migration patterns. The groundwater-monitoring program would consist of semi-annual sampling of approximately 34 long-term monitoring wells. Monitoring would be continued for a period of time agreed to by the Wyoming Land Quality Division (WYLQD) and DOE.

2.3 SUMMARY OF TREATMENT ALTERNATIVES

The significant characteristics of the Proposed Action and the alternatives are summarized in Table 2.2. The Proposed Action and Alternative 2 (*in situ* chemical oxidation) would be expected to involve approximately the same amount of surface disturbance, volume of topsoil stripped, number of wells drilled, and volume of purge water. By comparison, Alternative 1 would require the disturbance of more topsoil (both surface area and volume) and would also generate about 1.6 million gal (6.05 million L) of groundwater each year that would require on-site evaporation. The Proposed Action and Alternatives 1 and 2 would require a similar number of annual sampling events and number of new wells. The No Action alternative would produce only minor disturbances, because no construction, clearing, or new well drilling would take place. Long-term monitoring would take place at 34 existing wells over a minimum of about 20 years. No new wells would be drilled for this long-term monitoring.

TABLE 2.2
CHARACTERISTICS OF EACH ALTERNATIVE

Characteristic	*In situ* Aeration	Groundwater Pump and Treat	*In situ* Chemical Oxidation	No Action
Area of disturbance	5 ac 2 ha	14 ac 5.6 ha	5 ac 2 ha	0.1 ac 0.04 ha
Volume of topsoil stripped	8,000 yd^3 6,103 m^3	23,000 yd^3 17,547 m^3	8,000 yd^3 6,103 m^3	0 0
Number of new wells installed for processing or monitoring	59	59	59	0
Volume of drill cuttings disposed	62 yd^3 47 m^3	62 yd^3 47 m^3	62 yd^3 47 m^3	0 0
Treatment process operation: Volume of groundwater requiring treatment and disposal annually	10,000 gal [(a)] 37,795 L	1,600,000 gal 6,047,179 L	10,000 gal [(a)] 37,795 L	0 0
Treatment process monitoring: Number of sampling events annually & number of wells per event	4 events 30 wells/event	4 events 30 wells/event	4 events 30 wells/event	0 0
Treatment process monitoring: Volume of purge water produced annually	24,000 gal 90,720 L	24,000 gal 90,720 L	24,000 gal 90,720 L	0 0
Long-term monitoring: Number of sampling events annually & number of wells per event	2 events 34 wells/event	2 events 34 wells/event	2 events 34 wells/event	2 events 34 wells/event
Long-term monitoring: Volume of purge water produced annually	13,000gal 49,133 L	13,000 gal 49,133 L	13,000 gal 49,133 L	13,000 gal 49,133 L
Time period for assumed site remediation	5 years	10 – 20 years	5 years	>20 years

Note: (a) Quantities are preliminary and are used for evaluation purposes. Final values may later change, based on WDEQ requirements.
Sources: Scharre, 2000a
Liefer, 2000.

SECTION 3

AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

This section describes existing conditions of the environmental resources that may be affected by the Proposed Action and alternatives. The analysis of environmental consequences focuses on the major effects or changes within each resource area. A definition of a major change is described for each resource type for each alternative. The Proposed Action and alternatives are compared to these standards to determine if there would be impacts and if these impacts would cause a major adverse environmental consequence. The environmental consequences for the Proposed Action and alternatives are discussed in terms of direct or indirect, short-term or long-term, and potential cumulative effects.

3.1 AIR QUALITY

3.1.1 Existing Environment

The climate in the study area is arid, with maritime-polar winds prevailing from the west. However, the western mountain ranges cause most of the moisture to precipitate before reaching the Rock Springs area. The mean annual precipitation is 8.3 in (21.1 cm), with an annual snowfall of 30 in (76.2 cm). Precipitation occurs as light rains throughout the spring and summer, but as the summer progresses most of the moisture evaporates before it infiltrates into the soil. The average monthly snowfall from November to April is about 4.3 in (10.9 cm). The warmest month is July, with an average high temperature of 87.4 degrees Fahrenheit (°F) (30.8 degrees centigrade [°C]) and a maximum high temperature of 98 °F (36.7 °C). The coldest month is January, with an average temperature of 31.7 F (-0.2 C) and a maximum low temperature of –26 °F (-32.2 °C) (Julander, 1997).

Temperature inversions are possible in the winter months, and air pollutants have the potential to build up during early morning hours. The benzene, ethyl-benzene, toluene, xylene, trichlorophenol, and PCP constituents detected in groundwater are listed as hazardous air pollutants (HAP) under the Clean Air Act (CAA), Title I, Part A,§ 112. The State of Wyoming Air Quality Division (WYAQD) adopted the Federal list of HAP in 1997.

All areas within Sweetwater County are currently designated attainment for all air quality pollutants, including particulate matter (PM_{10}) and HAP standards (Schlichpemeier, 1999). The nearest Class 1 air quality area is the Jim Bridger Wilderness area, located approximately 75 miles north of the Rock Springs site.

3.1.2 Environmental Consequences

Changes to air quality would be considered a major effect if they resulted in contributions to an existing or projected air quality violation or resulted in a nuisance to neighboring residents. The air pollutants that were considered for the Proposed Action and alternatives included fugitive dust from construction activities, fugitive dust from disturbed areas, carbon monoxide emissions from process and construction equipment, and contaminant vapors from contaminated groundwater that would be brought to the surface.

3.1.3 Proposed Action

Fugitive dust is a potential concern during construction of the air-sparging system and facilities to support the system. The quantity of fugitive dust emissions from site construction is proportional to the area of ground surface disturbed and the duration of the construction activity. The land disturbed by the Proposed Action would involve only 5 ac (2 ha). The U.S. Environmental Protection Agency (EPA) has estimated that uncontrolled fugitive dust from ground-disturbing activities would potentially result in about 50 pounds (lb) (18.7 kilograms [kg]) of PM_{10} emissions per ac (0.4 ha) per day (EPA, 1985).

To control dust effects, vegetation clearing would be minimized and water would be sprayed on disturbed areas. These measures would keep dust levels at a minimum. The Rock Springs Retort Site is in an attainment area for all pollutants. The PM_{10} emissions from fugitive dust would not be expected to exceed the annual particulate standard of 50 $\mu g/m^3$ (50 ppb) or the 24-hour average concentration standard of 150$\mu g/m^3$ (150 ppb). The WDEQ would not require modeling of particulate matter and suggested that a common sense approach be used in spraying water as conditions warrant in order to control dust (Schlichpemeier, 2000).

Benzene stripped from the groundwater during air sparging would be attenuated through bio-remediation, and only minor emissions would likely occur into the atmosphere. Therefore, no significant effects to air quality would be associated with the Proposed Action. The WDEQ has indicated that an air quality permit would not be required for the project (Scharre, 1999b).

3.1.2.1 Groundwater Pump and Treat

Air quality (fugitive dust) effects associated with this alternative would be somewhat greater compared to the Proposed Action because approximately 14 ac (5.6 ha) of land would be cleared for construction of facilities. As with the Proposed Action, water spraying and selective clearing would effectively mitigate fugitive effects of this alternative. Because this alternative would emphasize treatment through evaporation from surface ponds, more benzene would be released to the atmosphere compared to other alternatives. An air permit would not be required.

3.1.2.2 *In situ* Chemical Oxidation

Implementation of this alternative would require about the same surface disturbance as the Proposed Action (*in situ* treatment would involve only 5 ac (2 ha) of land disturbance). Therefore, fugitive dust air effects would be expected to be similar to the Proposed Action. An air permit would not be required.

3.1.2.3 No Action

Under the No Action alternative the existing treatability study equipment and any surface piping would be removed. Areas that were disturbed during treatability study testing would be seeded with native grasses and fertilized as needed to restore the native vegetation, according to the reclamation requirements of the Agreement between WDEQ and DOE. Only about 0.1 ac (0.04 ha) of land would be disturbed. Therefore, no air effects would be expected.

3.2 BIODIVERSITY

3.2.1 Existing Environment

Biodiversity addresses the potential presence of unique or rare plants, animals, scenic vistas, or other natural features. As described in other sections of this EA, the Rock Springs Retort Site is located in an area of similar topography, vegetation, wildlife habitat, and aesthetic conditions as the surrounding area. Unusual features are not present.

3.2.2 Environmental Consequences

A major effect to biodiversity would be expected if construction or operation of remediation facilities resulted in the loss of unique or unusual environmental features that are not commonly found in the region.

3.2.3 Proposed Action and All Alternatives

No biodiversity effects would be expected, because the site does not contain any unique or unusual features. A short-term loss of habitat would occur during construction activities. However, this would not be expected to affect wildlife due to the large expanse of similar vegetation around the site.

3.3 CULTURAL RESOURCES

3.3.1 Existing Environment

A cultural resource survey was conducted in all of Section 15; the S½, SW¼, SW¼ of Section 10; and the E¼ of Section 16 (Keck, 1997 and Keck, 1999). Section 15 was surveyed in 1978 and surveys of Sections 10 and 16 were conducted in 1979, 1982, and 1966 (Murray, 1996). Nine sites were identified, and four of these sites were eligible for listing on the National Historic Register. None of the eligible cultural resource sites are located near any retort sites.

Five separate cultural resource surveys were conducted along the right-of-way for three pipelines and five fiberoptic lines that cross the southern portion of Section 16 and through the center portion of Section 15. These surveys were conducted for the Mountain Fuel Overthrust pipeline (1979), the Mountain Fuel Overthrust/Trailblazer pipeline (1982), the Chevron carbon dioxide slurry pipeline (1984), AMOCO, the Williams Telecommunications fiber optic lines (1986), and the AT & T fiber optic lines (1987). No cultural resource sites were recorded along the rights-of-way (Currit, 1997).

