Piñon Ridge Project Environmental Report
Montrose County, Colorado

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Prepared by

Edge Environmental, Inc.

405 Urban Street, Suite 310
Lakewood, Colorado 80228
303-988-8844

Prepared for

ENERGY FUELS RESOURCES CORPORATION
44 Union Boulevard, Suite 600
Lakewood, Colorado 80228

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Abbreviations and Acronyms

AADT	average annual daily traffic
AASHTO	American Association of State Highway and Transportation Officials
ACL	Alternate Concentration Limits
AEC	Atomic Energy Commission
ALARA	As Low As Reasonably Achievable
AMS	air monitoring station
amsl	above mean sea level
ANSS	Advanced National Seismic System
APCD	Air Pollution Control Division
APENs	Air Pollution Emission Notices
APLIC	Avian Power Line Interaction Committee
ASTM	American Society for Testing of Materials
AUMs	animal unit months
BACT	best available control technology
BBC	BBC Research and Consulting
BBS	Breeding Bird Survey
BCC	Birds of Conservation Concern
Berger	Louis Berger Group
BGEPA	Bald and Golden Eagle Protection Act
bgs	below ground surface
BLM	Bureau of Land Management
BLS	U.S. Bureau of Labor Statistics
BMC	Birds of Management Concern
BMPs	best management practices
BOCC	Board of County Commissioners
BOR	U.S. Bureau of Reclamation
CAAQS	Colorado Ambient Air Quality Standards
cal/cm^2	langelys
CCD	Census County Division
CCD	counter current decantation
CCR	Colorado Code of Regulations
CDLE	Colorado Department of Labor and Employment
CDNR	Colorado Department of Natural Resources
CDOLA	Colorado Department of Local Affairs
CDOT	Colorado Department of Transportation
CDOPS	Colorado Division of Oil and Public Safety
CDOW	Colorado Division of Wildlife
CDP	Census Designated Place
CDNR	Colorado Department of Natural Resources
CDPHE	Colorado Department of Health and Environment
CDWR	Colorado Division of Water Resources
CEO	Chief Executive Officer
CEQ	Council on Environmental Quality
CFOI	Census of Fatal Occupational Injuries
CFR	Code of Federal Regulations
cfs	cubic feet per second
CGS	Colorado Geological Survey
cm	centimeter

CNHP	Colorado Natural Heritage Program
CO	carbon monoxide
COGCC	Colorado Oil & Gas Conservation Commission
COOP	Cooperative Observer Network
CPIF	Colorado Partners in Flight
cpm	counts per minute
CPUE	catch-per-unit effort
CSP	Colorado State Patrol
CV	coefficients of variation
DAC	Derived Air Concentration
DAU	Data Analysis Unit
dB	decibels
dBA	decibels on the A-weighted scale
DBH	diameter at breast height
DCS	Data Collection System
Denison	Denison Mines Corporation
DHV	Design Hour Volume
DOE	U.S. Department of Energy
DOGM	Division of Oil, Gas and Mining
DOI	U.S. Department of the Interior
DRMS	Division of Reclamation, Mining and Safety
EDC	Economic Development Corporation
EIA	U.S. Energy Information Administration
EIS	Environmental Impact Statement
Energy Fuels	Energy Fuels Resources Corporation
EO	Executive Order
EPA	U.S. Environmental Protection Agency
ER	Environmental Report
ERG	Environmental Restoration Group
ERO	ERO Resources Corporation
ESA	Endangered Species Act
ET	evapo-transpiration
ft	feet
ft^2	square feet
GCL	geosynthetic clay liner
GIS	Geographic Information System
GJFO	Grand Junction Field Office
GMU	Game Management Unit
Golder	Golder Associates, Inc.
gpm	gallons per minute
H_2SO_4	sulfuric acid
HAPs	hazardous air pollutants
HCP	Habitat Conservation Plan
HDPE	High-Density Polyethylene
HIP	Habitat Improvement Plan
IBC	International Building Code
ISL	in-situ leaching
ISR	in-situ recovery
IUC	International Uranium Corporation
km	kilometer
km^2	square kilometers
KOPs	key observation points
kV	kilovolt
kwh/m^2	kilowatt-hours per square meter
lb	pound
LCRS	Leak Collection and Recovery System

MBTA	Migratory Bird Treaty Act
MCE	maximum credible earthquake
MDL	method detection limit
MED	Manhattan Engineer District
Metals Reserve	Metals Reserve Company
mg/L	milligram per liter
mi^2	square miles
MLS	multi-listing service
MMGRMA	Meteorological Monitoring Guidance for Regulatory Modeling Applications
MOU	Memorandum of Understanding
mph	mile per hour
mrem/yr	millirem per year
MSHA	U.S. Mine Safety and Health Administration
MVMT	million vehicle miles traveled
NAAQS	National Ambient Air Quality Standards
NABCI	North American Bird Conservation Initiative
NaOH	sodium hydroxide
NCRP	National Council on Radiation Protection
NDIS	Natural Diversity Information Source
NEPA	National Environmental Policy Act
NESHAPs	National Emission Standards for Hazardous Air Pollutants
NFS	National Forest System
NH_3	ammonia
NHPA	National Historic Preservation Act
NHTSA	National Highway Traffic Safety Administration
NMFS	National Marine Fisheries Service
NMSS	Nuclear Material Safety and Safeguards
NO_2	nitrogen dioxide
NO_x	nitrogen oxides
NHPA	National Historic Preservation Act
NRC	U.S. Nuclear Regulatory Commission
NRCS	Natural Resource Conservation Service
NRHP	National Register of Historic Places
NUREG	NRC Regulatory Guide
NWS	National Weather Service
O_3	ozone
OAHP	Office of Archaeology and Historic Preservation
OHV	off-highway vehicle
OMB	Office of Management and Budget
ORP	oxidation-reduction potential
OSL	Optically Stimulated Luminescence
P-G Class	Pasquill-Gifford Stability Class
Pb	lead
Pb-21	Lead-210
PCA	Potential Conservation Area
$pCi/m^2/s$	picoCuries per meter squared per second
pCI/g	picoCuries per gram
PGA	peak ground acceleration
PIF	Partners in Flight
PILT	payment in lieu of taxes
$PM_{2.5}$	particulate matter less than 2.5 microns in effective diameter
PM_{10}	particulate matter less than 10 microns in effective diameter
PMF	probable maximum flood
PMP	probable maximum precipitation
Po-210	Polonium-210
PPE	personal protective equipment

ppm	parts per million
PSD	Prevention of Significant Deterioration
PVSN	Paradox Valley Seismic Network
PVU	Paradox Valley Unit
Ra-226	Radium-226
RACT	Reasonable Available Control Technology
RAWS	Remote Automated Weather Station
RCRA	Resource Conservation and Recovery Act
RESRAD	Residual Radiation
RH	Radiation Health
RIPRAP	Recovery Implementation Program Recovery Action Plan
RMAG	Rocky Mountain Association of Geologists
RMP	Resource Management Plan
Rn-222	Radon-222
RSO	Radiation Safety Officer
RV	recreational vehicle
RWPs	Radiation Work Permits
SAG	semi-autogenous grinding
SH	State Highway
SHPO	State Historic Preservation Officer
SMPA	San Miguel Power Association, Inc.
SO_2	sulfur dioxide
SOII	Survey of Occupational Injuries and Illnesses
SP	sample point
SPCC	Spill Prevention, Control and Countermeasure
SRDT	Solar Radiation/Delta T
SRMA	Special Recreation Management Area
Standard Chemical	The Standard Chemical Company
SUP	Special Use Permit
SWMP	Stormwater Management Plan
SX	solvent extraction
TDS	total dissolved solids
TEDE	total effective does equivalent
Th-230	Thorium-230
TLD	Thermoluminescence Dosimeters
TMDL	Total Maximum Daily Load
T&E	threatened and endangered
tpd	tons per day
tpy	tons per year
TSP	Total Suspended Particulates
TSS	total suspended solids
TurnKey	TurnKey Consulting, LLC
uS/cm	micro Siemens per centimeter
uR/hr	micro Roentgens per hour
U_3O_8	uranium oxide
UBC	Uniform Building Code
UDOT	Utah Department of Transportation
UDPS	Utah Department of Public Safety
ug/m^3	microgram per cubic meter
UMC	Uncompahgre Medical Center
UMTRCA	Uranium Mill Tailings Radiation Control Act
Union Minere	Union Minere du Haut Katanga
URECO	Uranium Reduction Company
USACE	U.S. Army Corps of Engineers
USCS	Unified Soil Classification System
USDA	U.S. Department of Agriculture

USDI	U.S. Department of Interior
USDOT	U.S. Department of Transportation
USGS	U.S. Geological Survey
USFWS	U.S. Fish and Wildlife Service
USV	United States Vanadium Company
UV	ultraviolet
V_2O_5	vanadium oxide
VCA	Vanadium Corporation of America
Visus	Visus Consulting Group, Inc.
VOC	Volatile Organic Compounds
VRM	Visual Resource Management
WEPAC	West End Planning Advisory Committee
WL	working level
WoUS	Waters of the United States
WQCC	Water Quality Control Commission
WQCD	Water Quality Control Division
WSDOT	Washington State Department of Transportation
WTI	Wetland Training Institute
WWA	Western Water Assessment

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Section 1.0
Introduction

1.1 INTRODUCTION

Energy Fuels Resources Corporation (Energy Fuels) proposes to construct and operate the Piñon Ridge Mill Facility (Mill Facility) to process uranium/vanadium ore mined from its existing nearby operations and from area mines owned and operated by other entities in order to produce both uranium oxide (U_3O_8) concentrate and vanadium oxide (V_2O_5) concentrate and to dispose of the resulting processing wastes in on-site tailings cells (the Proposed Action). The Property Boundary for the Proposed Action encompasses approximately 880 acres in Montrose County, Colorado (Site) and is located approximately 12 miles west of Naturita and approximately 7 miles east of Bedrock, along State Highway (SH) 90. The Site address is 16910 Highway 90, Bedrock, Colorado 81411 (see Figure 1.1-1).

The operating life of the Mill Facility is 40 years at a projected milling rate of 500 tons per day (tpd); however, the life could be extended with regulatory approval of additional tailings cells and evaporation ponds. In addition to the Mill, proposed facilities include tailings cells, evaporation ponds, an ore stockpile pad, access roads, and administration, maintenance and warehouse buildings. The Mill Facility is expected to employ up to 85 people and operate 24 hours per day, 350 days per year.

The Proposed Action would involve a milling operation that would begin with the receipt of the uranium/vanadium ore at the ore pad. The ore would be mixed with water and ground into a fine slurry, which in turn would be treated (i.e., leached) with sulfuric acid to dissolve the metals from the solid material. Uranium and vanadium would be recovered from the leach solution using a solvent extraction process and then precipitated as concentrates. The concentrates would be sealed in U.S Department of Transportation (USDOT) approved 55-gallon, steel drums and transported off-site for further enrichment and processing. The slurry containing the barren solids would be pumped to the lined tailings cells where the fine-grained solids would settle out of solution and the clarified solution would be pumped back to the Mill for reuse. The majority of the wastewater (i.e., raffinate) from the solvent extraction process would be recycled. The remaining raffinate would be disposed of in lined evaporation ponds. At the conclusion of milling, the mill buildings and equipment would be demolished and placed in the final tailings cell. In addition, the ore pad, evaporation pond, and other materials contaminated with radionuclides would be placed in the final tailings cell. The tailings cells would be capped with a radon soil barrier and an evapo-transpiration (ET) cover consisting of soil, rock, and vegetation. A detailed description of the Proposed Action is provided in Section 2.0. The potential uses of uranium include fuel for electric power generation, while the potential uses for vanadium include manufacturing of industrial chemicals, medical applications, and the formation of high strength alloy steels, amongst others.

Construction of the Mill Facility would commence following full regulatory approval, which is anticipated in early 2011, with milling operations following through approximately 2051. The operating life could be extended by an additional 10 years or more if economic conditions warrant. The company would initiate closure following the productive life of the Mill Facility.