Two unassociated sites were identified in Sections 15 and 16. A segment of the Overland Trail is located in the southern half of Sections 15 and 16. The trail generally follows along Bitter Creek and is covered in several places by the Union Pacific Railroad and segments of old U.S. Highway 30 (US-30). Segments of the trail that have not been affected by the railroad, US-30, and right-of-ways for pipeline or optic fiber lines would be considered important linear cultural resources. An eligible historic railroad camp is located near the project area but would not be affected by the proposed project facilities.

In November 1999, the Western Wyoming Community College (WWCC), Archaeological Services Department performed a Class III cultural resources inventory and site survey at the Rock Springs site (WWCC, 1999). The survey was conducted using standard 30 m (98.4 ft) transects within a 300 ac (121.8 ha) portion of Section 15, Township 18 North and Range 106 West. A relatively large survey area was selected by the DOE to ensure that possible resource effects would be identified, regardless of the selected alternative. The survey resulted in the discovery of three prehistoric lithic scatters, two isolated finds, and three previously recorded sites. None of the sites was considered eligible for inclusion on the National Register of Historic Places (NRHP). DOE has provided notification of survey results to the SHPO.

3.3.2 Environmental Consequences

Major cultural resource effects would occur if construction or operation of remediation facilities would affect cultural resources currently listed or potentially eligible for listing on the NRHP.

3.2.3 Proposed Action and All Alternatives

The Proposed Action and alternatives would have similar environmental consequences. Regardless of the selected alternative, no site on or eligible for the NRHP would be affected. Based upon the survey results and lack of significant cultural resource material, the WWCC recommended that cultural resource clearance be granted. Site surveys conducted in 1999 determined that cultural resources eligible for listing on the NRHP were not associated with the project area (WWCC, 1999).

3.4 ECOLOGICAL RESOURCES

3.4.1 Threatened and Endangered Species

3.4.1.1 Existing Environment

Consultation was conducted with the USFWS, the Wyoming Game and Fish Department, and the Nature Conservancy's Wyoming Natural Diversity Database (WYNDD) to determine whether species listed as threatened or endangered, species proposed for listing, or designated critical habitat for listed species, occur on or near the project site. Responses from these agencies are included in Appendix B. Table 3.1 presents the species listed as threatened, endangered, or of concern by the WYNDD and USFWS that may potentially be present in the project area.

TABLE 3.1
THREATENED, ENDANGERED, AND SPECIAL-CONCERN SPECIES

Common Name	Scientific Name	Federal and State Status	Potential Occurrence
Black-footed ferret	*Mustela nigripes*	LE/E	Potential resident in prairie dog colonies
American peregrine falcon	*Falco peregrinus anatums*	Delisted	Throughout western United States
Pallid bat	*Antrozous pallidas*	SC	Potential in arid grassland, roosts in rock crevices
Midget faded rattlesnake	*Crotalus viridis concolor*	SC	Potential in arid areas and rocky ledges
Brewer's sparrow	*Spizella brewereri*	SC	Sagebrush and shrub land
Ferruginous hawk	*Buteo regalis*	SC	Plains, sage steppe
Loggerhead shrike	*Lanius ludovicinaus*	SC	Plains, sage steppe
Mountain plover	*Charadrius montanus*	PT	Possible nesting in short vegetation and bare ground often with rocks nearby
Ute ladies'-tresses orchid	*Spiranthes diluvialis*	T	Wetlands, marsh areas (not found in alkaline areas)
Daggett rock cress	*Arabis demissa languida*	SC	Potential on rocky, windswept, calcareous hillsides in sagebrush-grassland community
Contracted Indian ricegrass	*Oryzopsis contracta*	SC	Present in basin areas of Western Wyoming
Hooker wild buckwheat	*Eriogonum hookeri*	SC	Present on dry hill sides in sagebrush-grassland community
Sage grouse	*Centrocercus urophasianus*	SC	Sage and shrub lands

a/ Sources: Neighbours, 1997; Neighbours, 1999; Jennings, 1997; and Jennings, 1999.

LE/E -- Federal listed endangered: species that are in danger of extinction throughout all or a significant portion of their ranges.
T -- Federal list threatened species
PT -- Proposed for Federal listing as a threatened species
C -- Federal candidate species: (does not have protected status).
SC -- State of Wyoming species of special concern (does not have protected status).

The USFWS identified three species that may be present in the project area. These included the mountain plover, the black-footed ferret, and the Ute ladies'-tresses orchid (Long, 1999). The WYNDD records search covered all sections within the township and range of the *in situ* project site as well as a one-township buffer zone. The database listed

22 species of concern that could occur in the region, defined by the WYNDD as T17-19N and R105-107W.

The black-footed ferret resides in prairie dog colonies of sufficient size where the burrows are used for dens and the prairie dogs constitute its prey. The ferret feeds primarily on prairie dogs (Fagerstone, 1987). A small colony of white-tailed prairie dogs (*Cynomys leucurus)* is present at the project Site. Mountain plover prefer to nest on bare ground in heavily grazed grassland sites with sparse vegetation and are rarely found near water (Ryder, 1980). They may be associated with prairie dog colonies (Knowles et al., 1982). The project site is within the mountain plover's range. Available data indicate that population numbers are declining rangewide, and the USFWS recommends surveys be conducted for mountain plover habitat in suitable locations in the project area prior to conducting remediation activities.

In 1998 and 1999, the DOE contracted with Intermountain Resources to survey the Rock Springs site and surrounding area for threatened or endangered plants or animals. Intermountain Resources also completed surveys for candidate species, nesting raptors and other species of concern. The 1998 surveys were conducted during April, June, and August, and the 1999 surveys were in February, April, and June. The Intermountain survey report (dated September 24, 1999) is included in Appendix B of this EA. Based on these surveys, the following site conclusions were reached:

- Habitat does not exist on-site for the threatened Ute ladies'-tresses orchid.
- Habitat does exist on-site for the mountain plover, which is currently proposed for listing as a threatened species. Surveys were completed for this species, but no individuals were observed.
- The black-footed ferret was not observed.
- Raptor nesting habitat is limited, but does occur in some adjacent areas. No raptor nests were recorded that would be affected by the Proposed Action or alternatives.
- Three species of concern were recorded on-site, including the ferruginous hawk, the loggerhead shrike, and the Brewer's sparrow. The ferruginous hawk was not observed nesting within 1 mi (1.6 km) of the area.

3.4.1.2 Environmental Consequences

A major effect would result if the project affected a population of a listed, proposed, or candidate species or a designated critical habitat.

3.4.1.3 Proposed Action and All Alternatives

The Proposed Action and alternatives would have similar environmental consequences, even though Alternative 1 would result in more surface disturbance. This is because no threatened or endangered species are likely present at the Rock Springs Retort Site. On February 12, 1997, BLM wildlife biologists (Rock Springs District) surveyed the site for the black-footed ferret, the American peregrine falcon, and special status plants and wildlife. The BLM concluded that no adverse impact to special-status plants or wildlife is anticipated). On this basis, BLM also indicated "initiation of formal consultation is not recommended." (Dunder, 1997).

The USFWS indicated it is unlikely that the proposed work would adversely affect any threatened or endangered species, including the black-footed ferret and the Ute ladies'-tresses orchid, nor would the project affect the mountain plover. In addition, the USFWS also noted that the project would be unlikely to result in a violation of the Migratory Bird Treaty Act (Long, 1999a). If the Proposed Action is later modified in a way that would result in additional clearing or construction, the USFWS would again be consulted pursuant to Section 7(a)(2) of the Endangered Species Act (ESA) of 1973, as amended.

3.4.2 Vegetation

3.4.2.1 Existing Environment

The plant community is dominated by plant species with a high tolerance to salt and capable of withstanding droughty and shallow soil conditions. The plant community is composed of about 45 percent grasses, 15 percent forbs, and 40 percent shrubs. The dominant grasses included bottlebrush squirreltail, Indian ricegrass, needle-and-thread, Sandberg bluegrass, and western wheatgrass. The major forbs are asters, milkvetch, fringed sagewort, and halogeton. Shrubs included big sagebrush, Gardner's saltbush, greasewood, gray horsebrush, rabbitbrush, shadescale saltbush, and winterfat. Utah junipers are scattered along the draws and hillsides on the north and west sides of the property.

The surface area has been previously disturbed in the past along the rights-of-way for US-30, pipelines, and service roads. Approximately 34 ac (13.8 ha) were disturbed by roads and work areas around the oil shale retort sites. Some of the disturbed areas around the test sites have been reseeded with a wheatgrass mixture.

3.4.2.2 Environmental Consequences

A major vegetation effect would occur if the Proposed Action resulted in land that could not be revegetated, the loss of a unique vegetation type, or the loss of valuable or critical habitat.

3.4.2.3 Proposed Action and All Alternatives

The Proposed Action and alternatives would have similar environmental consequences. The site does not contain any unique vegetation types. The salvage of topsoil or suitable plant growth medium should ensure successful revegetation of the disturbed areas following site remediation.

All disturbed areas would be topsoiled and seeded with a mixture of native grass species. The reclaimed areas may take two or three years for the vegetation to become established. Once established, the vegetation would be equal to or better than the vegetation present before being disturbed. Reclamation of the disturbed areas would meet the WDEQ-DOE Agreement for restoration of the site to pretest conditions.

Although the site does not contain valuable or unique wildlife habitat, it does have habitat that could be suited to the mountain plover and the black-footed ferret (Orpet, 2000). However, as described in Section 3.3.1.1, the plover and ferret were not observed during a recent biological survey of the site.

3.4.3 Wetlands

3.4.3.1 Existing Environment

No wetlands are located within the Rock Springs site. The nearest wetland is located along Bitter Creek, approximately 0.5 mi (0.8 km) south of the project area.

3.4.3.2 Environmental Consequences

Major adverse environmental effects would occur if more than 0.5 ac (0.2 ha) of jurisdictional wetlands are damaged.

3.4.3.3 Proposed Action and All Alternatives

The Proposed Action and alternatives would have similar environmental consequences. Wetlands would be unaffected because none are present on-site or in the immediate area.

3.4.4 Wildlife

3.4.4.1 Existing Environment

The site is located on a gentle sloping hillside at the foot of White Mountain. The vegetation is typical of sagebrush-grassland communities found in the basin areas of Wyoming. A small colony of white-tailed prairie dogs covering an area of about 1 ac (0.4 ha) is located in the vicinity of Retort Site 9. The land is used occasionally by wildlife species for forage; however, there are no valuable or unique habitats on the property.

The site is occupied by wildlife species associated with the dominant vegetative cover type. Typical mammals likely to be found on the site include the northern pocket gopher, black-tailed jackrabbit, pronghorn antelope, and mule deer. Predators such as coyote, badger, and striped skunk use the site at least occasionally. Songbirds typically nesting in the sagebrush grassland include the western meadowlark, horned lark, lark bunting, and lark sparrow. The sage grouse is a common resident of the sagebrush grassland. Common reptiles include the prairie rattlesnake, bull snake, and western plains garter snake.

There are no special-interest wildlife concentration or use areas present on-site or on adjacent areas. The area is not considered an important winter use area for mule deer or antelope (Orpet, 2000).

3.4.4.2 Environmental Consequences

A major effect to wildlife would occur if the project caused a widespread habitat change, eliminated the presence of a high-value or high-use habitat component (e.g., critical big game winter range or active raptor nest site), or created a contaminant exposure pathway that caused a measurable population decline for a given species.

3.4.4.3 Proposed Action

For the Proposed Action, only 5 ac (2 ha) of land would be affected by construction of the air sparging system, road, and buildings. The potentially disturbed areas and surrounding lands are not considered to possess special or high-value wildlife habitat values. Due to its limited wildlife value, the unavailability of the land required for the Proposed Action would cause minimal or no effect on wildlife.

3.4.4.3.1 Groundwater Pump and Treat

Approximately 14 ac (5.6 ha) of land would be lost through construction of the evaporation ponds and installation of wells. However, as with the Proposed Action, this small area of land (none of which includes critical habitat) would be considered to have a relatively minor benefit to wildlife. The availability of open surface water in the evaporation ponds could attract birds during the warm spring, summer, and fall months. The relatively high evaporation rate and inherent low toxicity of the contaminants (benzene, ethyl-benzene, xylene, and others) of concern that would collect in the ponds would not be considered to pose a wildlife hazard. It would therefore not be necessary to cover open ponds. As water evaporates from the ponds, most of the contaminants of concern would be released into the atmosphere and would not harm wildlife. The DOE and its contractors would periodically test any residue that accumulates at the bottom of the settling ponds.

3.4.4.3.2 *In situ* Chemical Oxidation

The effects of this alternative to wildlife would be similar to the Proposed Action, because the total land disturbance and other types of changes would be similar.

3.4.4.3.3 No Action

The No Action alternative would involve clearing about 0.1 ac (0.04 ha), which is less than for any other alternative. Therefore, the effects of this alternative to wildlife species would be minor. A pathway for groundwater contaminants to wildlife has not been established, and water quality measurements at Bitter Creek have not shown detectable levels of the contaminants of concern. Although monitoring activities would produce small amounts of contaminated groundwater, wildlife would be unaffected. Monitoring activities would be required by the WDEQ to ensure that cleanup is effective.

3.5 GEOLOGY AND TOPOGRAPHY

3.5.1 Existing Environment

The site is situated along the eastern edge of the Green River Basin. The basin is located primarily in southwestern Wyoming and northern Utah and Colorado and covers an area roughly rectangular in size 100 mi (161 km) long and 60 mi (96 km) wide. The Green River Basin is a large synclinal basin defined on the west, north, and east by escarpments formed from the Green River and Wasatch formations. On the east side of the basin is an anticlinal structure known as the Rock Springs Uplift. The *in situ* oil shale experiments took place on the western dipping slope of this Uplift (Dames & Moore, 1996).

Site topography is typical of the basin-rolling plains interspersed with buttes and escarpments formed by differential erosion of flat-lying strata. White Mountain is located to the north of the site and forms a north-south trending butte that is part of the eastern escarpment. The project site is located along the base of the south slopes of White Mountain. The surface slopes gently to the south and is cut by several deep washes that drain the White Mountain area into Bitter Creek. The surface elevations range from about 6,240 ft (1,902 m) above mean sea level (msl) in the northern portion of the study area to 6,280 ft (1,914 m) above msl in the southern portion. Bitter Creek lies approximately 0.5 mi (0.8 km) south of the site at an elevation of 6,180 ft (1,884 m) above msl (Dames & Moore, 1996).

The sediments that comprise the basin and underlie the study area are, from younger to older: the Green River Formation and Wasatch Formation. These sediments are tertiary in age and are relatively flat lying in the vicinity of the site. The Green River Formation was formed in the Middle Eocene era from sediments of Lake Gosuite. The lake shrank, as the climate became more arid and dropped below the level of the outlet. The water became brackish, and extensive trona beds and saline minerals were deposited.

Figure 3.1 illustrates the relationship and relative size of the Wilkins Peak member and the Tipton shale member. The Tipton shale member is the lowest unit of the Green River Formation and is approximately 150 ft (45.7 m) thick near Retort Site 9. Overlying the Tipton shale member is the Wilkins Peak member, a brackish water deposit composed of mudstone, marlstone, and shales with occasional tuff and sandstone beds. The Wilkins Peak member can be seen in the cliffs on the south face of White Mountain. A basal portion of the Wilkins Peak member, approximately 80 to 120 ft (24.4 to 36.5 m) thick, overlays the Tipton Shale member at the site. The formations in the vicinity of the retort sites dip about 1 to 1.5 degrees to the southwest. Fractures are present in these formations, but no known faulting is present in the study area. As a result of this formation dip, groundwater movement is also toward the southwest.

3.5.2 Environmental Consequences

Major effects to the Rock Springs site geology would result from a permanent change in the hydrogeologic properties of the site that could affect down gradient users of groundwater. Major effects would also be associated with contamination to the underlying Wasatch Aquifer.

FIGURE 3.1 ROCK SPRINGS SITE GEOLOGIC CROSS-SECTION

3.5.3 Proposed Action and All Alternatives

The Proposed Action and alternatives would have similar environmental consequences. The proposed action and its alternatives would not alter geologic or extensive topographic features of the project area. Air sparging, which would involve using existing wells and surface features, would not have any effect on site geology or hydrology. The potential effects of these alternatives on the migration of contaminants in groundwater are described in Section 3.9.2.

3.6 ENVIRONMENTAL JUSTICE

Executive Order 12898 requires each Federal agency to identify and address disproportionate high and adverse human health effects of its programs, policies or activities on minority populations or low-income populations. The Executive Order applies to all Federal actions and has two basic purposes:

- To focus the attention of Federal agencies on the human health and general environmental conditions in minority communities and low-income communities.

- To foster nondiscrimination in Federal programs that could substantially effect human health or the environment. To give minority and low-income communities greater opportunities for public participation on matters relating to human health and safety.

3.6.1 Existing Environment

No individuals reside at the Rock Springs site and the nearest resident in the area is over two miles from the site.

3.6.2 Environmental Consequences

3.6.3 Proposed Action and All Alternatives

There are no low income or minority communities in the project area that could potentially be affected by groundwater contamination. No Native American land or Indian Trust Assets would be affected by the project.

3.7 HUMAN HEALTH AND SAFETY

3.7.1 Existing Environment

The site is not regularly occupied nor are there any residents near the project area. Cumulative site data indicate that benzene is the primary contaminant of concern at the Rock Springs site. However, as listed in Table 1.1, other contaminants are also present. These include ethyl-benzene, acetone, toluene, xylene, methylphenols, trichlorophenols, and PCP. In 1996, a human health risk assessment was conducted as part of the remedial action alternative study. The risk assessment concluded that the site does not currently pose a risk to human health or the environment due to the lack of a complete exposure pathway (Dames & Moore, 1996). The human health risk assumed a future residential receptor at the Rock Springs site ingesting and using the contaminated groundwater, even though there are no residents at or near the site. Benzene and PCP were the only contaminants identified that could pose a human health risk under the assumed post-remediation land use (Dames & Moore, 1996). The other groundwater contaminants were not identified as a contaminant of concern from a human health or safety perspective. Groundwater flow is toward the southwest.

3.7.2 Environmental Consequences

An effect would occur if the contaminants of concern affected human health, or if construction or other remedial activities resulted in serious injury or fatality to site workers.

3.7.3 Proposed Action

It is unlikely that groundwater would pose a risk to human health because of the lack of a complete exposure pathway. There are no drinking water or livestock wells on or near the site, and there are no known plans for residential development at or near the site. The nearest residents are located approximately 2.2 mi (3.5 km) east of the site and do not obtain drinking water from the Tipton Aquifer. The residents of both Rock Springs and Green River obtain potable water from the Green River. River water is treated by the City of Green River and is conveyed by pipeline to Rock Springs. For these reasons, human health effects would not be expected.