Energy Fuels is a State of Colorado Corporation with offices in Nucla and Lakewood, Colorado and Kanab, Utah and is a wholly-owned United States subsidiary of Energy Fuels Inc., a publicly traded Canadian Corporation based in Toronto, Ontario. The principal business activity

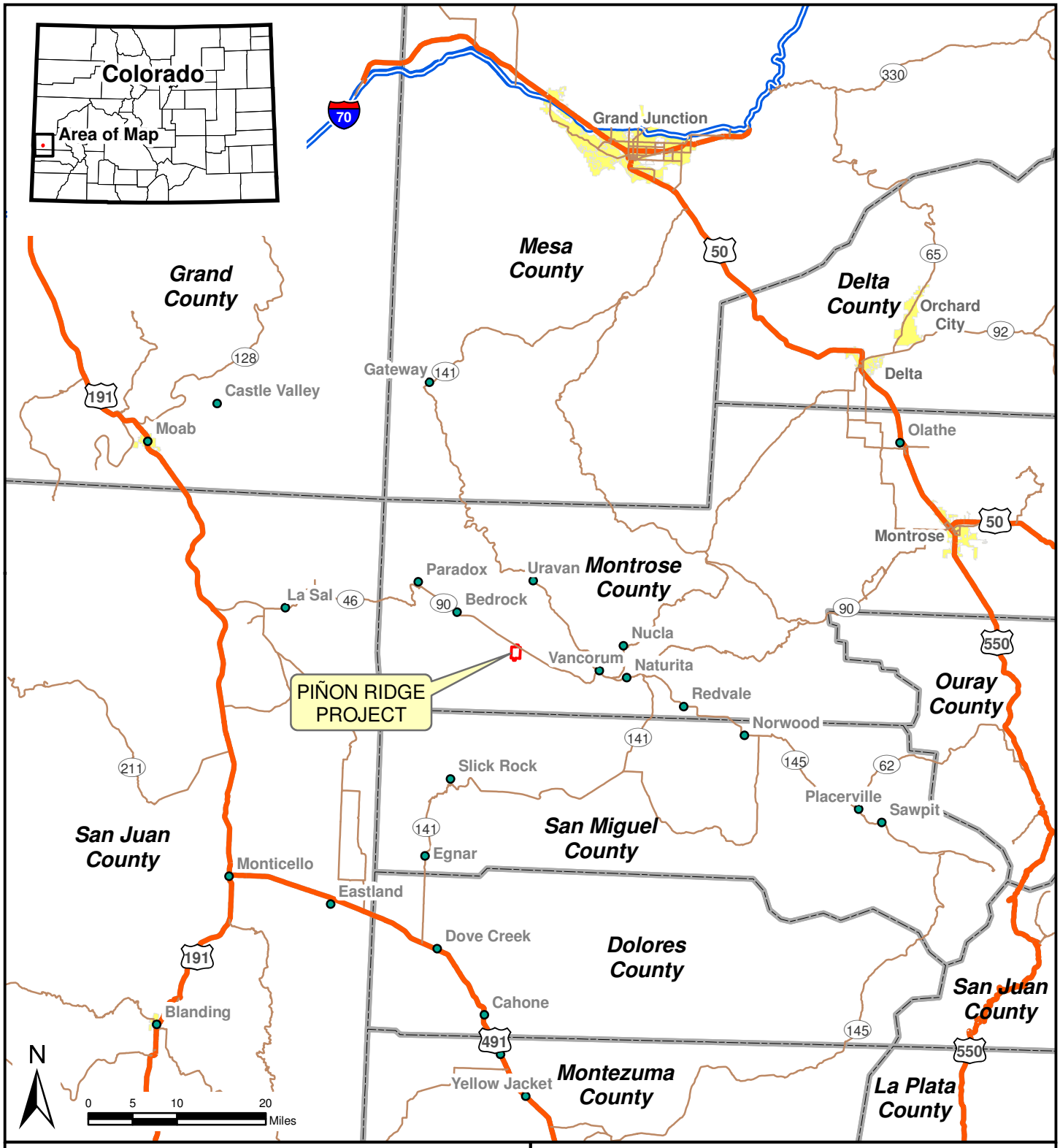


Figure 1.1-1

General Location

of the company is mineral exploration, development, and mining of uranium and vanadium properties located in the states of Colorado, Utah, and Arizona. Energy Fuels has acquired property interests covering 12 former operating uranium mines and, since September 2006, has been taking steps to bring these former mines into production. In July 2007, Energy Fuels purchased the Site in Montrose County with the intent to license, construct, and operate the Mill Facility for processing uranium/vanadium ore from Energy Fuels' mines and mines operated by other entities.

The Colorado Department of Public Health and Environment (CDPHE) is the primary licensing authority for uranium mills in the State of Colorado pursuant to an agreement with the U.S. Nuclear Regulatory Commission (NRC) under Section 274 of the Atomic Energy Act of 1954, as amended. This Environmental Report (ER) has been prepared in compliance with the applicable regulations implemented by CDPHE for the licensing of uranium processing including 6 Colorado Code of Regulations (CCR) 1007-1, Parts 3, 4 and 18 (CDPHE, 2005a, 2005b, and 2001) and NRC Regulatory Guide (NUREG) 3.8 (NRC, 1982a). Where applicable, NUREG-1748 (NRC, 2003a) and other applicable guidance have been used to guide the preparation of this ER.

1.2 LOCAL MINING HISTORY

The Settlement of Paradox Valley. Paradox Valley, located in western Montrose County, Colorado, was named by surveyor A.C. Peale in 1875. Peale recognized the paradox in the way that the Dolores River ran perpendicular to the valley instead of parallel to the valley, as rivers usually do (Rockwell, 1965). "The result of this paradox is to leave the eastern two-thirds of the valley a desert. The western third of the valley likewise cannot be irrigated by the uncooperative river, but the springs which rise there in the valley and the creek which flows into it from the La Sal Mountains have made this area habitable" (Gramlich, 1908). Paradox Valley was part of the Ute Indian Reservation until September 1881 when it was opened for settlement. The part of Paradox Valley west of the Dolores River became a farming country while that portion east of the river was used as grazing land (Rockwell, 1965).

In the fall of 1877, Thomas Goshorn and Riley Watson were the first to settle in what is now known as West Paradox from the Blue Mountains of eastern Utah. In 1879, Frank Steele arrived in the valley bringing cattle, and Prescott Stevens relocated his family to the area in 1880, partnering with Steele to form the Stevens and Steele Cattle Company (Rockwell, 1965). The early years of settlement were colorful, to say the least, as "outlaws and men on the dodge" frequented the area "due to its proximity and quick access into the State of Utah and particularly the outlaw trail" (Greager, 1992). There were also disputes over water rights, cattle rustling, and claim jumping which resulted in gun fights and untimely deaths (Greager, 1992 and Rockwell, 1965).

The Cashin Mine, which was situated a few miles west of Bedrock on La Sal Creek, played an important role in the early history of Paradox Valley. Around 1895, a copper deposit was discovered in the area. By 1899, the Cashin Mine was in full operation, producing copper ore. The ore initially had to be transported to a mill 70 miles away in Placerville by horse freight wagons and pack-trains. The trip required approximately 6 days to complete. Eventually, a mill was built closer to the Cashin Mine. Coke ovens were built on Dry Creek near a coal mine, 4 miles west of Naturita, to supply coke for the Cashin Mine Mill. The copper boom, which lasted from 1899 to 1908, attracted many settlers to the area (Rockwell, 1965).

Late 1890's to 1920's. The beginnings of the uranium/vanadium industry revolved around the radioactivity research by French scientists, Antoine Henri Becquerel and Pierre and Marie Curie. It started in 1896 when Becquerel discovered that uranium emitted particles and energy as it decayed and concluded that it was radioactive. Soon after, Pierre and Marie Curie isolated radium from uranium ore and discovered that it could be utilized in the treatment of certain cancers. In 1900, Charles Poulot and another Frenchman named Voilleque conducted experimental work on extracting vanadium and uranium oxides from carnotite ores at the camp of the Cashin copper mine on La Sal Creek (Chenoweth, 1981). It was believed that the ore with which the Curies conducted their research was the carnotite ore that originated from the Colorado Plateau. These discoveries sparked a world-wide interest in the search for radioactive materials especially in southwestern Colorado and southeastern Utah, which would come to be known as the Uravan Mineral Belt.

By 1910, miners had developed operations along the Dolores and San Miguel rivers in western Colorado to mine carnotite ores which contained rich concentrations of uranium, vanadium, and radium. The Standard Chemical Company (Standard Chemical) established its headquarters at the old Coke Ovens, 4 miles west of Naturita, Colorado (Rockwell, 1965). Standard Chemical began acquiring mining claims in east Paradox Valley in 1910, including the Thunderbolt group of claims on the southwest side of the valley, which are part of the claim group to be known later as the Joe Dandy Camp (Hahne, 1989). In 1913, Standard Chemical purchased land in the San Miguel Valley, near the confluence of the San Miguel and Dolores rivers, east of Paradox Valley, to begin a concentrating mill, lab, and boarding house. The small town was named Joe Junior after the son of the company president.

The demand for radium got into full swing when the federal government entered the picture in 1913 by creating the National Radium Institute. Its primary objective was to conduct extensive experiments in radium therapy with special reference to the cure of cancer. During the "radium era" of 1913 to 1921, the chief fields of activity were at Long Park, situated on the north mesa above east Paradox Valley, the San Miguel Club Ranch near Joe Junior, and in Bull Canyon, which was reached by a trail up the south side of Paradox Valley and then down a long narrow canyon (Rockwell, 1965). The Bull Canyon ore was packed by burro to the top of Monogram Mesa (just southeast of the Piñon Ridge Site), where it was loaded on the Joe Dandy Tram. The ore buckets on the tram took the ore to the valley floor in east Paradox Valley (Greager, 1990). There, the ore wagons with six-horse teams would be loaded up, and the ore would be hauled to Placerville or Joe Junior for concentrating. With the increase in demand for radium, miners poured into the San Miguel Valley and Paradox Valley from the nearby town of Bedrock (Rockwell, 1965).

By 1919, four main companies produced 95 percent of the radium ore mined in Colorado: Standard Chemical operated along the lower San Miguel River, in Long Park and Bull Canyon; The Radium Luminous Material Corporation operated around Long Park; The Radium Company of Colorado operated in Long Park and Roc Creek; and The Carnotite Reduction Company operated near Gateway. Radium was also mined in Utah mainly around the Thompsons, San Rafael, and Henry Mountains mining districts.

Radium ore production came to a halt in 1922 when Union Minere du Haut Katanga of Belgium (Union Minere) announced that it had discovered a rich new source of ore containing uranium and radium in its mines in the Belgium Congo. This ore was 40 to 100 times more pure than the Colorado carnotite. With refineries in place before the announcement of the discovery, Union Minere easily cornered the radium market after the announcement. The Belgian monopoly

forced the American producers off the market. In 1923, Standard Chemical closed the Joe Junior Mill and camp.

Mining officials in the United States continued to study the carnotite's vanadium content, which led to the use of vanadium as an alloy to strengthen steel. It was also found that vanadium was easily extracted from the carnotite mined in Colorado. Seeing the new market potential, in 1927, Union Carbide and Carbon Corporations purchased the United States Vanadium Company (USV) and made it a wholly-owned subsidiary. A year later they expanded holdings by purchasing the Joe Junior Mill and adjacent claims from Standard Chemical. Between 1934 and 1935, the assets of the Colorado Radium Company and the Radium Luminous Metals Company were acquired by the Vanadium Corporation of America (VCA) (Chenoweth, 1981). This was the beginning of the revival of the mining industry in the region.

1930's to 1945. Most of the established mines in the area were reopened by 1935 including mine operations near and within Paradox Valley at Longs Park, Bull Canyon, and Monogram Mesa. VCA built a new town and vanadium mill at Vancorum, west of Naturita. USV moved its vanadium processing plant from Rifle to the Joe Junior site in 1936, thus founding the townsite of Uravan (the name was derived from *Ura*nium and *Van*adium). North Continent Mines Company built a mill in the Slick Rock area, as did International Vanadium Corporation in Dry Valley, Utah. Many new mines were developed throughout the area during the 1930s and early 1940s. A small vanadium mill was built at Gateway, Colorado by Gateway Alloys, Inc. (Chenoweth, 1981).

The United States' entry into World War II in 1941 gave the vanadium industry new impetus, as vanadium alloy steel was used in tanks and other military applications. In order to stimulate the production of vanadium and other strategic metals, the federal government formed the Metals Reserve Company (Metals Reserve) in 1942. Metals Reserve began an ore purchasing program and two vanadium mills were constructed for the program by VCA and USV in Monticello, Utah and Durango, Colorado, respectively. The Metals Reserve program lasted from 1942 to 1944 and greatly stimulated vanadium mining and milling; however, vanadium mining all but ended in the area after the termination of the program (Chenoweth, 1981).

With the advancements that were taking place in the research and development of controlled nuclear fission technology, uranium became one of the most important components for military use and power generation. In August 1942, the U.S. Army Corps of Engineers' (USACE) Manhattan Engineer District (MED) arrived in Uravan to begin reprocessing the vanadium tailings to recover uranium as part of a top-secret mission to develop the atomic bomb. This mission was referred to as the Manhattan Project.

The initiation of the Manhattan Project created strategic laborers out of uranium miners and millers. The project transformed the communities that they worked in into national security towns. In May 1943, the U.S government signed a top-secret contract with USV to operate plants in Uravan for the procurement of uranium. The uranium was extracted from vanadium tailings at Uravan and tailings were shipped in from other vanadium mills in the area in 1943 and 1944. This uranium was concentrated in Grand Junction and then shipped to military facilities where it was used to manufacture atomic bombs. The dropping of atomic bombs at Hiroshima and Nagasaki in August 1945 ended World War II (Amundson, 2002). The Uravan Mill remained open until October 1945 when both the mill and the town were closed. According to a confidential MED report, the best and most easily accessible uranium ore had already been mined. The federal government withdrew, closing and dismantling the plant (Amundson, 2002).