Human health and safety issues also apply to the construction and operation of the proposed facilities. The organization responsible for system construction, operation, and maintenance would be required to submit a site Health and Safety Plan for approval before beginning work. Work activities would conform to all Occupational Safety and Health Administration (OSHA) requirements in 29 CFR Part 1910 Section 120, and 29 CFR Part 1926, Section 65 related to "Hazardous Waste Site Operations and Emergency Response." With the use of proper protective equipment and compliance with the site Health and Safety Plan, construction and operation would not be expected to affect human health and safety. Each remediation site would be fenced and locked to prevent injury to unauthorized visitors.

3.7.2.1 Groundwater Pump and Treat

Effects to human health and safety with this alternative would be similar to the Proposed Action.

3.7.2.2 *In situ* Chemical Oxidation

Effects to human health and safety with this alternative would be similar to the Proposed Action.

3.7.2.3 No Action

Because no additional remedial action would take place under this alternative, there would be no risk to workers. The risk to humans from drinking groundwater would remain as discussed in Section 1.1.3 (Previous Investigations and Tests). However, the risk for drinking contaminated water would be considered minimal because there are no residents at the site and the nearest residents are up gradient. Because monitoring wells would be closed, they would not present any risk from airborne contamination.

3.8 NOISE

3.8.1 Existing Environment

As previously described, the site is located in a relatively remote area, and there are no nearby residences or other receptors that would be considered sensitive to changes in noise levels. Other than the sound of vehicles using Interstate Highway 80 (I-80), the only noticeable noises in the site area are associated with ongoing treatment feasibility testing activities being conducted by EG&G and Harza. In the past, no Sweetwater County residents have expressed concerns with noise originating from the site during the experiments and remedial demonstration activities.

3.8.2 Environmental Consequences

A major effect from noise would result from a change in ambient noise levels that interferes with normal lifestyles of residents near the project site or that exceeds established noise standards for residential areas.

3.8.3 Proposed Action

The proposed air sparging and pump-and-treat alternatives would generate noise levels similar to those currently produced by demonstration tests. Based on the remediation technologies employed, the primary sources of noise from the Proposed Action would result from vehicles transporting materials and personnel to the site, construction equipment used during the remediation phase, and operation of blowers and pumps. The equipment evaluated for noise production during the construction and remediation phase include drill rigs for installation of air sparging wells and monitor wells for the Proposed Action and electric air compressors for the air sparging and pump and treat alternatives.

Air blowers and water pumps would be enclosed in small buildings that would greatly attenuate noise levels in the surrounding area. For example, recent noise measurements taken outside the enclosed Retort Site 4 pump station registered noise levels of around 80 dB at a distance of less than 10 ft (3.1 m) (Covell, 1999). This noise level is similar to noises commonly created by an electric generator or a pump at a distance of 25 ft (7.6 m). The increase in noise levels at I-80 (400 to 500 ft (122 to 152 m) away from Retort Site 4) would probably be inaudible to most motorists. Table 3.2 shows the typical sound levels associated with different construction activities.

3.8.3.1 Groundwater Pump and Treat

Effects to human health and safety with this alternative would be similar to the Proposed Action. Adverse effects would not be anticipated.

3.8.3.2 *In situ* Chemical Oxidation

Effects to human health and safety with this alternative would be similar to the Proposed Action. Adverse effects would not be anticipated.

TABLE 3.2
SELECTED COMMON CONSTRUCTION SOUNDS

Construction Task	Noise Level (dBA) At 25 Ft (7.6 m)
Bulldozer	81-95
Drill Rig	82-104
Pump	76-86
Water Truck	76-102
Generator	76-88
Welding Machine	81-91

Source: CERL, 1978.

3.8.3.3 No Action

The only noise effects associated with No Action would occur as a result of the removal of existing treatability study equipment and piping; site cleanup and revegetation; and long-term groundwater monitoring. These effects are considered minor for the same reasons that were described for the Proposed Action and alternatives.

3.9 SOCIOECONOMICS

3.9.1 Existing Environment

Rock Springs is 7 mi (11.3 km) east of the site and has a population of 19,100 people. Green River is the county seat for Sweetwater County (population 12,700) and is located 5.6 mi (9 km) west of the site. The primary industrial activities in the area are mining for coal and trona, production of natural gas, railroad center, and livestock production. The site does not include lands owned or controlled by Native Americans.

3.9.2 Environmental Consequences

Socioeconomic effects would occur if project development caused local population to substantially increase or decrease or if public services became overburdened.

3.9.3 Proposed Action and All Alternatives

The Proposed Action and alternatives would have similar environmental consequences. Construction of all facilities (including well drilling) would require a peak workforce of less than 15 individuals at the site (long-term remediation would be achieved with several technicians). Such a small workforce would not noticeably affect the local economy or infrastructure. Socioeconomic benefits would be generated from worker salaries and purchases of equipment or supplies from the local area.

3.10 TRANSPORTATION

3.10.1 Existing Environment

The site is approximately 7 mi (11.3 km) west of Rock Springs. Interstate 80 passes approximately 300 ft (91.4 m) to the south of the site and an abandoned segment of US-30 crosses through the site. The location of the site in relationship to nearby roads is presented in Figure 1.1. The Wyoming Department of Transportation (WYDOT) reported that I-80 in this area receives a two-way average of 15,290 vehicles per day, 6,480 of which are trucks. The Union Pacific Railroad also passes within one-half mile of the site as it follows Bitter Creek. There are no known or reported traffic congestion conditions associated with routes leading to and from the project area. The present road network readily accommodates this traffic volume.

3.10.2 Environmental Consequences

Transportation effects would occur if increased traffic associated with project construction or operation caused the level of service on adjacent roads and highways to be downgraded.

3.10.3 Proposed Action

Traffic increases associated with construction and operation of the proposed site facilities would probably be limited to several vehicles per day and workers would use I-80 to reach and depart the site. Such a minor traffic increase would not be noticeable, and the level of service rating for local roads would be unaffected. Project-related traffic would not create unsafe or traffic hazard conditions.

3.10.3.1 Groundwater Pump and Treat

Transportation effects with this alternative would be similar to the Proposed Action. Adverse effects would not be anticipated. Because 14 ac (5.6 ha) would be disturbed (compared to 5 ac (2 ha) for the Proposed Action), vehicle activity may be slightly greater for this alternative.

3.10.3.2 *In situ* Chemical Oxidation

Transportation effects with this alternative would be similar to the Proposed Action. Adverse effects would not be anticipated.

3.10.3.3 No Action

The No Action alternative would generate less vehicle activity compared to the Proposed Action. This is because the only site activity would consist of periodic groundwater monitoring.

3.11 VISUAL RESOURCES

3.11.1 Existing Environment

There are no high-interest or unique visual or scenic features associated with the site. The general visual character of the site is similar to the surrounding sagebrush grasslands.The site is within approximately 300 ft (91.4 m) of I-80 on a gentle sloping hillside at the foot of White Mountain. The water storage tanks at Retort Sites 9 and 12 and the two mobile trailers at Retort Site 9 are visible from the road, but not from residences. The small areas of disturbance around the retort sites are visible from the highway but do not appear to be different from other naturally occurring barren or sparsely vegetated areas along the ridges and rock outcrops.

3.11.2 Environmental Consequences

A visual effect would occur if project development affected the existing visual character of the area or resulted in the loss or degradation of a high-interest or unique visual feature.

3.11.3 Proposed Action

The Proposed Action and alternatives would have similar environmental consequences. Much of the project site is not visible from areas or viewpoints that are accessible to the public. The construction of additional temporary structures and roads and the presence of drill rigs would not create a visual consequence, because the surface land has been previously disturbed and the site is remote from existing populations. The two mobile trailers at Retort Site 9 would be removed and replaced by a more durable structure similar to the one currently at Retort Site 4. Alterations to the landscape would be similar to those already created by past activities. Following site restoration, the visual quality of the land would be improved compared to the present condition.

3.11.3.1 Groundwater Pump and Treat

Visual effects would be associated with the three large evaporation ponds, which would be constructed at a distance of approximately 500 to 750 ft (150 to 230 m) from public access. Although the ponds could be viewed by motorists along I-80; the duration of the view would only be several seconds, based on a posted speed limit of 75 mph (120.7 kilometers per hour [kph]).

3.11.3.2 *In situ* Chemical Oxidation

Visual effects for this alternative would be similar to the Proposed Action.

3.11.3.3 No Action

Visual effects for this alternative would be similar to the Proposed Action.

3.12 LAND USE

3.12.1 Existing Environment

The *in situ* retort experiments took place in Section 15, Township 18 North, Range 106 west, on the north side of I-80. The Rock Springs site is located on land currently owned and operated by the Rock Springs Grazing Association. The property is zoned for agriculture use and has been under the same ownership for over 50 years. It is used seasonally for grazing sheep.

Approximately 20 groundwater-monitoring wells were located along the eastern border of Section 16. The surface rights of Section 16 are under the stewardship of the BLM, and the State of Wyoming owns the mineral rights. Surface water samples were collected from three locations along Bitter Creek, two in Section 21 and one in Section 22. Three surface sample locations and 22 groundwater well locations in Section 15 are on land owned by the Rock Springs Grazing Association.

Several right-of-ways cross the property along a diagonal that extends from the southwest quarter of Section 16 to the northeast quarter of Section 15. These rights-of-ways include the AMOCO pipeline, two Mountain Fuel Overthrust pipelines, the Chevron carbon dioxide (CO_2) slurry pipeline, three fiber optic lines owned by Williams Telecommunications Witel, and two fiber optic lines owned by AT&T. The AMOCO pipeline is the only utility that crosses through the project area. The pipeline crosses between Retort Sites 1 and 7. All of the retort test sites are located north of I-80, and access to the Rock Springs Retort Site is provided along the abandoned section of US-30. No prime or unique farmland is present and no active mining claims are located on the property.

3.12.2 Environmental Consequences

Land use effects could occur if the project affected prime farmland, if a change in land ownership occurred as the result of site remediation, or if the project was inconsistent with zoning ordinances.

3.12.3 Proposed Action and All Alternatives

The Proposed Action and alternatives would have similar environmental land use consequences. Implementing the Proposed Action or other alternatives would not adversely affect land uses, land ownership, or zoning at (or near) the site. Site remediation would be consistent with existing zoning as identified in *the Sweetwater County Development Codes and Zoning Resolution*, revised in 1998. Under each alternative, both past and planned surface disturbances would be revegetated and the land would continue to be used for livestock grazing. The Bureau of Land Management would continue to administer the land and there would be no expected change in grazing rights.

3.13 SOLID AND HAZARDOUS WASTE

3.13.1 Existing Environment

Small amounts of solid and hazardous waste are present at the site and consist of well refuse and general rubbish. Some debris and solid waste that were generated in the 1960s and 1970s when *in situ* retort testing took place would remain on the site. Wastewater, solid waste, and trash currently undergo disposal at the Sweetwater County Landfill.

3.13.2 Environmental Consequences

Adverse effects from solid and hazardous waste would result from a change that would cause a violation of either solid or hazardous waste laws or that would cause a hazard to human health.

3.13.3 Proposed Action

Air sparging would generate drill cuttings and waste refuse, some of which might be considered hazardous. In addition, small amounts of hazardous material could accumulate in the evaporation ponds. This material would be collected for periodic disposal at the Sweetwater County Landfill. This facility is an approved hazardous waste disposal facility and complies with Federal and state waste disposal requirements. No major effect would be anticipated from the Proposed Action. The evaporation ponds would only be used for purge water associated with treatment and monitoring (approximately 29,000 gal per year). The alternative to use of the evaporation ponds would be disposal of the purge water at the Sweetwater County Landfill.

3.13.3.1 Groundwater Pump and Treat

No major effects would be anticipated from the pump and treat alternative because similar solid and hazardous waste disposal techniques described for the Proposed Action would be used for this alternative. However, some inorganic material may accumulate in the sediment on the bottom of the on-site evaporation ponds. To monitor the concentration of accumulated hazardous materials, periodic toxicity characteristic leaching procedure (TCLP) testing would be performed. All hazardous materials would undergo disposal at the Sweetwater County Landfill in accordance with Federal and state disposal requirements.

3.13.3.2 *In situ* Chemical Oxidation

No major effect would be expected for the *in situ* chemical treatment alternative. This treatment would require the extensive use of hydrogen peroxide and potassium permanganate. Although potassium permanganate is not a hazardous material, hydrogen peroxide is considered hazardous in high concentrations. However, when these chemicals are introduced into the soil and groundwater environments, they chemically transform into water, oxygen, carbon dioxide, and non-toxic potassium and manganese compounds. These materials would not be considered hazardous materials.

3.13.3.3 No Action

No major effect would be anticipated. Small amounts of solid or hazardous waste may be generated by the installation and operation of monitoring wells. Equipment and supplies currently used for pilot testing studies would be removed.

3.14 SOILS

3.14.1 Existing Environment

Soils consist of two major types (Julander, 1997). The Monte sodic phase-McKinnon-Thayer complex occurs on the alluvial fans in the northern half of the test area in the vicinity of Sites 1, 6, 9, and 12. The Horsley-Huguston complex occurs on the shale residuum in the southern half of the test area on the ridge crests and shoulders of slopes in the vicinity of Sites 2, 3, 4, 5, 7, and 8. Neither of these soil units is “prime” or “unique”.

The clay loam and channery loam soils of the Monte-McKinnon-Thayer complex are deep and well drained. Available water capacity is moderate to high, 6 to 8 in (15 to 30 cm). The soils are strongly alkaline and restrict the kinds of plants that will grow. Effective rooting depth is 60 in (152 cm). Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is slight.

The Horsley soils formed in residuum from shale, and the Huguston soils formed in residuum from sandstone. These soils are shallow and have a very low available water capacity. The soils are strongly alkaline and have an effective rooting depth of 4 to 20 in (10 to 51 cm). Runoff on this unit is medium to rapid, and the water erosion hazard is moderate to severe. The wind erosion hazard is moderate.

3.14.2 Environmental Consequences

The Farmland Protection Policy Act requires Federal agencies to determine if projects would affect prime or unique farmlands. Soil effects could occur if the action resulted in the loss of topsoil, reduced soil productivity, or produced a decrease in the total number of cultivated acres.

3.14.3 Proposed Action

The limited number of acres that would be affected would not noticeably [can’t read the word] change runoff or erosion. Approximately 5.0 ac (2 ha) of land would be disturbed by the Proposed Action. Application of conventional best management practices, such as topsoil stripping, stockpiling, and protection from wind and water erosion, would ensure no loss of topsoil or suitable growth material for site revegetation and reclamation.

The limited number of acres exposed to wind and water erosion, the small size of each disturbed area, the use of water or spray for soil stabilization and installation of sedimant control structures would minimize adverse effects to the soil resource.

3.14.3.1 Groundwater Pump and Treat

This alternative would involve disturbing approximately 14 ac (5.6 ha); however, 9 ac (3.6 ha) would be maintained as evaporation ponds. These ponds would be managed to avoid soil erosion because such processes would threaten the stability and integrity of the ponds. To reduce the amount of possible soil erosion on other areas, vegetation clearing would be minimized and disturbed-area revegetation would be completed as soon as possible.

3.14.3.2 *In situ* Chemical Oxidation

Effects would be similar to the Proposed Action because the total acreage disturbed would be similar.

3.14.3.3 No Action

Areas previously disturbed would be selectively topsoiled and reclaimed. Site reclamation would restore the soil productivity to a level equal to or better than site conditions before the retort experiments took place.

3.15 WATER RESOURCES

3.15.1 Existing Environment

3.15.1.1 Surface Water

There are no surface water bodies present at the project site. Surface runoff from the southern slope of White Mountain drains southerly across the site through several large, deep ravines. Measurable flows are limited to early spring snowmelt periods and following heavy rains. Surface runoff in these ravines discharges into Bitter Creek. Bitter Creek is a Class 4 stream, which indicates that the water is suitable for industrial but not domestic use. It also indicates that the stream is not able to support a fishery. Infiltration from precipitation and surface runoff from White Mountain may provide a local source of groundwater recharge to the Tipton aquifer.

Previous studies indicated that the only water source that has been affected by the oil shale retort experiments is the groundwater in the Tipton aquifer (Lindner-Lunsford et al., 1990 and Dames & Moore, 1996). Contaminants have not been found in either the underlying Wasatch aquifer or nearby Bitter Creek. The following sections describe groundwater hydrology and water quality.

The site is not within a 100-year floodplain. The nearest surface water body is Bitter Creek, which is approximately 0.5 mi (0.8 km) south of the project area. Surface water samples are collected from Bitter Creek at three locations. Access to these sample collection points is along existing roads and trails, and no disturbance would occur within the floodplain.

3.15.1.2 Groundwater Quality

Water quality of the Tipton aquifer is generally poor, due to high concentrations of sodium, bicarbonate, and carbonate, and natural organic acids that exceed drinking water regulations. Sodium concentrations average 19,700 mg/L (19,700 ppm), pH values are normally around 11, and total dissolved solids (TDS) can be as high as 48,600 mg/L (48,600 ppm) (Lindner-Lunsford, et al., 1990). The low permeability, slow flow rate, and long residence time of water in the shale, trona, and saline parent materials are responsible for the poor water quality. Groundwater samples were also analyzed for selected metals and inorganic constituents. Concentrations of nitrogen and sulfur species, arsenic, boron, cyanide, and fluoride were 3 to 30 times greater than the drinking water limits.

Volatile and semi-volatile contaminants were found in the upper and mid Tipton aquifer around Retort Site 9, down gradient and south of Retort Site 9 approximately 2,500 ft (762 m), and down gradient and southwest of Retort Site 12 approximately 500 ft (152 m). No contaminants were found in the underlying Wasatch aquifer or in nearby Bitter Creek. Remediation of the Tipton aquifer should ensure that contamination does not reach the underlying Wasatch aquifer.

The volatile contaminants present in the groundwater include acetone, 2-butanone, benzene, ethyl-benzene, toluene, and xylene. The semi-volatile contaminants included, 2,4,5-trichlorophenol, 2,4,6-trichlorophenol, 2-methylphenol, 4-methylphenol, PCP, 3-4 methylphenol, and 2-4 dimethylphenol. Volatile contaminants have been found in 11 of the monitoring wells. Semi-volatile contaminants were found in four of the monitoring wells, two around Retort Site 9 and two south of Retort Site 9.

The maximum concentrations of contaminants detected in August-September 1999 (EG&G, 1999 and Harza, 2000b) are shown in Tables 3.4, 3.6, and 3.8, at the end of this section. By contrast, Tables 3.3, 3.5 and 3.7 present maximum contaminant levels at the same test wells about one year earlier, in October 1998. A comparison of contamination levels at these monitoring wells between 1998 and 1999 suggests that pilot testing strategies were effective in reducing contamination.