1945 to 1970. The federal government, with the advent of the Cold War, initiated a new and aggressive government uranium-buying program in 1946. With the program, came the Atomic Energy Commission (AEC), created by President Truman in October of 1946. The AEC's objectives were to keep uranium mills, which were formerly used to process vanadium, in operation by developing a U.S. uranium reserve base and increasing production capabilities (Hahne, 1989). The AEC designed procurement programs that helped prolong programs implemented during wartime to ensure the post-war survival of the uranium industry. Additional details of these programs are presented in Appendix A, U.S. Regulatory History of Uranium Mills.

In response to the AEC programs, a prospecting boom occurred in 1947, which eventually led to the emergence of hundreds of small underground mine start-ups. The Uravan Mill reopened a year later. VCA procured its first uranium concentration for the mill at Naturita, Colorado in 1947. USV signed a contract for a mill in Rifle, Colorado. In the same year, the AEC established the Colorado Raw Materials office in Grand Junction, along with an Exploration Branch (Odell, 1999). In April of 1948, the government approved a plan to expand uranium production on the Colorado Plateau and its surrounding areas. As a result, the Metals Reserve Mill at Monticello was modified by the AEC to recover uranium. Climax Uranium Company began operating the first mill in the United States designed primarily for the production of uranium with vanadium as a byproduct at Grand Junction in 1951.

During the late 1940s and early 1950s, the AEC obtained mineral rights on approximately 700 square miles – mi^2 (1,800 square kilometers - km^2) of land on the Colorado Plateau. Exploration was conducted on these lands by the AEC and the U.S. Geological Survey (USGS), and when significant ore bodies were found, the land was leased for mining. Most of the land was eventually returned to the public domain, however; approximately 40 mi^2 (104 km^2) was retained for the leasing program, of which over 80 percent was in the Uravan area (Chenoweth, 1981) including large tracts in the Joe Dandy District along the south side of Paradox Valley and in the Long Park District on the north side of Paradox Valley.

Moab, in east central Utah, became a hub for uranium prospecting in the late 1940s and early 1950s. In 1952, Charlie Steen's discovery of the now famous Mi Vida Mine in the Lisbon Valley area of Utah resulted in an economic boom for the area. The Uranium Reduction Company (URECO) opened an ore buying station in May 1954 in Moab and built and began operating a new mill at the same location in October 1956. This mill was later sold to Atlas Minerals and renamed the Atlas Mill.

In the mid-1950's, the AEC authorized the expansion of nuclear research for the production of electricity. More companies began to shift their focus to developing electricity-producing reactor technologies. The nuclear power industry continued to grow at a rapid rate through the late 1950's (U.S. Department of Energy - DOE, 2009).

Between 1956 and 1961, the AEC made several announcements that changed the uranium market. In 1957, the AEC announced that the federal government was no longer interested in the expansion of uranium production (Odell, 1999) for the purposes of building a U.S. uranium reserve base and maintaining maximum production capacities. Previously offered incentives were no longer available and expansion efforts were limited. All of the AEC mine leases expired by March 1962. The prosperous uranium period gradually came to a halt as the AEC ended its ore buying program and stretched out and eventually ended its purchase of uranium concentrates on December 31, 1970 (DOE, 2009 and Chenoweth, 1981). During this period many of the older mills, mines, and buying stations closed including the Naturita Mill, which

closed in 1958 but continued to purchase and concentrate ore for shipment to the Durango Mill until 1963 (U.S. Energy Information Administration - EIA, 2009a).

1970 to 1990. Research in nuclear power experienced rapid growth during the early 1960's, being seen as a new form of electricity production that was not only economical but also environmentally clean and safe. However, nuclear power generation did not develop as rapidly as had been anticipated and uranium production continued to decline into the early 1970s. The demand for vanadium kept the mining industry in the Uravan area from collapsing completely. In 1970, the Climax Mill at Grand Junction closed, and most of the Climax mine properties were acquired by Atlas Minerals.

By the mid-1970's, uranium mining and milling began to pick up again as the AEC began to partially release market controls, allowing sales of uranium to private utilities and increasing the authorized number of nuclear power plants (Odell, 1999). Production in the Uravan area reached an all time low of 371 tons (740,000 pounds) of U_3O_8 in ore in 1973. Following this, the rise in uranium prices to new record levels by the mid-1970s resulted in a surge of activity and increasing production. The Uravan Mill was expanded in 1976 to process 1,300 tpd of ore. A buying station was established by General Electric's Nuclear Division at the Naturita Mill site. Cotter Corporation, then a wholly owned subsidiary of Commonwealth Edison, built a crushing and sampling plant in Whitewater, just south of Grand Junction. This facility received ore from Cotter's mines, many of which were located on AEC lease blocks in Paradox Valley, and shipped the ore by train to its mill in Cañon City, Colorado (Chenoweth, 1981).

In 1976, Ranchers Exploration and Development Corporation purchased the old vanadium tailings at Vancorum (i.e., the Naturita Mill). They moved these tailings to a lined heap leach facility in the southeast end of Paradox Valley near the Coke Ovens where the tailings were leached to recover uranium (American Institute of Petroleum Geologists, 2009). This facility was later reclaimed in place.

In eastern Utah, Rio Algom developed the Lisbon Valley Mine and Mill complex north of Monticello in 1972. A vanadium circuit was added by Atlas at its Moab Mill in 1976. In June 1980, Energy Fuels Nuclear opened the White Mesa Mill near Blanding, Utah (Chenoweth, 1981). With the addition of the White Mesa Mill and Rio Algom Mill, and the continued operation of the Atlas and Uravan mills, ore produced in the area increased to 5,500 to 6,500 tpd (i.e., more than 10 times the capacity of the proposed Piñon Ridge Mill) (Kuestermeyer, 1984).

Amidst growing concern by congress regarding the health and safety aspects of the uranium industry, the Energy Reorganization Act of 1974 was passed. This Act resulted in the creation of the NRC in January 1975, which assumed the regulatory control of uranium milling as well as enrichment operations and nuclear power generation. Other non-regulatory functions of the AEC, such as the promotion of atomic energy, were transferred to the Energy Research and Development Agency, which, in 1977, became the U.S. Department of Energy (DOE).

In 1978, congress enacted the Uranium Mill Tailings Radiation Control Act (UMTRCA), which established a joint federal/state-funded program for remedial action at abandoned uranium tailings sites where tailings resulted primarily from the weapons program. This program, called Title I (see Appendix A for more details), required DOE to design and implement cleanup and remediation of the abandoned sites with the NRC evaluating the plans for compliance with NRC and U.S. Environmental Protection Agency (EPA) standards. UMTRCA also established a Title II program (see Appendix A for more details) that regulated the operation and eventual closure of private-sector uranium mill sites licensed by the NRC or Agreement States (NRC, 2009).

Agreement States, which currently include Colorado and Utah, are those states that have entered into agreements with the NRC to exercise regulatory authority over uranium recovery operations. Under UMTRCA, the DOE is responsible for long-term care and maintenance of closed Title I and Title II sites.

By the late 1970's into the 1980's, growth and interest in nuclear power slowed due to lower than expected electric generating needs and rising health and environmental concerns (DOE, 2009). Safety concerns regarding the Three Mile Island Nuclear Power Plant incident in March 1979, where a partial core meltdown occurred, played an important role in a decreasing public acceptance of new nuclear power plants. This, along with sale of stockpiled uranium by the federal government and lower-cost uranium imports from Canada and Australia, resulted in the shutdown and closure of most of the mines and mills in the area.

Because of the severe downturn in demand for fuel for the nuclear power industry, the Uravan Mill operated only about 6 months per year from 1981 to 1984 when the town and mill permanently closed. In 1986, Union Carbide reached an agreement with the State of Colorado, which had assumed regulatory authority from the NRC as an Agreement State, to begin a 15-year cleanup project. The project would cost about $140 million, split almost equally between Umetco Minerals Corporation (a Union Carbide subsidiary) and the federal government. The federal government was responsible for a share of the cleanup because a large portion of the tailings and other mill wastes were produced as part of the uranium production for the government's weapon program. Under the agreement, Umetco officially closed the town in 1988 and leveled the town to pre-mining and milling conditions. Most other mines in the area were also reclaimed or operations were put on standby. Tailings and residual radioactive material from both the Naturita Mill and the Gateway Mill were hauled to Uravan and disposed of in a constructed disposal cell (EIA, 2009a).

The Atlas Mill in Moab also closed in 1984. The Rio Algom Mill cut back its production from the Lisbon Valley Mine starting in 1981, but was able to continue toll milling (i.e., processing uranium for another owner without taking title to the uranium) until 1988, when it too closed (Amundson, 2002).

1990 to Present. The White Mesa Mill was able to continue milling into the late 1990s due to the processing of higher grade ores from the breccia pipe mines in northern Arizona and occasional spikes in the price of vanadium. The mill and associated mine properties were acquired by International Uranium Corporation (IUC). IUC discontinued their milling of ore, but was able to keep the mill operating by processing alternate feeds. Alternate feeds are uranium-bearing materials that contain other radionuclides or hazardous substances. The mill recovers the uranium from the alternate feed, but also charges the generator of the material, which typically originates from environmental cleanup actions, a fee for disposal of the waste product.

The 1990s and early 2000s saw most of the Title I and Title II mills in the area closed and reclaimed including the Uravan Mill and the Lisbon Valley Mill. In some cases, where the facilities were located in poor physical locations or in close proximity to population centers, the tailings were removed from the site during reclamation and placed in off-site repositories. Cleanup was also complicated in those areas where mill tailings had been used for building foundations and backfill, as was the case with the Climax tailings in Grand Junction. As a result, cleanup and removal of tailings was also required for many residential and commercial buildings in those areas where tailings had been used for these purposes.

The Atlas Mill in Moab is one of the few unreclaimed tailings facilities left in the area. This facility was a Title II facility with both private and federal funding obligations for closure; however, Atlas went into bankruptcy and its bond and Moab assets were managed by a bankruptcy trustee with the intent of conducting in-place closure of the facility. Ultimately, however, Congress made the Moab site a Title I site and DOE decided to move the tailings to an off-site repository due to the facility's location on the Colorado River floodplain. This work, which is funded by the federal government, was started in May 2009.

Uranium prices were severely depressed through most of the 1990s and early 2000s reaching a low of about $7/pound on the spot market in 2000. Between 2000 and 2004, the price gradually rose to about $20/pound. Starting in 2005, the price rose rapidly reaching an all-time high of $137/pound in June, 2007. Since that point in time, the spot price has fallen back to between $40/pound and $50/pound in 2009. As a result of the price increase, Cotter reopened a number of its mines in Montrose County between 2003 and 2005 and shipped ore to its Cañon City Mill. This effort was unsuccessful due to a number of factors including the long haul distance. In 2006 and 2007, IUC reopened mines in both Colorado and Utah and began shipping ore to the White Mesa Mill. IUC, which merged with Denison Mines Corporation (Denison) in late 2006, also announced that it would refurbish and restart its conventional milling circuit for uranium ore. This circuit was restarted in April 2008. Since that time, the mill has alternated between conventional and alternate feed depending on contractual requirements (Louis Berger Group - Berger, 2009). At this time, the White Mesa Mill is the only operating mill in the area and obtains most of its ore from its own mines. Some smaller mining companies sell their ore to Denison under purchase agreements, but Denison has not agreed to toll mill ore for other companies.

1.3 PURPOSE AND NEED

The purpose and need for Energy Fuels' proposal is to develop the uranium and vanadium resources of the area in support of the Energy Policy Act of 2005 (Public Law 109-58), which emphasizes the reestablishment of nuclear power (Sections 601 through 657). The Proposed Action is consistent with the following:

- The Domestic Minerals Program Extension Act of 1953 - stipulates that each department and agency of the federal government charged with responsibilities concerning the discovery, development, production, and acquisition of strategic or critical minerals and metals shall undertake to decrease further, and to eliminate where possible, the dependency of the United States on overseas sources of supply of each such material.

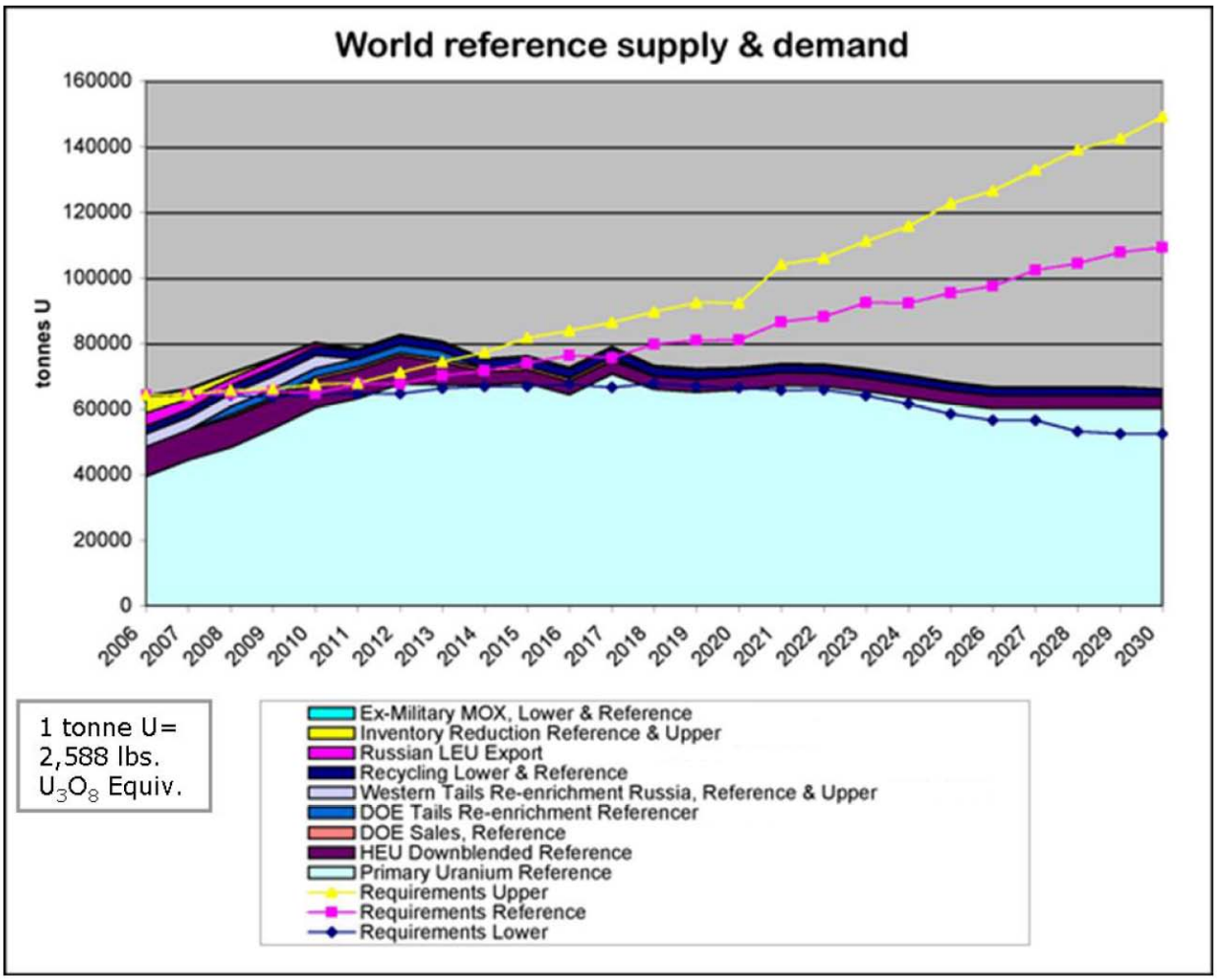
- The Mining and Minerals Policy Act of 1970 - declares that it is the continuing policy of the federal government to foster and encourage private enterprise in the development of a stable domestic minerals industry and the orderly and economic development of domestic mineral resources.

- The National Materials and Minerals Policy, Research and Development Act of 1980 - requires the Secretary of the Interior to improve the quality of minerals data in federal land use decision-making.

- The Energy Policy Act of 2005 - encourages energy efficiency and conservation; promotes alternative and renewable energy sources; reduces dependence on foreign sources of energy; increases domestic production; modernizes the electrical grid; and encourages the expansion of nuclear energy.

Uranium. Uranium provides the majority of the fuel for power-generating nuclear reactors. Worldwide, there are currently 436 power-generating nuclear reactors operating and producing 15 percent of the global electrical power demand. In the United States, 104 nuclear reactors are operating and producing 20 percent of the domestic electrical demand (World Nuclear Association, 2009a). World electricity demand is forecast to increase about 50 percent by 2030 (EIA, 2007). Nuclear power plants are the only source of carbon free, reliable base-load electricity. Uranium is also used in small nuclear reactors to produce isotopes for medical, industrial, and research purposes around the world. Figure 1.3-1, which was prepared by the World Nuclear Association (2007), shows the projected available uranium supply at currently forecast prices, broken down by various sources compared with the projected demand scenarios from Year 2006 until Year 2030. Yellowcake from the Mill Facility would be included in the "Primary Uranium Reference" category. The shortfall in uranium supply for both the base case (Requirements Reference) and the most aggressive case (Requirements Upper) beginning in the 2014 to 2016 timeframe are obvious and lead one to conclude that, in order for uranium supplies to grow to meet projected demand, prices higher than forecast will be required. The uranium demand for the least aggressive case (Requirements Lower) is assumed to be conformed to the available supply. The only expanding source of uranium supply for the future is found in the "Primary Uranium" (i.e. "newly mined") category.

Figure 1.3-1
Projected World Uranium Supply and Demand



Source: World Nuclear Association, 2007.

Uranium is mined from the earth and concentrated into U_3O_8 or (yellowcake) in facilities like the proposed Mill Facility. The yellowcake is the raw material for nuclear fuel that, after enrichment, is further processed into fuel rods. The fuel rods, when placed in a reactor, provide the heat to produce steam for generating electricity.

Yellowcake is a totally fungible, high-valued commodity that is able to move great distances in global trade. In 2008, the U.S. nuclear industry purchased 53 million pounds of yellowcake, while the U.S. uranium mining industry produced only 4 million pounds (EIA, 2009a). In 2008, worldwide there were 181 million pounds of yellowcake consumed but only 115 million pounds mined. The difference came from stockpiled uranium inventories from around the world which are approaching depletion (RBC Capital Markets, 2009).

Almost 60 percent of the world's primary (or newly mined) uranium supply is mined in just three countries: Canada, Australia, and Kazakhstan; just four companies produce 60 percent of the world's uranium supply: Rio Tinto, Cameco, Areva, and KazAtomProm; and 41 percent of the world supply comes from just four mines: McArthur River in Canada; Ranger and Olympic Dam in Australia; and Rossing in Namibia (World Nuclear Association, 2009b).

Vanadium. The primary use of V_2O_5 is as an alloying agent in the manufacture of high strength, low-alloy steels, which are known for their increased strength and durability. Vanadium consumption in China, the primary steel-producing country, is growing at a significantly higher rate than overall steel consumption, because of the shift to better quality steels with higher strength to weight ratios than basic carbon steels. Vanadium is also used in several applications, including surgical instruments, tool and die steels, engineering alloy steels used in axles, crankshafts and gears, stainless steels, rail steels, and titanium alloys. Additionally, vanadium serves as a catalyst in numerous industrial processes. Currently, there is work underway to develop a new, large-scale battery technology, the vanadium redox battery, which would find application in the pursuit for renewable energy supplies. The vanadium battery has the ability to store large quantities of electrical energy with minimum storage losses and can put that energy back out quickly as demanded by the electrical grid.

Uranium/Vanadium Milling. As provided in the *Socioeconomic Baseline and Impact Analysis Report* (Berger, 2009), as uranium/vanadium mines reopen, a potential bottleneck exists due to the lack of conventional mills to process the ore. Table 1.3-1 summarizes the status of all conventional uranium processing mills in the U.S. as reported by the EIA (2009a). Currently, the only conventional mill operating in the U.S. is the White Mesa Mill in Blanding, Utah which reopened in April 2008 and is owned by Denison. Denison invested approximately $31 million in new mill equipment in refurbishing this facility. In 2008, they produced 791,000 pounds of uranium and 1,233,000 pounds of vanadium from processed ores. Denison has been processing ores primarily from its underground mine operations in Utah and Colorado with some purchase of ores from other companies. The company also recently announced that it would start milling ore from its higher grade mines in Arizona, starting with the Arizona 1 Mine.

Table 1.3-1
Status of Conventional Uranium Milling Operations in the U.S. (4th Qtr 2008) [1]

Mill Owner	Mill Name/ Location	Capacity (short tons or ore per day)	Status
Cotter Corp.	Cañon City Mill Cañon City, CO	400 [2]	Standby
Denison White Mesa	White Mesa Mill Blanding, UT	2,000	Operating
Energy Fuels Resources	Piñon Ridge Mill Western Montrose County, CO	1,000 [3]	Developing
Kennecott Uranium Corp	Sweetwater Uranium Mill Sweetwater County, WY	3,000	Standby
Uranium One	Shootaring Canyon Uranium Mill Ticaboo, UT	750	Changing license to operational
	Total	**7,150**	

[1] Source: EIA, 2009b.
[2] Earlier reports show capacities as high as 1,500 tpd.
[3] The Piñon Ridge Mill would initially be permitted to process 500 tpd; however, the Mill Facility is designed for expansion to 1,000 tpd.

Cotter Corporation announced in March that it intends to reopen the mill in Cañon City in 2014, although they stated that the ore would come from their Mount Taylor Mine in New Mexico by train and made no mention of its mining properties in Montrose County (Cotter, 2009). The Sweetwater Uranium Mill is on standby and could restart; however, it is located in southern Wyoming and it would not be economical to ship ore from the Uravan Mineral Belt to this mill. The Shootaring Canyon Mill in south central Utah, although closer than Sweetwater, is approximately 250 miles by highway from the center of the Uravan Mineral Belt and has been partially decommissioned. In addition, neither the Shootaring nor Sweetwater mills have vanadium circuits, which would make processing or the uranium/vanadium ore uneconomical at today's prices even if the mills were located closer.

The Piñon Ridge Mill Facility is necessary because it is currently uneconomical for the uranium mines in western Colorado to haul ore to Cañon City for processing, and capacity availability is uncertain at the White Mesa Mill, especially with the restarting of their Arizona mining operations. White Mesa is also reluctant to provide toll milling for other companies; therefore, mines in western Colorado are left with no alternatives economically. The Mill Facility would provide an economical alternative due to its location and its intent to provide toll milling services.

1.4 APPLICABLE REGULATORY REQUIREMENTS, PERMITS, AND REQUIRED CONDITIONS

Since August 2007, Energy Fuels has been conducting environmental baseline studies at the Site and preparing Mill Facility designs in preparation towards submitting a Radioactive Material License application (Mill License Application) to the Radiation Management Program of the CDPHE. Table 1.4-1 provides a list of the required permits for the Mill Facility, the respective regulating authorities, and the status of the regulatory processes. Table 1.4-2 provides a list of other government agencies that regulate specific aspects of the Mill Facility construction and operation in compliance with state and federal regulations. Detailed descriptions of the individual permit requirements are also provided.

Table 1.4-1
Regulatory Permitting Requirements

Permit	Regulated Aspect	Government Agency	Regulatory Reference	Current Status
Mill License	All media, including air, water, soil, radiation, waste disposal	Radiation Management Program of CDPHE	6 CCR 1007-1 Parts 4, 14, & 18	Submitted concurrently with this ER
Special Use Permit	Land Use	Planning Division of Montrose County Land Use Department	Montrose County Zoning Resolution	Application Approved September 2009
Access Permit	Highway Access	Colorado Department of Transportation	2 CCR 601-1	Application Approved May 2008
Air Emissions Permits	Air Quality	Air Pollution Control Division of CDPHE	5 CCR 1001-3, -5, -8, -9, & -10	Application submitted July 2009
Stormwater Discharge Permit	Stormwater Runoff	Water Quality Control Division of CDPHE	5 CCR 1002-61	Application will be submitted prior to the start of construction activities
Water Well Permits	Well Installation	Division of Water Resources of Colorado Department of Natural Resources	2 CCR 402-2	Approvals Received in 2007 and 2008
Water Rights	Water Use and Consumption	District Court, Water Division No. 4	2 CCR 402-15	Application submitted November 2009
Tank Permits	Aboveground Storage Tanks	Division of Oil and Public Safety of Colorado Department of Labor and Employment	7 CCR 1101-14	Application to be submitted at later date
Potable Water System	Drinking Water	Water Quality Control Division of CDPHE	5 CCR 1003-1	Application to be submitted at later date
Building Permits	Building Design and Construction	Building Division of Montrose County Land Use Department	Montrose County Resolution No. 55-00	Application to be submitted at later date
Septic System Permit	Septic Design and Construction	Building Division of Montrose County Land Use Department	Montrose County Resolution No. 13-2006	Application to be submitted at later date

Table 1.4-2
Other Regulatory Requirements

Government Agency	Regulatory Reference	Regulated Aspect
Radiation Management Program of CDPHE	30 CFR	Worker Health and Safety (radiological)
U.S. Mine Safety and Health Administration	Subparts C, D, & O MINER Act	Worker Health and Safety (nonradiological)
U.S. Department of Transportation	6 CCR 1007-1 Part 4	Transportation of ore, process chemicals and processed yellowcake
U.S. Environmental Protection Agency	49 CFR Parts 100 - 185	Regulation of emissions, spills or other containment issues
U.S. Nuclear Regulatory Commission	40 CFR Parts 60, 61, 63, 68, 192, 302, & 355	Oversight of the CDPHE Radiation Management Program
U.S. Army Corps of Engineers	10 CFR Parts 20 & 40	Protection of U.S. Waters and Wetlands
U.S. Fish and Wildlife Service	33 CFR Part 328	Protection of threatened, endangered and sensitive species
Colorado Division of Wildlife	2 CCR 406-10	Protection of State threatened, endangered and sensitive species
Colorado Office of Archaeology and Historic Preservation	8 CCR 1504-7	Protection of historic and prehistoric cultural resources
Colorado Hazardous Materials and Waste Management Division	6 CCR 1007-3 Part 273	Regulation of the off-site disposal of solid wastes

Radioactive Material License, Radiation Management Program – Hazardous Materials and Waste Management Division of the CDPHE. The State of Colorado establishes performance objectives and procedural requirements for uranium milling and recovery operations through its radioactive material licensing program. This program establishes specific technical and financial requirements for siting, constructing, operating, decontaminating and closing, and reclaiming uranium recovery facilities. The program also addresses license transfer and termination following closure with long-term site surveillance and monitoring conducted by either CDPHE or DOE.