At Sites 4 and 7, the highest August 1999 concentrations of BETX occurred at well IW-8, with a concentration of 3,551 μg/L (3,551 ppb). Benzene levels at well IW-8 exceeded 1,540 μg/L (1,540 ppb). Wells IW-4, IW-7 and IW-11 produced BETX concentrations of 300 μg/L (300 ppb) or more. BETX concentrations at wells R-7 and RS-7 were found to be 144 μg/L and 57μg/L, respectively. The lowest BETX concentrations at Site 4 or Site 7 monitoring wells were detected at wells IW-2 and IW-6 (readings below 2 μg/L).

Remediation testing activities at Sites 4 and 7 have shown continued reductions in BETX concentrations. For example, testing in January 2000 showed that BETX levels at well IW-8 had dropped to 370 μg/ L (57 ppb), which represented a 90 percent reduction compared to previous levels. Wells IW-4, IW-7 and IW-11 have shown similar decreases in BETX at Sites 4 and 7 since the 1998-1999 levels (Covell, 2000).

The maximum concentrations of volatile and semi-volatile organic compounds at Sites 9 and 12 (measured in September 1999) are presented in Tables 3.6 and 3.8, respectively.

Organic compounds tested included benzene, ethyl-benzene, toluene, xylene and acetone. The highest benzene concentration measured was 290 μg/L (290 ppb) at well 9-4. As Table 3.6 indicates, concentrations of benzene were only detected at four of the monitoring wells at Sites 9 and 12 (wells 9-4, N9U-4, N26U and 25S). For the other 12 wells, benzene was not measured above the detection limit. Also at well 9-4, the ethyl-benzene concerntration was measured at 25 μg/L (25 ppb), higher than at any other monitoring well at Sites 9 or 12. The highest toluene concentration was 6 μg/L (6 ppb), measured at Well 25S. Xylene was only detected in measurable quantities at Wells N9U-4 and 25S and measurable amounts of acetone were found at 7 test wells. The greatest acetone concentration was 200 μg/L (200 ppb), which was observed at Well 25S. Despite relatively high BETX levels, pilot testing during 1999 reduced BETX at well 9-4 by 73 percent (Harza 2000c).

Semi-volatile organic compounds were also tested in September 1999. These sampling results are presented in Table 3.8. Compounds tested included 2-methylphenol, 4-methylphenol, 2,4,5 trichlorophenol, 2,4,6 trichlorophenol and PCP. No levels were measured above the detection limits.

3.15.1.3 Hydrogeology

The hydrogeology consists of two aquifers and two confining units. From top to bottom these units consist of the Wilkins Peak confining unit, Tipton aquifer, the upper Wasatch confining unit, and the Wasatch aquifer (Figures 3.1 and 3.2). The Wilkins Peak confining unit is approximately 140 ft (42.6 m) thick at the site and is composed of mudstones, marlstones, and gray-green shale.

The Tipton aquifer is comprised of a lower sandstone bed of the Wilkins Peak member and the Tipton shale member, which are approximately 9 ft (2.7 m) and 135 ft (41.1 m) thick, respectively, at Retort Site 9. The sandstone member outcrops in a gully about 0.75 mi (1.2 km) east of Retort Site 9 and along Bitter Creek. The Tipton shale member is an aquifer in the study area and is considered a confining unit in a regional assessment of the Green River basin. Therefore, there is little information about regional groundwater movement. Aquifer tests in monitor wells at the site suggest groundwater movement is very slow and occurs primarily along bedding planes and fractures in the shale and through tuff and sandstone beds. The hydrologic properties of the Tipton aquifer were obtained from slug tests performed in 13 monitor wells in March 1994 and eight monitor wells in July 1989. Hydraulic conductivity ranged from 0.03 to 1.6 feet per day (fpd) (0.01 to 0.5 m per day) (Lindner-Lunsford, et al., 1990).

Groundwater movement would not affect the water quality in nearby Bitter Creek. This is because water in the creek originates from snow melt and rainfall in the region and not from deep-water springs or seeps. Overall, only small amounts of water move through the unit in a generalized horizontal direction from north to south. Little or no vertical flow is actually taking place except possibly at the retort chamber. Vertical hydraulic conductivity was four to six orders of magnitude less than the horizontal hydraulic conductivity (Linder-Lunsford, et al., 1990).

The Wasatch confining unit is composed of a 7 ft (2.1 m) layer of limestone and a 225 ft (68.6 m) layer of mudstone and shale. The Wasatch aquifer, the basal aquifer in the study area, is approximately 500 ft (152 m) below the ground surface. The aquifer consists of medium-grained sandstone and sandy mudstone. A confining unit more than 200 ft (61.0 m) thick separates the Tipton and Wasatch aquifers. Hydraulic-head data indicate that the vertical gradient in most parts of the study area is upward from the Wasatch aquifer to the shallower Tipton aquifer. Therefore, it is unlikely that the Wasatch aquifer could be contaminated by water from the overlying Tipton aquifer.

FIGURE 3.2 THE HYDROLOGIC UNITS OF THE WASATCH AND GREEN RIVER FORMATIONS

3.15.2 Environmental Consequences

An adverse effect to water quality would include any of the following:

- An decrease in the quantity or quality of surface water or groundwater that is available to downstream or down gradient users.

- An increase in the concentration of a contaminant that would cause a water quality standard for a designated use to be exceeded.

- Sustained or increased degradation of groundwater quality, or reduction in the groundwater quantity flowing through and out of the site.

3.15.3 Proposed Action

Implementation of the Proposed Action would not affect any surface water bodies. Contaminants of concern would be degraded by native aerobic bacteria into harmless byproducts of carbon dioxide and water (U.S. Army Corps of Engineers, 1997). As a result, groundwater quality at the site would be improved. Groundwater contaminants of concern would be reduced from present levels to concentrations that are acceptable pursuant to the May 1998 Agreement between the State of Wyoming and DOE. The source of potential offsite groundwater contamination would be remediated, and the potential migration of groundwater contamination offsite would be reduced. Ultimately, groundwater would again be suitable for such historic uses as livestock watering.

Feasibility testing of this alternative indicated that air sparging would significantly reduce the levels of dissolved contaminants of concern in groundwater at the site. It appears that a low-pressure, low-flow rate, pulsed air injection would result in optimal conditions for removal of subsurface contaminants of concern. Implementing the Proposed Action would not change the quantity of groundwater available for offsite users. The only groundwater removed would be purge water associated with process operations and monitoring. As indicated in Table 2.2, an estimated 39,000 gal per year (147,400 L) would be removed from the aquifers. This is the sum of 10,000 gal (37,795 L) for treatment process operations and 29,000 gal (109,605 L) for monitoring. In addition to this amount, approximately 13,000 gal (49,133 L) of water would also be removed annually for long term monitoring. (Harza, 2000a).

3.15.3.1 Groundwater Pump and Treat

Groundwater quality would be improved and groundwater contamination would be reduced. However, unlike the Proposed Action and the *in situ* chemical oxidation alternative, this alternative would not treat the source of contamination. Therefore, pump and treat would continue as long as the potential for offsite migration of contaminated groundwater was a concern to the WDEQ.

3.15.3.2 *In situ* Chemical Oxidation

This alternative would not be expected to significantly improve or degrade groundwater quality. Groundwater treatment by chemical oxidation would probably be difficult due to natural subsurface hydrogeologic characteristics of the site. The process relies on the adequate distribution of the oxidant in the subsurface. Given complex site hydrogeology, this may be difficult to achieve as was indicated by bench-scale treatability test results. These complications were described previously in section 2.2.2.

In addition, test results suggest that the required potassium permanganate dosages may form a precipitant, thereby potentially clogging well screens and the surrounding formation. Finally, the high natural pH and alkalinity of the groundwater would limit oxidant effectiveness.

3.15.3.3 No Action

Under the No Action alternative, no remedial actions would be performed to treat the groundwater or subsurface material. Only natural degradation processes would be relied upon to remediate groundwater contaminants. Existing treatability study equipment and any surface piping would be removed, and areas that were disturbed during treatability study testing would be seeded with native grasses and fertilized as needed to restore the native vegetation.

On-site groundwater would continue to be of poor quality and locally unsuitable for livestock use. The quantity of groundwater available to offsite users would be unaffected during or after implementation of this alternative. A condition of the DOE research permit from the State of Wyoming required the DOE to contain all ecological effects within site boundaries. If contaminated groundwater moves off the site, the DOE may be subject to litigation and/or substantial fines under state jurisdiction and enforcement under Section 401 of the Clean Water Act (CWA).

This alternative would implement institutional controls, such as placing a notice on the plat maps located in Cheyenne, Wyoming, to notify other parties interested in the property that there is a potential for groundwater contamination. The specific form and substance of institutional controls would be developed in consultation with the WDEQ and the Wyoming State Engineer's Office.

Groundwater would be periodically sampled to measure contaminant levels and migration patterns. The groundwater-monitoring program would consist of semi-annual sampling of approximately 34 monitoring wells. Monitoring would be continued for a period of time agreed to by the WYLQD and DOE.

The No Action alternative may not meet the general purpose of the 1998 Agreement signed between the State of Wyoming and the DOE. That Agreement stated that the affected aquifers must be restored to a quality of use consistent with the use for which water was suitable before research activities took place.

TABLE 3.3
MAXIMUM CONCENTRATIONS OF BETX AND CONSTITUENT CHEMICALS IN THE TIPTON AQUIFER October, 1998
RETORT SITES 4 AND 7

(μg/L) (ppb)

Well No.	BETX	Benzene	Ethyl-benzene	Toluene	Xylene
IW-1	DNA	DNA	DNA	DNA	DNA
IW-2	DNA	DNA	DNA	DNA	DNA
IW-3	DNA	DNA	DNA	DNA	DNA
IW-4	DNA	DNA	DNA	DNA	DNA
IW-5	DNA	DNA	DNA	DNA	DNA
IW-6	DNA	DNA	DNA	DNA	DNA
IW-7	DNA	DNA	DNA	DNA	DNA
IW-8	DNA	DNA	DNA	DNA	DNA
IW-9	DNA	DNA	DNA	DNA	DNA
IW-10	DNA	DNA	DNA	DNA	DNA
IW-11	DNA	DNA	DNA	DNA	DNA
R-4	720	220	100	100	300
R-7	276	52	37	47	140
RS-5	DNA	DNA	DNA	DNA	DNA
RS-7	DNA	DNA	DNA	DNA	DNA

Source: Balcom, 2000

DNA = Data not available. Wells in the IW and RS series were drilled in 1999. Therefore, data are not available for October 1998.

TABLE 3.4
MAXIMUM CONCENTRATIONS OF BETX AND CONSTITUENT CHEMICALS IN THE TIPTON AQUIFER AUGUST 1999
RETORT SITES 4 AND 7

(μg/L) (ppb)

Well No.	BETX	Benzene	Ethyl-benzene	Toluene	Xylene
IW-1	185	23	9	25	128
IW-2	1.5	< 5	< 5	< 5	1.5
IW-3	2	< 5	< 5	< 5	2
IW-4	311	100	11	69	131
IW-5	2.3	0.3	0.2	0.2	1.6
IW-6	1.7	< 5	0.3	< 5	1.4
IW-7	364	55	< 5	3	306
IW-8	3551	1540	163	1150	698
IW-9	64	26	3	9	26
IW-10	206	46	19	71	70
IW-11	333	96	9	67	161
R-4	65	8	1	3	53
R-7	144	36	17	22	69
RS-5	15.9	12	0.6	0.9	2.4
RS-7	57	21	4	12	20

Source: EG&G, 1999

TABLE 3.5
MAXIMUM CONCENTRATIONS OF VOLATILE ORGANIC COMPOUNDS IN THE TIPTON AQUIFER October 1998
RETORT SITES 9 AND 12

(µg/L) (ppb)

Well No.	Benzene	Ethyl-benzene	Toluene	Xylene	Acetone
9-4					
N9U-1	5U	5U	5U	5U	10U
N9U-2	5U	5U	5U	5U	10U
N9U-3	5U	5U	5U	5U	10U
N9U-4	11	5U	5U	21	10U
N9U-5	96	5U	5U	5U	10U
N1U	5U	5U	5U	5U	10U
N2U	5U	5U	5U	5U	10U
NSU	5U	5U	5U	5U	10U
N12U	5U	5U	5U	5U	10U
N26U	5U	5U	5U	5U	20
25S	5U	5U	5U	5U	10U
28S	6.4	5U	5U	8	10U
32S	5U	5U	5U	5U	10U
R12	46	5U	5U	18	10U
NBU	5U	5U	5U	5U	10U

Source: Balcom, 2000 and Spears, 2000

U = Concentration was below the detection limit

TABLE 3.6
MAXIMUM CONCENTRATIONS OF VOLATILE ORGANIC COMPOUNDS IN THE TIPTON AQUIFER SEPTEMBER 1999
RETORT SITES 9 AND 12
(μg/L) (ppb)

Well No.	Benzene	Ethyl-benzene	Toluene	Xylene	Acetone
9-4	290	25	130	202	--
N9U-1	5 U	5 U	5 U	5 U	10 U
N9U-2	5 U	5 U	5 U	5 U	10 U
N9U-3	1	5 U	4	3	18
N9U-4	7	5 U	2	10	32
N9U-5	89	5 U	5 U	5 U	10 U
N1U	5 U	5 U	5 U	5 U	10 U
N2U	5 U	3	2	3	10 U
NSU	5 U	5 U	5 U	5 U	17
N12U	5 U	5 U	5 U	5 U	U
N26U	7	5 U	5 U	5 U	18
25S	12	5 U	6	11	200
28S	5 U	5 U	10 U	5 U	5 U
32S	3	5 U	5 U	5 U	50
R12	5 U	5 U	5 U	5 U	10 U
NBU	2	5 U	1	5 U	47

Source: Harza, 2000(b) and Spears, 2000.

U = Concentration was below the detection limit

[1] Harza 2000 (c). Data sampled on January 12, 1999.

TABLE 3.7

MAXIMUM CONCENTRATIONS OF SEMI-VOLATILE ORGANIC COMPOUNDS IN THE TIPTON AQUIFER October 1998 RETORT SITES 9 AND 12

(µg/L) (ppb)

Well No.	2-Methyl-phenol	4-Methyl-phenol	2,4,6 Trichloro-phenol	2,4,5 Trichloro-phenol	PCP
N9U-1	10U	10U	10U	10U	5U
N9U-2	10U	10U	10U	10U	5U
N9U-3	10U	10U	10U	10U	5U
N9U-4	10U	10U	10U	10U	5U
N9U-5	10U	10U	10U	10U	5U
N1U	10U	10U	10U	10U	5U
N2U	10U	10U	10U	10U	5U
NSU	10U	10U	10U	10U	5U
N12U	10U	10U	10U	10U	5U
N26U	10U	10U	10U	10U	5U
25S	10U	10U	10U	10U	5U
28S	10U	10U	10U	10U	5U
32S	10U	10U	10U	10U	5U
R12	10U	10U	10U	10U	5U
NBU	10U	10U	10U	10U	5U

Source: Balcom, 2000 and Spears, 2000

U = Concentration was below the detection limit

TABLE 3.8

MAXIMUM CONCENTRATIONS OF SEMI-VOLATILE ORGANIC COMPOUNDS IN THE TIPTON AQUIFER SEPTEMBER 1999 RETORT SITES 9 AND 12

(μg/L) (ppb)

Well No.	2-Methyl-phenol	4-Methyl-phenol	2,4,6 Trichloro-phenol	2,4,5 Trichloro-phenol	PCP
N9U-1	10 U	10 U	10 U	25 U	25 U
N9U-2	10 U	10 U	10 U	25 U	25 U
N9U-3	10 U	10 U	10 U	25 U	25 U
N9U-4	10 U	10 U	10 U	25 U	25 U
N9U-5	10 U	10 U	10 U	25 U	25 U
N1U	10 U	10 U	10 U	25 U	25 U
N2U	10 U	10 U	10 U	25 U	25 U
NSU	10 U	10 U	10 U	25 U	25 U
N12U	10 U	10 U	10 U	25 U	25 U
N26U	10 U	10 U	10 U	25 U	25 U
25S	10 U	10 U	10 U	25 U	25 U
28S	10 U	10 U	10 U	25 U	25 U
32S	20 U	20 U	20 U	5 U	5 U
R12	10 U	10 U	10 U	25 U	25 U
NBU	10 U	10 U	10 U	25 U	25 U

Source: Harza, 2000(b) and Spears, 2000.

U = Concentration was below the detection limit

SECTION 4

CUMULATIVE EFFECTS AND LONG TERM ENVIRONMENTAL CONSEQUENCES

Cumulative effects are defined as environmental changes resulting from the combined effects of the current action with those of past, present and future actions by all Federal agencies, non-Federal government and private entities. This section addresses the potential cumulative environmental consequences of the Proposed Action and the alternatives on environmental resources surrounding the Rock Springs Site. As indicated in Section 3, the site is undeveloped and is approximately 7 mi (11.3 km) west of Rock Springs (population of 19,100 people). The primary industrial activities in the area are mining for coal and trona, production of natural gas, railroad center, and livestock production.

4.1 PROPOSED ACTION AND ALL ALTERNATIVES

The Proposed Action and alternatives would have similar environmental consequences and no cumulative or long term environmental effects were identified. No other Federal or non-Federal activities have taken place in the area and none are currently proposed. The proposed characteristics for each alternative are summarized in Table 2.2. These include the extent of surface disturbance, the number of new wells, volume of process water and monitoring water and other features. Reclamation activities would initially consist of spreading topsoil on the areas stripped before remediation activities. Areas covered with topsoil would be seeded with a mixture of native grasses approved by the WDEQ.

Following the completion of remediation, all disturbed areas would be topsoiled and seeded with a mixture of native grass species. The reclaimed areas may take two or three years for the vegetation to become established. Once established, the vegetation would be equal to or better than the vegetation present before being disturbed. Reclamation of the disturbed areas would meet the WDEQ-DOE Agreement for restoration of the site to pretest conditions

SECTION 5

IRREVERSIBLE AND IRRETREVIABLE COMMITMENTS OF RESOURCES

The Proposed Action would require the use of fossil fuels and electrical energy. These resources are considered irretrievably committed to the project. At this time, these resources are not in short supply, and are considered to be readily available. Therefore, the use of these resources is not expected to to result in an adverse effect on their continued availability.