The Mill License Application submitted by Energy Fuels includes comprehensive baseline studies and impact analyses, detailed engineering plans for the Mill Facility, radiation modeling, environmental monitoring plans, health and safety procedures, emergency response and spill control plans, and closure and reclamation plans including a financial assurance cost estimate. Collected baseline data for surface water, groundwater, geology, seismology, cultural resources, livestock, wildlife, vegetation, soils, climate, air quality, radiological background levels, socioeconomics, and traffic are provided in the application.

Once the CDPHE considers the application to be complete, a minimum of two public meetings would be held at a local level and public comment and participation would be solicited. Montrose County would have an opportunity to participate in the review and comment process with county funding of up to $50,000 provided by Energy Fuels. The CDPHE is required to make a timely decision on the license application which could be to approve the application, approve the application with conditions, or deny the application.

Special Use Permit, Planning Division of the Montrose County Land Use Department. The Site is located within the General Agricultural zone district. Within each zone district, uses are listed as a “use-by-right,” a “special use,” or a “prohibited use.” The proposed use of “Mineral Processing” is not listed as a use-by-right or a prohibited use under the General Agricultural zone district; therefore, a “Mineral Processing” operation requires authorization subject to a Special Use Permit (SUP) through Montrose County under the listed special use of “New mineral resource development and extraction operations and facilities.”

Energy Fuels submitted a *Special Use Permit Application* to Montrose County in July 2008, which included general plans for roads, parking areas, buildings, stockpile pads, processing facilities, tailings cells, evaporation ponds,, and water, septic, power, and heating systems. The Land Use Department commented on the application and Energy Fuels revised the application in response to the comments. The revised *Special Use Permit Application* was submitted to the Planning Commission for review and discussion in May 2009 (Visus Consulting Group - Visus, 2009). Following unanimous recommendations for approval by the West End Planning and Advisory Committee (WEPAC) and the Planning Commission, the application was forwarded to the Board of County Commissioners for final review and decision, for which approval was issued September 30, 2009. Reviews were conducted by both the Planning Commission and Board of County Commissioners as part of six public hearings, which included testimony from more than 300 individuals, agencies, and organizations.

In reaching a determination on Energy Fuels’ Special Use Application based on the applicable criteria, the Board of County Commissioners made several land use findings in their Resolution (Montrose County, 2009a) some of which included:

- The use and its location as proposed and subject to the conditions of approval as provided herein are in conformance with the County’s Master Plan as the area in which

the mill is to be located is in an area that has a long history of mining related operations and facilities;

- The site plan conforms to the district design standards of the Zoning Resolution and other applicable regulations and any variations are approved as part of the special use conditional approval;
- All on and off-site impacts have been satisfactorily mitigated either through agreement, public improvements, site plan requirements, buffering, mandatory compliance with state and/or federal licensing requirements, conditions of approval as specified herein and other mitigation measures implemented by the applicant;
- The special use proposed is not planned to be developed on a nonconforming parcel;
- The proposed special use addresses a demonstrated community need in fostering job creation and economic development on the west end of Montrose County; and
- The geographic and geological nature of the area is suitable for the proposed special use.

Access Permit, Colorado Department of Transportation. Access roads off State of Colorado highways must be permitted with the Colorado Department of Transportation (CDOT). CDOT has strict requirements for highway access roads, depending on the existing traffic levels on the highway, the proposed increase in traffic, and the physical characteristics of the highway and land in the vicinity of the proposed access. These regulations are designed to maximize vehicle safety and provide for efficient routing of traffic.

Energy Fuels obtained an Access Permit for the Mill Facility from CDOT in May 2008 (CDOT, 2008). The access permit to SH 90 includes a traffic study of the highway incorporating future projections of the increased traffic that would occur from the Mill Facility and other sources (LANDesign Consulting Engineers, 2008). Based on these evaluations, access to and from the Site was designed in accordance with CDOT guidelines. This included the addition of a de-acceleration lane that would allow westbound vehicles to slow down and turn into the Site without slowing traffic and a 10-foot wide shoulder on the eastbound lane of SH 90 starting at the Site entrance and proceeding eastward.

Final design drawings were submitted to CDOT in November 2009 (Del-Mont Consultants, Inc., 2009). Energy Fuels would be required to post a performance bond for these improvements prior to receiving a Notice to Proceed from CDOT. Construction of the access improvements is expected to occur in 2010 prior to the start of the Mill Facility construction.

Air Emission Permits, Air Pollution Control Division of the CDPHE. The Colorado Air Pollution Control Division (APCD) of CDPHE requires that proposed processing facilities monitor ambient air quality and meteorological conditions and then calculate projected emissions and air quality impacts for the facility based on ambient conditions and the proposed processing activities. The APCD then makes a determination as to whether the proposed activities meet state air quality regulations for control of air emissions.

Air Pollution Emission Notices (APENs) were filed for the Mill Facility in July 2009 with the APCD for estimated stack emissions from the Mill Facility and fugitive dust from the roads, stockpiles, evaporation ponds, and tailings cells (Kleinfelder, 2009a). In response to comments received from the APCD, additional APENs, lists and quantities of materials, and a Reasonable Available Control Technology (RACT) analysis were submitted in November 2009 (Kleinfelder, 2009j). Air modeling results, which predict the impact of the Mill Facility on ambient air quality, will be submitted once the APENs have been accepted by APCD. The modeling will be based on the data collected from two meteorological stations located at the Site.

The majority of the mineral processing systems would be equipped with the best available control technology to reduce emissions to the lowest practical level. Roads, stockpiles, and tailings cells would be sprayed with water and treated, as necessary, with chemical dust suppressants to minimize fugitive dust. Air monitors have been installed at three on-site locations and two off-site locations both east and west of the Site. These air monitoring stations were used initially to establish background levels and would later be used to verify compliance with the Site's air emission permit limits.

The APCD is expected to review and comment on the additional APENs and supporting information provided by Energy Fuels. Energy Fuels would then respond to APCD's questions and concerns and conduct air modeling in accordance with APCD protocols. If all issues were resolved, the APCD would prepare draft permits and solicit public comment. Final permits would be issued after the resolution of any public comments received by the APCD.

Colorado Construction Stormwater Discharge Permit, Water Quality Control Division of the CDPHE. The Water Quality Control Division (WQCD) of CDPHE requires that construction sites over 1 acre in size obtain a stormwater construction permit and develop and implement a Stormwater Management Plan (SWMP). These regulations are designed to protect streams from sedimentation that may result in physical, chemical, and biological harm to the State's waters. The above-referenced general permit will be filed with the WQCD when final construction plans have been generated. A SWMP for the construction phase will be developed for the Site prior to application for this permit. During construction, the construction contractors would be required to install and maintain the necessary BMPs to control stormwater runoff from leaving the site.

Under Colorado water quality regulations, a stormwater discharge permit is not required for mill operations because the Mill Facility is a "zero-discharge facility." Although not required by the WQCD, a SWMP for operations and minor construction occurring during operations has been prepared and is submitted with the Mill License Application to the Radiation Management Program (Golder Associates Inc. – Golder, 2009a). The SWMP includes stormwater monitoring of both contained and diverted stormwater.

Well Permits and Water Rights, Division of Water Resources of the Colorado Department of Natural Resources. The water supply for the Mill Facility would come from a series of groundwater production wells. Process water would be recycled and reused where feasible to minimize the amount of water needed for milling. Three production wells have been installed to date, two at the south end of the Site and one in a designated well field west of the Site. Up to four additional production wells would be added in the designated well field with the agreement of the landowner. All production and monitoring wells installed to date have been permitted with the Colorado Department of Natural Resources (CDNR) Division of Water Resources.

The proposed Mill Facility is located in eastern Paradox Valley, which is designated by the Colorado Division of Water Resources as a non-critical area; therefore, neither augmentation nor a water right is required under Colorado water law to use the water. However, Energy Fuels applied for water rights for the existing and future production wells in November 2009 to secure a priority for these wells (Energy Fuels, 2009a). This also was done to meet Condition 11 of the September 30, 2009 Resolution of the Montrose County BOCC (Montrose County, 2009a) approving the Special Use Permit, specifically that "Water rights for all wells to be used at the mill shall be obtained prior to operation of the facility." Surface water rights for the direct precipitation falling on the zero-discharge portions of the site (see stormwater above) were also included in the water rights application.

Aboveground Fuel Storage Tank Permits, Division of Oil and Public Safety of the Colorado Department of Labor and Employment. The Colorado Division of Oil and Public Safety (CDOPS) of the Colorado Department of Labor and Employment (CDLE) regulates aboveground storage tanks that store substances such as petroleum products and chemical reagents that are not otherwise classified as hazardous wastes or radioactive materials, which are regulated by CDPHE. The CDOPS regulations establish rules for the design, installation, registration, construction, and operation of these storage tanks. The regulations are intended to reduce potential damage to the environment and risk to the public caused by leaking storage tanks and to mitigate such damage when it occurs. CDOPS also inspects and certifies boilers and pressure vessels to ensure their safe operation. CDOPS rules for boilers and pressure vessels are based on nationally recognized codes and standards.

Energy Fuels would be required to permit and register its fuel, oil, and chemical reagent tanks containing between 660 and 40,000 gallons with CDOPS. These tanks would be installed above ground and would be provided with secondary containment, puncture protection, and fire suppression equipment. A *Spill Prevention, Control and Countermeasure (SPCC) Plan* has been prepared for the Site in accordance with federal Oil Pollution Prevention regulations (Energy Fuels, 2009b). The SPCC Plan include measures for preventing petroleum spills and releases, personnel training, containment and cleanup of spills, and reporting of spills. A *Material Containment Plan* has also been prepared for the Site to address the storage and use of chemical reagents (Energy Fuels, 2009c).

In addition to CDOPS' aboveground storage tank requirements, the storage tanks would also be inspected by Mine Safety and Health Administration (MSHA) safety inspectors as part of the non-radiation health and safety program. Processing and storage tanks that contain radioactive compounds would be regulated and inspected by the Colorado Radiation Management Program under the provisions of 6 CCR 1007-1 and the Radioactive Material License. Boilers and pressure vessels would be installed in accordance with state regulations and would be inspected and certified by state inspectors.

Potable Water System Permit, Water Quality Control Division of the CDPHE. The WQCD has established drinking water standards for potable water systems serving more than 25 people. These standards are designed to protect water users from drinking water containing harmful constituents. The groundwater on Site does not meet all drinking water standards for a potable water system serving more than 25 people. Rather than attempt to treat the on-site water, Energy Fuels would transport treated water from the Town of Naturita and use that as the water source for the potable systems at the Administration Building and Mill. The potable water systems would be designed and constructed in accordance with the "State of Colorado Design Criteria for Potable Water Systems." CDPHE decisions regarding the review and approval of plans and specifications of the system would be based upon compliance with these criteria. Within 45 days after the receipt of a request for approval of the complete set of final plans and specifications, the CDPHE would review the submitted documents and render its decision.

Building Permits and Septic System Permits, Building Division of the Montrose County Land Use Department. Montrose County requires that all building and wastewater disposal systems meet building and state codes for safety and hygiene. The Building Division provides plan review, inspections, and enforcement of the currently adopted building codes and is responsible for review and approval of individual sewage disposal systems (septic systems). Detailed building and septic system plans would be developed and submitted to Montrose County once the Radiation Management Program of CDPHE reviews and approves the Mill

Facility layout and design. The septic systems would be designed and constructed according to state and county health and sanitation requirements.

1.5 PUBLIC PARTICIPATION

1.5.1 Public Meetings and Information

Table 1.5-1 provides a summary of the public meetings held to-date for the Piñon Ridge Project. Early in the process, Energy Fuels voluntarily hosted two open houses on March 25 and March 26, 2008 in Naturita, Colorado and Montrose, Colorado, respectively, to inform the public of its plans. The meetings were advertised in local newspapers and flyers were posted on bulletin boards. In these meetings, Energy Fuels' President, provided a 20-minute overview of the project, and technical specialists at separate tables provided more detailed information to the public on the permitting process and public involvement, environmental aspects, radiation health and safety, and project economics. At the request of the San Miguel Board of County Commissioners, Energy Fuels attended the county's board meeting in Norwood, Colorado on May 28, 2008 and gave an abbreviated version of the March presentations.