Specifically, the following energy costs of remediation were identified. It was estimated that groundwater remediation would require approximately 196,000 kilowatt-hours (kWh) (668.9 x 10^6 British Thermal Units (BTUs) of energy each year, which is roughly equivalent to an energy cost of $15,000. This estimate is based on two 15 horsepower compressors at each site, operating 24 hours per day, seven days per week. This level of energy consumption is not considered excessive or wasteful. Adoption of the No Action alternative would result in even less energy consumption, because the only site activities would include cleanup and periodic monitoring

Construction of remediation facilities would require the use of various types of raw building materials, including cement, aggregate, steel and asphalt, electrical supplies, piping and other building materials. Utilization of these resources would be irretrievable. Construction and operation of project facilities would require some labor, which would unavailable for other projects.

SECTION 6

SIMILAR ACTIONS AND ACTIONS BEING CONSIDERED UNDER OTHER NATIONAL ENVIRONMENTAL POLICY ACT REVIEWS

The Proposed Action is not a segment of any other action currently being considered by (or currently being implemented by) DOE and is not related to any other actions currently being evaluated by DOE under NEPA reviews.

SECTION 7

RELATIONSHIP TO APPLICABLE LAND USE PLANS AND POLICIES

Implementation of the Proposed Action or other alternatives would be consistent with all existing Sweetwater County, Wyoming land use plans and zoning ordinances and would comply with the 1993 and 1998 Agreements between the WDEQ and DOE. No other applicable land use plans or policies have been identified.

SECTION 8

REGULATORY REVIEW AND PERMIT REQUIREMENTS

This section lists the relevant laws that pertain to the proposed and alternative actions and addresses regulatory review and permit requirements.

8.1 RELEVANT FEDERAL, STATE, AND LOCAL STATUTES, REGULATIONS, AND GUIDELINES

8.1.1 Federal Regulations

Regulations implementing NEPA are detailed in 40 CFR, Parts 1500-1508 and 10 CFR Part 1021. In addition to the requirements of NEPA, other Federal requirements are considered in the preparation of an EA. Conforming to these regulations is an important aspect of complying with the NEPA process. Environmental laws with which the Proposed Action must comply are described below.

8.1.1.1 Endangered Species Act (16 USC 1531-1542)

The Endangered Species Act (ESA) of 1973, amended in 1982 and 1987, is intended to prevent the further decline of endangered and threatened plant and animal species and to help restore populations of these species and their habitats. The ESA, jointly administered by the Departments of Commerce and the Interior, requires that each Federal agency consult with the USFWS to determine whether endangered or threatened species are known to exist or have critical habitats on or near the site of a Proposed Action. Section 7(c) of the ESA authorizes the USFWS to review proposed major Federal actions to assess potential effects on listed species.

The USFWS, Wyoming Game and Fish Department, and WYNDD were consulted concerning threatened and endangered species. The results of the consultation are shown in Appendix B.

8.1.1.2 National Historic Preservation Act (16 USC 470-470t)

The National Historic Preservation Act (NHPA) of 1966, as amended, establishes historic preservation as a national policy and defines it as the protection, rehabilitation, restoration, and reconstruction of districts, sites, buildings, structures, and objects significant in American history, architecture, archaeology, or engineering. It also expands the NRHP (36 CFR 60) to include resources of state and local significance and establishes the Advisory Council on Historic Preservation (ACHP). NHPA Section 106, implemented by regulations issued by the ACHP (36 CFR 800), requires Federal agencies to consult with the State Historic Preservation Officer (SHPO) regarding effects that a Proposed Action may have on cultural resources.

Consultation with the SHPO was made regarding historic and cultural resources. Results of the consultation are shown in Appendix B.

8.1.1.3 Clean Water Act (33 USC 1251 et seq.)

The Federal Water Pollution Control Act (FWPCA) of 1972, as amended by the Clean Water Act (CWA) of 1977 and the Water Quality Act (WQA) of 1987, forms the legal framework to support maintenance and restoration of water quality and also addresses wetlands. The FWPCA established the National Pollutant Discharge Elimination System (NPDES) as the regulatory mechanism to achieve water quality goals by regulating pollutant discharge to navigable streams, rivers, and lakes.

8.1.1.4 Clean Air Act (42 USC 7401 et seq.)

The Clean Air Act (CAA) of 1970 establishes national ambient air quality standards and sets emission limits for certain air pollutants from specific sources. Two pertinent sections of the CAA are Section 109 and Section 176(c). Section 109 allows the setting of standards for the following "criteria" pollutants: particulate matter less than or equal to 10 microns in diameter, sulfur dioxide, carbon monoxide, ozone, nitrogen dioxide, and lead. Section 176(c) of the CAA establishes a conformity requirement for Federal agencies in which all environmental documents must address applicable conformity requirements and the status of compliance (40 CFR Part 93, Subpart B).

The Rock Springs site is not located in an area designated for non-attainment. Emissions from fugitive dust (particulate matter) and carbon monoxide were evaluated as potential pollutants in the EA. The need for an air permit is discussed under the state regulations in Section 4.2.

8.1.1.5 Occupational Safety and Health Act (20 USG 333)

The Occupational Safety and Health Act (OSHA) forms the framework for a body of regulations (29 CFR 1910 and 29 CFR 1926) that, among other things, are intended to ensure worker safety and health through regulation of work practices and work environments. The OSHA specifically addresses construction projects, hazardous waste operations, emergency responses, toxic and hazardous substance operations, and communication of information concerning occupational hazards, specifying appropriate protective measures for all employees.

The Proposed Action was evaluated to determine if there would be a change in work practices and the need for administrative actions other than normal compliance with OSHA standards.

8.1.1.6 Comprehensive Environmental Response, Compensation, and Liability Act (42 USC 9601 et seq.)

In 1980, Congress enacted CERCLA or "Superfund" to provide funding and enforcement authority for cleaning up past hazardous waste activities. The Rock Springs site is not a CERCLA waste site and is not on the National Priorities List. Procedures have been developed under CERCLA for conducting remedial investigations and feasibility studies. These procedures were used at the Rock Springs site to characterize the nature and extent of contamination, to define the risks posed by contaminants at the site, and to identify alternative treatment technologies for protection of human health and the environment.

8.1.1.7 Farmland Protection Policy Act (Public Law 97-98).

This Act requires Federal agencies to determine if certain actions may affect prime or unique soils or could result in less cultivated farmland. This Act determines if Federal activities could result in the loss of major amounts of farmland.

8.1.1.8 Environmental Justice (Executive Order 12898).

This Executive Order requires that Federal agencies make environmental justice part of their missions by identifying disproportionately high and adverse human health or environmental effects of programs on minority and low-income populations.

8.1.2 State of Wyoming Regulations

Many of the relevant State of Wyoming regulations and guidelines appropriate to this project were written to comply with the Federal acts described above. The laws pertaining to the Proposed Action and alternatives at the Rock Springs site would be subject to the Wyoming Environmental Quality Act promulgated in 1973. The WDEQ administers the state regulations through the WYAQD, WYLQD, and WYWQD. Article 4, Wyoming Statute 35-11-426 through 436, states than any person engaged in *in situ* mineral mining or research and development testing is required to comply with the Environmental Quality Act.

8.1.2.1 Wyoming Air Quality Standards and Regulations

In Section 22, the WYAQD has incorporated by reference the EPA regulations on Standards of Performance for New Stationary Sources (40 CFR Part 60). Section 14 requires that emissions of fugitive dust shall be limited by all persons handling, transporting, or storing any material to prevent unnecessary amounts of particulate matter from becoming airborne. A list of control measures is provided that should be considered for such control. Section 21 establishes permit requirements for construction, modification, and operation of a site that may cause an increase in the issuance of air contaminants into the air before any actual work is begun on the site.

8.1.2.2 Wyoming Land Quality Rules and Regulations

Performance requirements for *in situ* mining (Chapter 11 of WYLQD regulations) require that all *in situ* processing activities shall return affected groundwater to a condition such that its quality of use is equal to or better than (and consistent with) the uses for which the water was suitable prior to the operation by employing the best practicable technology.

8.1.2.3 Wyoming Water Quality Rules and Regulations

Chapter II, Section 4, Appendix A of WYWQD regulations sets requirements for point source discharges. Chapter XI, Part G establishes minimum requirements for design, construction, and abandonment of wells. All wells that are no longer used must be plugged and properly abandoned to ensure that groundwater supply is protected and preserved for further use and to eliminate the potential physical hazard. Chapter XVI sets requirements for Class V Injection Wells (including air sparging wells). Chapters XI and XVI fulfill Wyoming state obligations under Section 1422 of the Federal Safe Drinking Water Act and Federal Underground Injection Control regulations found in 40 CFR 124 and 40 CFR 144-148.

8.1.2.4 Air Sparging Permit

Pursuant to Chapter 16 of the WDEQ Water Quality Rules and Regulations, the DOE would obtain an air sparging permit.

8.1.3 Local Regulations

8.1.3.1 Sweetwater County Conditional Use Permit

Also referred to as a Temporary Use Permit, this permit is issued by the Sweetwater County Department of Planning and Zoning. It requires the applicant to demonstrate that construction of proposed facilities would not pose a disturbance or environmental risk and that site cleanup would take place following completion of construction.

8.2 PERMIT REQUIREMENTS

The following permit requirements are anticipated for the actions described for the Proposed Action or alternatives. In some cases, the requirement for a permit has already been discussed with the state and determined not to be required.

- Permit from the State Engineer’s Office for construction of new process or monitoring wells.

- Permit from the State Engineer’s Office for abandoning wells (provides status of wells proposed for abandonment).

SECTION 9

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SECTION 10

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APPENDIX A

U.S. DOE / STATE OF WYOMING
1998 SITE CLEANUP AGREEMENT

APPENDIX B

DEPARTMENT OF ENERGY
INTERAGENCY CONSULTATION AND CORRESPONDENCE