Table 1.5-1
Public Meetings Held for the Piñon Ridge Project

Meeting Sponsor	Location	Date	Approximate Number of Attendees
Energy Fuels	Naturita Community Bldg. Naturita, CO	March 25, 2008	80
Energy Fuels	Montrose Pavilion Montrose, CO	March 26, 2008	80
San Miguel County	Town Hall Norwood, CO	May 28, 2008	40
Montrose County Requested Presentation by CDPHE	Montrose Pavilion Montrose, CO	September 24, 2008	80
Montrose County	Nucla High School Nucla, CO	May 19, 2009	250
Montrose County	Friendship Hall Montrose, CO	June 10, 2009	200
Montrose County	Friendship Hall Montrose, CO	July 1, 2009	150
Montrose County	Nucla High School Nucla, CO	August 13, 2009	200
Montrose County	Friendship Hall Montrose, CO	September 9, 2009	250
Montrose County	Friendship Hall Montrose, CO	September 30, 2009	80

Energy Fuels launched "The Piñon Ridge Mill" website concurrently with the submittal of its SUP application to Montrose County. The SUP application was also posted on the Montrose County website and the CDPHE's website. Energy Fuels' website presents information about the Proposed Action as well as the company, and Energy Fuels provides a contact page where the public can ask questions or request additional information. Energy Fuels submitted numerous reports to the CDPHE during 2008 and 2009, which contained environmental baseline studies and engineering designs for the Proposed Action; they have been posted on CDPHE's website.

On September 24, 2008, the CDPHE Radiation Management Program, at the request of Montrose County, attended a meeting in Montrose where four of the Radiation Management Program's staff gave an overview of the agency's regulation of uranium milling facilities. After the formal presentation, the program's staff answered questions from county personnel including the planning department, engineering department, WEPAC, planning commission, and county commissioners. After adjournment of the meeting, state personnel answered questions from the general public.

Starting on May 19, 2009, a total of six public meetings were held by Montrose County in their review of the SUP application. These meetings consisted of presentations by Energy Fuels and its technical consultants and testimony by members of the public, both for and against the project. Written comments were also taken by the county during the public comment period.

1.5.2 Summary of Issues

Numerous comments, both written and verbal, have been made regarding the Mill Facility. Comments for and against the project have been fairly equally divided, with the pro positions mostly socioeconomic-based and the con positions more varied. Issues, concerns, and positive comments provided by the public, industry, interested groups, and agencies regarding the Mill Facility are generally summarized below by resource or topic. The comments raising technical issues have been addressed in the applicable resource sections of the ER.

Land Use

- Mill would harm tourism;
- Mill is inappropriate land use in agricultural area;
- Potential for mill to impact cattle;
- Mill is appropriate, because it is central to existing uranium mines in the area; and
- Mill is appropriate, because it is located in a historic mining district.

Transportation

- Increased local traffic, including truck traffic;
- Danger posed by material being transported; and
- Potentially less traffic from ore trucks than from tourism to Telluride.

Geology and Soils

- Site unsuitability due to numerous faults that parallel the mesa; and
- Site unsuitability due to the Paradox Valley Unit deep injection well near Bedrock creating earthquakes that have reached as high as 4.3 in magnitude.

Water Resources

- Inadequacy of water supply for construction, operation, and dust suppression;
- Inadequacy of pumping tests;
- Potential for groundwater consumption to negatively affect the groundwater and rivers;
- Potential of site runoff contaminating East Paradox Creek and the Dolores River;
- Necessity for water quality monitoring including third-party monitoring;
- Inadequacy of groundwater characterization under the tailings cells;
- Potential groundwater contamination due to leakage from the mill, tailings facility (liners), and other areas;
- Potential for neighboring well water/springs contamination and/or drawdown;

- Need to set parameters establishing when Energy Fuels must use alternate water source;
- Groundwater is deep or not present and would not be impacted by operations;
- Susceptibility of liners to puncture and degradation;
- Current liner technology is much improved and would provide sufficient protection;
- Need for liner leakage monitoring and shutdown procedures;
- Inadequacy of underdrains only on portions of the tailings cells;
- Need water rights for supply water;
- Need water rights for retained stormwater; and
- Legality of Naturita transferring water rights to Energy Fuels for the mill.

Ecological Resources

- Potential for wildlife to be killed by exposure to toxic chemicals;
- Potential wildlife mortality increase due to increased truck and auto traffic;
- Potential for ore truck or truck hauling yellowcake to spill near a river contaminating fish and other aquatic species;
- Potential for pumping of groundwater wells to deplete the groundwater flowing into the Dolores River and impact Sensitive Species of Fish; and
- Potential for depletion of San Miguel River to impact Sensitive Species of Fish if water is trucked from the San Miguel River.

Meteorology, Climatology, and Air Quality

- Potential for sediments in the evaporation ponds to blow away;
- Potential for dust storms to carry radioactive dust to Paradox Valley farms and to Telluride and to contaminate snowpack providing water supply for the region;
- Potential for rock crushing in open air to negatively affect air quality; and
- Potential for mill to emit 700 tons of radioactive and toxic chemicals annually.

Noise and Visual/Scenic Resources

- Potential for mill to cause noise and visual impacts.

Socioeconomics

- Need for financial ability to reclaim or clean-up the site when the mill closes;
- Capability of Energy Fuels to build and operate the mill;
- Financial success will profit Canada;
- Need for long-term, not just short-term, economic benefit to the area;
- Cost competitiveness of renewable energies such as solar and wind;
- Necessity of government subsidies for nuclear power to be economically viable;
- Volatility and failure of energy-based economies;
- Inadequacy, in terms of equipment and training, of the local firefighters and emergency response teams to deal with a major emergency/radiation contamination at the mill;
- Mill would increase jobs in the area;
- Mill would benefit local economy;
- Mill would diversify economy;
- Mining has deep roots in the local communities;
- Potential to create negative perception of organic crops grown in area;
- Potential to negatively affect tourism and agricultural business; and
- Potential to benefit local medical clinic with additional insurance coverage.

Public and Occupational Health

- Current and historical health risks, specifically cancer risks, of uranium mining and milling to workers and people in the area;
- Health risks associated with evaporation ponds – sulfuric acid harming to lungs;
- Potential for ore trucks to leak radioactivity and radioactive dust causing an increased cancer risk to county residents;
- Radiation from cigarettes is greater than from mill tailings;
- Mining and milling risks are known and manageable in this region; and
- Existing risks of naturally-occurring uranium (uranium dust) in the area.

Waste Management

- Potential that Energy Fuels would dispose of hazardous waste at the mill;
- Need for verification that ore is uranium/vanadium ore;
- Potential for mill to accept water treatment residuals coming from mines or other sources;
- Need for containment of spills/accidents;
- Potential for Energy Fuels to import mixed hazardous and radiological wastes (alternate feeds) to the mill; and
- Toxins permanently left on site after cessation of milling operations.

General

- Need for off-site monitoring
- Potential for sulfuric acid odor to emanate from the mill;
- Need for Environmental Impact Statement (EIS);
- Need for cumulative analysis based on large number of mines feeding the mill;
- Need to consider carbon footprint of nuclear energy life cycle (i.e. mining, mill construction, nuclear power plant construction);
- Mill design is for 1,000 tpd rather than 500 tpd;
- Uranium may be exported to foreign countries;
- Inadequacy of uranium ore supply to feed the mill;
- Risk that production of uranium domestically would curtail dismantling of Russia's nuclear arsenal;
- Preference of renewable energy;
- Inability of renewable energy to supply sufficient baseload energy;
- Energy Fuels' inability to pay for accidents or problems;
- Nuclear power provides a clean energy source
- Need for nuclear power in the U.S. energy mix;
- Nuclear power contributes to energy independence;
- Need for security of ore and yellowcake shipments;
- Security weakness of chainlink fence to deter terrorists that could use the yellowcake to build a dirty bomb; and
- Need for security verification.

Section 2.0
Alternatives

2.1 NO ACTION ALTERNATIVE

Under this Alternative, CDPHE would deny Energy Fuels' Mill License Application for the proposed Piñon Ridge Mill. Construction and operation of the conventional mill facilities would not occur, and environmental impacts associated with the Mill would not occur.

The positive economic benefits to western Montrose County resulting from additional employment and consumer stimulus to the local economy would not occur under the No Action Alternative. The No Action Alternative would require that mines in the area transport uranium/vanadium ore longer distances to Cotter's Cañon City Mill, which is not currently receiving and processing uranium/vanadium ore and which could be uneconomical for those mines, or to the White Mesa Mill in Blanding, Utah, where available capacity is uncertain and where toll milling is not currently being practiced. Uranium resources in the area would not be developed and could not support the Energy Policy Act of 2005 which emphasizes the reestablishment of nuclear power.

2.2 PROPOSED ACTION ALTERNATIVE

2.2.1 Site Location and Description

The Site is located in Montrose County, Colorado in Paradox Valley, approximately 12 miles west of Naturita and approximately 7 miles east of Bedrock, southwest of SH 90 along the northeastern edge of Davis Mesa. The Site is located on one 880-acre parcel owned by Energy Fuels. An adjacent parcel of approximately 80 acres to the west of the 880-acre parcel is a well field for the location of water supply wells. Specifically, the Proposed Action is located in portions of Section 5 and Section 17, and all of Section 8 in Township 46 North, Range 17 West of the New Mexico Prime Meridian. The Site is located on Bull Canyon and Davis Mesa USGS 7.5-minute topographic quadrangles. General access to the Site is along SH 90 to milepost 23. The general location is shown on Figure 1.1-1 in Section 1.1, Introduction.

2.2.2 Property Boundaries and Disturbance

The limits of the 880-acre parcel are considered to be the Property Boundary. The entire Property Boundary would be fenced except for the portion of the property on the north side of SH 90. The area inside the Mill License Boundary which consists of 307.8 acres would be fenced with a 6-foot chain-link fence topped with three strands of barbed wire and would include the following project components: the Mill, three tailings cells, 10 to 20 evaporation ponds, an ore pad, and ancillary facilities such as roads, stormwater diversions, mill offices, and laboratories. The facility layout is provided on Figure 2.2-1. Ancillary facilities outside of the Mill License Boundary include the main access road and some secondary roads, the ore dumping platform, the administration building, change house and laboratory building, warehouse, truck shop, guardhouse, stormwater diversions, and monitoring systems. The western portion of the Site would be used to stockpile soil excavated for project components within the Mill License Boundary that would eventually be used to reclaim the area within the Mill License Boundary (the restricted area). A 10-foot wide access road would be constructed outside of the Mill License Boundary to access water production wells south of the Mill License Boundary, and a 60-foot corridor with a pipeline and access road would be constructed west of the Mill License Boundary to access water supply wells on the adjacent 80-acre parcel.

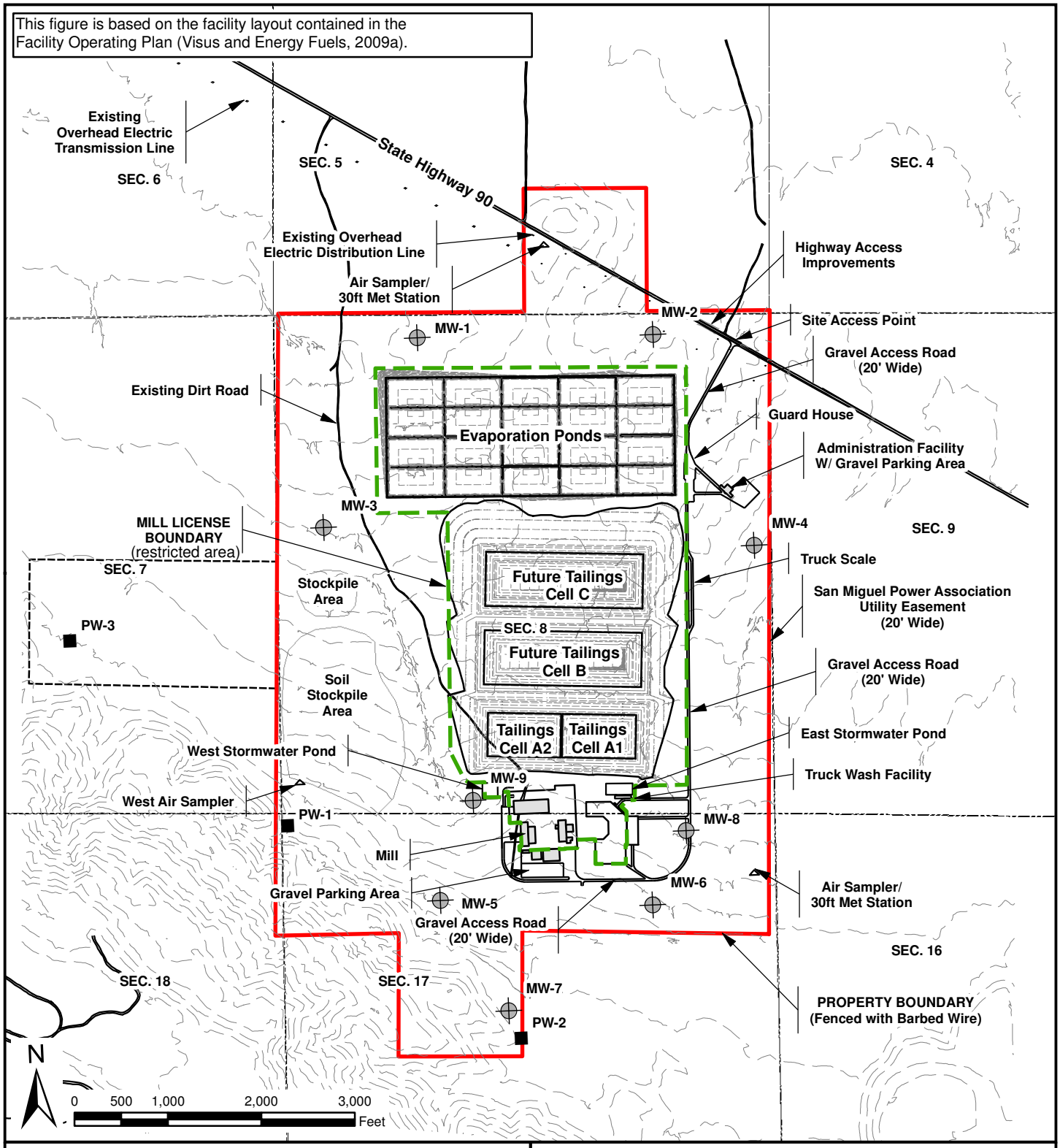


Figure 2.2-1

Site Plan

Table 2.2-1 provides the estimated surface disturbance for the Proposed Action both within and outside of the Mill License Boundary.

Table 2.2-1
Disturbance within and outside of Mill License Boundary

	Disturbance within Mill License Boundary (acres)	Disturbance outside of Mill License Boundary (acres)	Total Disturbance (acres)
Mill Components[1]	307.8	---	307.8
Stockpile	--	45.9	45.9
Topsoil Stockpile	--	6.0	6.0
Pipelines and Access Roads	--	5.6	5.6
Other	--	49.3	49.3
Total Disturbance	**307.8**	**106.8**	**414.6**

[1] Includes Mill, three tailings cells, 10 to 20 evaporation ponds, an ore pad.

2.2.3 Project Description

The Mill Facility consists of the Mill (i.e., mill processing buildings and equipment), tailings cells, evaporation ponds, an ore stockpile pad, and ancillary facilities including access roads, a truck scale, guard house, administration building, warehouse and maintenance buildings, laboratory, utilities, stormwater control structures, and soil stockpiles. At the start of operations, the Mill Facility would encompass approximately 300 of the 880 available acres and would gradually expand to encompass approximately 400 acres over the life of the Mill Facility or Proposed Action.

The Mill Facility would have a production rate of 500 tpd. With this production rate, most of the ore would be produced and delivered by mines owned by Energy Fuels. The balance of the ore would be purchased from, or toll milled for, other mines in the area. The life of the project is expected to be 40 years. Ore would be delivered to the Site and would be ground into a fine slurry and then leached with sulfuric acid to separate the uranium and vanadium from the remaining rock. Uranium and vanadium would be recovered from solution and precipitated as concentrates, which would be sealed in USDOT-approved 55-gallon steel drums and transported off site. The uranium concentrate would be sent to conversion facilities for uranium enrichment and the vanadium would be shipped to a plant that produces ferro-vanadium products.

2.2.3.1 Mine Locations and Hauling

Mine Locations and Resources. Mining methods, locations of mines, and regulatory requirements for mines are discussed in detail in the *Mine Operations Plan* (Energy Fuels, 2009d). Workforce requirements for the mines are also discussed in the *Mine Operations Plan* and considered in the workforce projections in Section 4.10, Socioeconomics.

The two, primary sources for uranium/vanadium ore delivered to the Site are the Energy Fuels Whirlwind Mine (formerly called the Packrat Mine and Urantah Decline) and the Energy Queen Mine (formerly called the Hecla Shaft Mine). These mines are located on the Colorado Plateau in Western Colorado and Eastern Utah, and are within reasonable truck hauling distance to the Site. More specifically, the Whirlwind Mine is located in Mesa County, Colorado and Grand County, Utah, approximately 5 miles southwest of Gateway, Colorado. The Energy Queen Mine is located in San Juan County, Utah between La Sal and La Sal Junction. Both of these mines are capable of producing 200 tpd or more of uranium ore and are fully permitted.

The balance of the ore feed could come from mines that are controlled and operated by other mining companies in the area. Energy Fuels also has approximately 20 additional uranium properties on the Colorado Plateau in Western Colorado and Eastern Utah that could become future sources of ore.

Ore Haulage Routes. The majority of uranium/vanadium ore transported to the Mill Facility would arrive on SH 90, from either east or west of the Site. Some of the ore may come to the Site directly from Monogram Mesa through the Cotter Corporation property located directly southeast of the Site. Ore delivered from the west would primarily come from several mines in an area located just south and east of La Sal, Utah. Additional tonnage would come from the north on U.S. Highway 191 from its junction with Interstate-70 and from the south on U.S. Highway 191 from mines located south of Monticello, Utah.

The route east of the Site would be used to deliver ore mined from the Monogram Mesa and Long Park areas via existing Montrose County roads connecting to SH 90 roughly 5 miles east of the Site. Ore would be transported to Vancorum from the north via SH 141 and then west via SH 90 to the Site. Ore from the north would be trucked from the mines to SH 141 on existing Montrose County and Mesa County roads. Ore from the south would come through Naturita via SH 141 and U.S. Highway 491. These highways are fed by numerous county roads located in both Colorado and Utah. Energy Fuels estimates that approximately 42 percent of the mill feed would come from west of the Site, 17 percent from near the Site and 41 percent east of the Site. Estimates of traffic related to ore hauling are provided in Section 2.2.6, Traffic.

The USDOT is the primary regulatory authority for uranium ore haulage. To allow for efficient interstate commerce, the Colorado Department of Transportation (CDOT) and the Utah Department of Transportation (UDOT) have adopted the USDOT regulations in their entirety. USDOT regulations for the transport of radioactive materials are codified in Title 49 of the Code of Federal Regulations (CFR). The *Ore Transportation Plan*, which is included as Appendix B to the *Mine Operations Plan* (Energy Fuels, 2009d), describes Energy Fuels' procedures and methods for shipping uranium/vanadium ore from a mine to an off-site mill. A brief summary of the plan follows.

The uranium/vanadium ore shipped would typically average 0.15 to 0.25 percent U_3O_8. At these levels, uranium ore is regulated as a Class 7 radioactive material under the USDOT hazardous material regulations. Uranium ores and concentrates of uranium ores, because of their low specific activity are generally exempt from most packaging, marking, labeling, and placarding requirements of other Class 7 radioactive elements.

The ore would be loaded into highway haul trucks with a front-end loader or from a bin, taking precautions to avoid spillage and inhalation of dust during loading. The ore would generally be probed and a sample collected for later compositing and grade analysis. Precautions would be taken to meet the road weight limit requirements and to minimize tracking of materials onto roadways.

Prior to hauling, the load would be covered and each transport vehicle would be surveyed for leakage and radiation. Shipping papers must be fully completed and in the possession of the driver. Records of the inspections and radiation scans for each shipment would be maintained on-site. The transport carrier would be responsible for compliance with all applicable laws and adhering to established procedures and protocols during the transport of the ore from the mine to the Mill.

Emergency response information would be immediately available to all persons who transport or handle uranium ore. The transportation contractor would be responsible for implementing the plan in the event of an accident that results in the spillage of uranium ore onto a public road. Energy Fuels would provide emergency response support in accordance with its contract with the ore transporter. This could range from verification sampling at the completion of the cleanup to a full response including medical aid, traffic control, ore isolation and cleanup, and verification sampling.

Mining and carrier personnel are trained for the proper loading and transporting of uranium ore. The training includes basic radiation concepts, dust and contamination control, vehicle scanning requirements, exclusive use transport provisions, and emergency response contact and response information. Training records would be documented and maintained at the mine site.

2.2.3.2 Ore Stockpile Pad

Energy Fuels proposes to construct an engineered ore pad to receive and store the ore that would be delivered to the Mill Facility for processing. Having the capability to stockpile ore would enable Energy Fuels to maintain a readily available source of mill feed, balance mining and milling operations, and maximize the mill efficiency by blending and feeding stockpiled ore to the mill at varying rates and grades as necessary. Furthermore, ore deliveries to the Mill Facility from area mines would not be jeopardized during scheduled and unscheduled mill shutdowns.

Approximately 1 acre of the ore pad would be lined with concrete and the remaining 5 acres would be lined with a geosynthetic clay liner (GCL) covered with a protective layer of compacted native soils and roadbase materials. The concrete pad would be located next to the feed hopper and conveyor, where equipment loading and unloading activity would be greatest. The 5-acre lined pad would have a horseshoe-shaped configuration encircling the feed hopper and concrete pad. A front-end loader would feed the dumped ore into the ore hopper. The hopper would be enclosed within a three-sided structure equipped with water sprays to minimize fugitive dust emissions.

Ore would be delivered to the Site in 24-ton capacity dedicated highway trucks via SH 90 at the estimated rate of 500 tpd, or 21 loads per day, predominately during daylight hours. Eastbound and westbound ore deliveries are expected to be approximately equal. The delivered ore would be stockpiled on the ore pad and ultimately processed in the Mill. After being weighed, the majority of the haul trucks would drive onto an elevated earthen platform (located on the east end of the ore pad) and dump their loads over a retaining wall onto the 5-acre ore pad without entering the ore pad area. Trucks dumping onto the pad from the dumping platform would not require washing prior to leaving the Site provided they pass radiation screening levels.

Some of the haul trucks delivering ore would enter directly onto the concrete ore pad or 5-acre ore pad to dump their loads. This could occur for a number of reasons including a fully loaded dumping platform (i.e., no space left to dump) or if the load were coming from a smaller mine that did not have a designated dumping point on the platform. Upon leaving the pad, these trucks would be washed at the on-site truck wash facility and screened for radiation prior to leaving the Site. When a haul truck needs to be released from dedicated ore haulage for maintenance or for other hauling activities, it would be required to pass through the truck wash and pass required gamma screening and surface sampling and analysis prior to leaving the Site.

2.2.3.3 Mill

Milling is the term used to describe the grinding and further processing of ore to extract the valuable minerals from the host rock. At the Mill, ore would be ground into a fine slurry and then leached with sulfuric acid to increase the solubility of the uranium and vanadium. Uranium and vanadium would be recovered from solution and precipitated as uranium oxide (U_3O_8) concentrate (called yellowcake) and vanadium oxide (V_2O_5) concentrate, respectively. The Mill Facility would be designed to treat up to 500 tpd of ore and to produce both U_3O_8 and V_2O_5 over a 40 year operating life.

Figure 2.2-1 shows the proposed layout of the Mill. The primary mill buildings and their respective square feet (ft^2) of floor space are the semi-autogenous grinding (SAG) Mill/Leach Tank Building (22,000 ft^2), the Boiler Building (6,000 ft^2), the Solvent Extraction (SX) Building (49,000 ft^2) and the Drying/Packaging Building (46,000 ft^2). These buildings would have varying heights of up to 85 feet. The areas outside these buildings would be surfaced with gravel and sloped to drain. A detailed description of each of the primary milling stages can be found in the *Facility Operating Plan* (Visus and Energy Fuels, 2009a).

The proposed milling stages would include:

- Grinding;
- Pre-leaching and Thickening;
- Leaching;
- Liquid/Solid Separation and Purification;
- Uranium Recovery; and
- Vanadium Recovery.

Each milling stage and associated chemical reagent storage locations would incorporate secondary containment in the form of concrete curbs or stem walls that are designed to contain the contents of the largest tank or processing component plus 10 percent. Floor sumps would also be double contained and would have leak detection systems in place to alert operators if the primary sump enclosure were to develop a leak. Pipes not located within secondary containment walls would be enclosed within an outer pipe sleeve or a lined trench and would have leak-detection observation points. The following is a brief description of each primary component of the milling process. Figure 2.2-2, provides a process flowsheet as shown in the *Facility Operating Plan* (Visus and Energy Fuels, 2009a) which illustrates the milling and process stages.

Grinding. Run-of-mine ore would be fed into the Mill Facility from on-site stockpiles using a front-end loader and/or trucks. The ore would be dumped into a feed hopper and delivered by belt conveyor to a SAG Mill located in the main mill building (Grinding and Leaching Building). In the SAG Mill, the ore would be combined with water and tumbled with steel balls. The tumbling action causes the larger ore pieces and steel balls to grind the ore into fine powder, exposing the uranium and vanadium mineral surfaces of the host rock.

Pre-leaching and Thickening. The resulting slurry from the SAG Mill, consisting of 0.03-inch sized particles and water, would be distributed to one of two large pulp storage tanks located outside in the area west of the Grinding and Leaching Building. The slurry would be pumped from the storage tanks to two pre-leach tanks where the pulp is mixed with the pregnant solution from the counter current decantation (CCD) thickeners, which carries excess sulfuric acid that starts the leaching process. The pulp would then report to a thickener tank. The overflow from

This figure is based on the
Facility Operating Plan (Visus and Energy Fuels, 2009a).

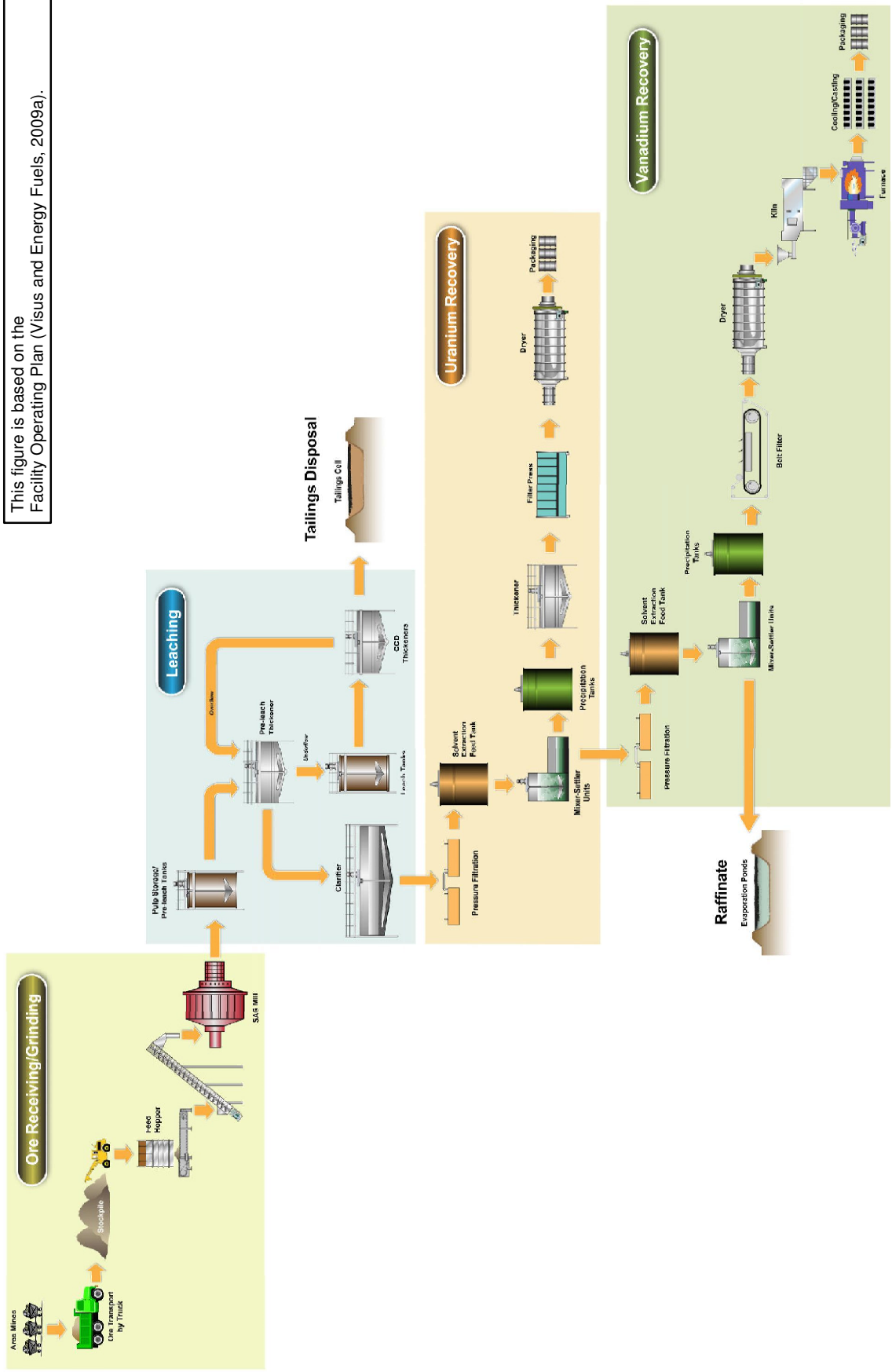


Figure 2.2-2

Process Flow

the thickener would be clarified, filtered, and sent to a feed tank for use in the uranium recovery circuit. The partially dewatered underflow from the thickener would be pumped to the leaching circuit.

Leaching. The leach circuit, located in the Grinding and Leaching Building, would consist of eight rubber-lined steel tanks with agitators. The tanks would be arranged in a cascading and staggered configuration so that individual tanks could be bypassed if necessary. In the leaching circuit, the pulp pumped from the pre-leach thickener tank would be heated with steam and then leached with sulfuric acid to dissolve the uranium and vanadium minerals. Sodium chlorate would be added as an oxidant, as necessary.

Liquid/Solid Separation and Purification. The leached pulp would be pumped to a series of 40-foot diameter CCD thickeners, where liquids and solids would be separated. The CCD thickener tanks would be located outside, on the north side of the Grinding and Leaching Building, and the CCD Thickener Building would run between the two rows of tanks. The uranium- and vanadium-bearing (or pregnant) solution would be separated from the remaining solids, called tailings, which consist of fine-grained sands mixed with low pH process water. The tailings also include low levels of radioactive elements that were present in the original ore. The pregnant solution would be pumped to the pre-leach tanks and subsequently to the uranium recovery feed tank while the tailings would be mixed with barren raffinate (i.e., wastewater) from the vanadium recovery circuit and pumped to the tailings cell.

Uranium Recovery. The uranium SX circuit would be located in the Solvent Extraction Building. In the SX process, the pregnant solution would be filtered and the uranium separated and concentrated using a kerosene-based solvent. The result is a pure, but weak, uranium solution. The uranium would be stripped from the solvent and concentrated using a sodium carbonate solution. The stripped solution would then be pumped to the Precipitation and Packaging Building, where the uranium would be continuously precipitated by adding hydrogen peroxide to the solution. The uranium would precipitate as a bright yellow powder referred to as yellowcake. The powder would be partially dewatered, washed, filtered, and dried in a zero-discharge vacuum dryer. Finally, the dried yellowcake would be packed, weighed, and sealed in USDOT-approved 55-gallon, steel drums for shipment. Each packed drum would weigh approximately 900 pounds. At an ore processing rate of 500 tpd, an average ore grade of 0.23 percent U_3O_8, and a 96 percent recovery rate, approximately 2,200 pounds of yellowcake (or 2.5 drums) would be produced per day.

Uranium Shipments. The drums of yellowcake would be shipped to a conversion plant by a USDOT-approved transportation contractor where the uranium would be converted to uranium hexafluoride, which can be enriched for use in nuclear power plants. Conversion plants currently in operation include the ConverDyn facility in Metropolis, Illinois, the Cameco facility in Port Hope, Ontario, and several more facilities in both France and Great Britain. Shipments to the North American facilities would be via trucks licensed to transport low-level radioactive material. Shipments overseas would require truck transport to a port, followed by ship transport. Typically, a transport truck can carry 25 to 27 tons of cargo, or up to approximately 55 to 60 drums of yellowcake. Approximately 15 truckloads of yellowcake would be shipped from the Mill Facility per year in accordance with USDOT regulations.

Vanadium Recovery. When uranium/vanadium ores are treated, the portion of the solution that remains after the uranium minerals have been recovered (i.e., the raffinate solution) would be prepared for vanadium recovery by oxidizing the vanadium ion species in solution with the addition of sodium chlorate, and reducing the acid concentration slightly by the addition of

ammonia. In a similar fashion to the uranium recovery process discussed above, the vanadium circuit would use an SX process to recover vanadium. The barren raffinate from the vanadium circuit would be pumped to the CCD circuit for use in transporting the tailings to the tailings cell or to the evaporation pond for disposal.

The vanadium SX circuit would be located in the Solvent Extraction Building. The vanadium would be precipitated by adding ammonium sulfate to the stripping fluid within the Precipitation and Packaging Building. The precipitate would be dewatered, dried, and removed of ammonium in a kiln. The V_2O_5 discharging from the kiln would be melted in a furnace and solidified into a black-flake product, which would be packed, weighed, and sealed in 55-gallon, steel drums for shipment. Each packed drum would weigh approximately 570 pounds. At an ore processing rate of 500 tpd, an average ore grade of 0.92 percent V_2O_5, and an 80 percent recovery rate, approximately 7,300 pounds of V_2O_5 (or 13 drums) would be produced per day.

Vanadium Shipments. The drums of V_2O_5 would be shipped via truck to a plant that produces ferro-vanadium products. Two of the larger of such plants include the Stratcor plant in Hot Springs, Arkansas and the Bear Metallurgical plant in Butler, Pennsylvania. Approximately 50 truckloads of V_2O_5 (which is not radioactive) would be shipped from the Mill Facility annually in accordance with USDOT regulations.

2.2.3.4 Waste Management Facilities

Following the extraction and recovery of the uranium and vanadium from the ore, the remaining waste products from the milling operation, which are classified as “11e.(2) byproduct material,” would be disposed of on-site, in engineered facilities designed to protect the environment. These facilities are designed to contain 40 years of waste material at a milling rate of 500 tpd. According to Section 11e.(2) of the Atomic Energy Act (as revised in 1978 and in 2005 by the Energy Policy Act), byproduct material is defined as “the tailings or waste produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content.” Byproduct material is not considered a hazardous waste under EPA regulations. To be a hazardous waste, material must first be classified as a solid waste by EPA. Under the Resource Conservation and Recovery Act (RCRA) regulation 40 CFR 261.4(a)(4), source, special nuclear, or byproduct material as defined by the Atomic Energy Act is excluded from the definition of solid waste. Byproduct material was excluded from EPA’s RCRA regulations because the NRC adopted regulatory standards developed by EPA that were specific to tailings disposal operations (see Appendix A).

Tailing Cells. After extraction of the uranium, the finely ground byproduct (called tailings or 11e.(2) byproduct material) would be mixed with barren raffinate from the vanadium SX circuit and pumped as a slurry through a pipeline to a tailings cell for deposition, dewatering, and permanent disposal. The tailings consist of all materials remaining in the ore following the extraction of uranium and vanadium. The main radioactive materials remaining in the tailings would be Thorium-230 and Radium-226.

The National Emission Standards for Hazardous Air Pollutants (NESHAPs), 40 CFR 61, limits disposal in lined tailings cells to:

> (1) "Phased disposal in lined tailings impoundments that are no more than 40 acres in area and meet the requirements of 40 CFR 192.32(a) as determined by the Nuclear Regulatory Commission. The owner or operator shall have no more than two impoundments, including existing impoundments, in operation at any one time," or

(2) "Continuous disposal of tailings such that tailings are dewatered and immediately disposed with no more than 10 acres uncovered at any time and operated in accordance with §192.32(a) as determined by the Nuclear Regulatory Commission."

Energy Fuels would implement phased disposal, as described in alternative 1 above. Detailed design of the Mill Facility tailings cells is included in the *Tailings Cell Design Report* (Golder, 2008a). The tailings cells have been designed in accordance with 6 CCR 1007-1, Part 18, Appendix A (CDPHE, 2001) and 40 CFR Parts 264 Subpart K and 192 Subpart D. The tailings cells would be synthetically-lined impoundments constructed predominately below ground level, covering approximately 30 acres each. A total of three tailings cells (Cells A, B, and C), each with a capacity of 2.3 million tons, would be required to store the tailings over a 40-year operating life. No more than two tailings cells, each not more than 30 acres, would be in operation or otherwise uncovered at any time. The tailings cells would be closed and covered in phases as well, in accordance with Criteria 6(3) and 6A(1) of Appendix A, 6 CCR 1007-1, Part 18 (CDPHE, 2001). The cells would be covered in the same order as they were initially constructed – Cell A, then B, and finally C. Cell A would be closed prior to initiating operations in Cell C. Therefore, not more than two 30-acre cells would be in operation at any time.

The design capacity of each cell would incorporate adequate vertical distance (freeboard) between the top elevation of the tailings material and the top elevation of the cell embankment. Cell A has been divided into two subcells (Cells A1 and A2) to provide operational flexibility in discharging tailings to the facility. Similar subcells may be constructed in Cell B and Cell C. After the tailings slurry is discharged to a cell, the sands settle and the majority of the process water would be recovered by a floating barge-mounted pump. The recovered water would be returned to the mill for reuse. Each cell or subcell would have an underdrain system designed to recover any water percolating through the sands and not recovered by the pump system. The water pool that collects on top of a tailings cell would be covered with floating plastic balls (a.k.a., bird balls) to deter birds and bats from landing on or drinking the process water.

Once a tailings cell reaches full capacity, the entire cell would be covered with an engineered cap consisting of soils derived from on-site excavation and imported rock aggregate products (see Section 2.2.7, Closure). The tailings cell covers have been designed to meet or exceed Criterion 6 of 6 CCR 1007-1, Part 18, Appendix A (CDPHE, 2001) of Colorado's Radiation Management Program's regulations. The design includes a thick soil radon barrier that reduces radioactivity levels at the cover's surface to prescribed levels and gradual, armored surficial slopes and drainages that are resistant to erosion. Additional details regarding closure are included in Section 2.2.7.

The tailings cell design, shown in Figure 2.2-3, utilizes a double layer liner system with an intervening Leak Collection and Recovery System (LCRS) underlain by a third composite clay/synthetic liner. The liner system consists of the following components (from top to bottom):

Upper (Primary) Liner: The upper primary liner would consist of a textured 60-mil HDPE (high density polyethylene) geomembrane. An HDPE geomembrane liner was chosen for its long-term performance characteristics. It has excellent chemical resistance properties, resistance to ultraviolet (UV) radiation, high tensile strength, and high stress-crack resistance (Lupo & Morrison, 2005). Textured rubsheets would be extrusion welded over the top of the primary liner in high use areas (e.g., under tailings lines and walkways) to provide extra protection of the liner.

This figure is based on the Tailings Design Report (Golder, 2008a).

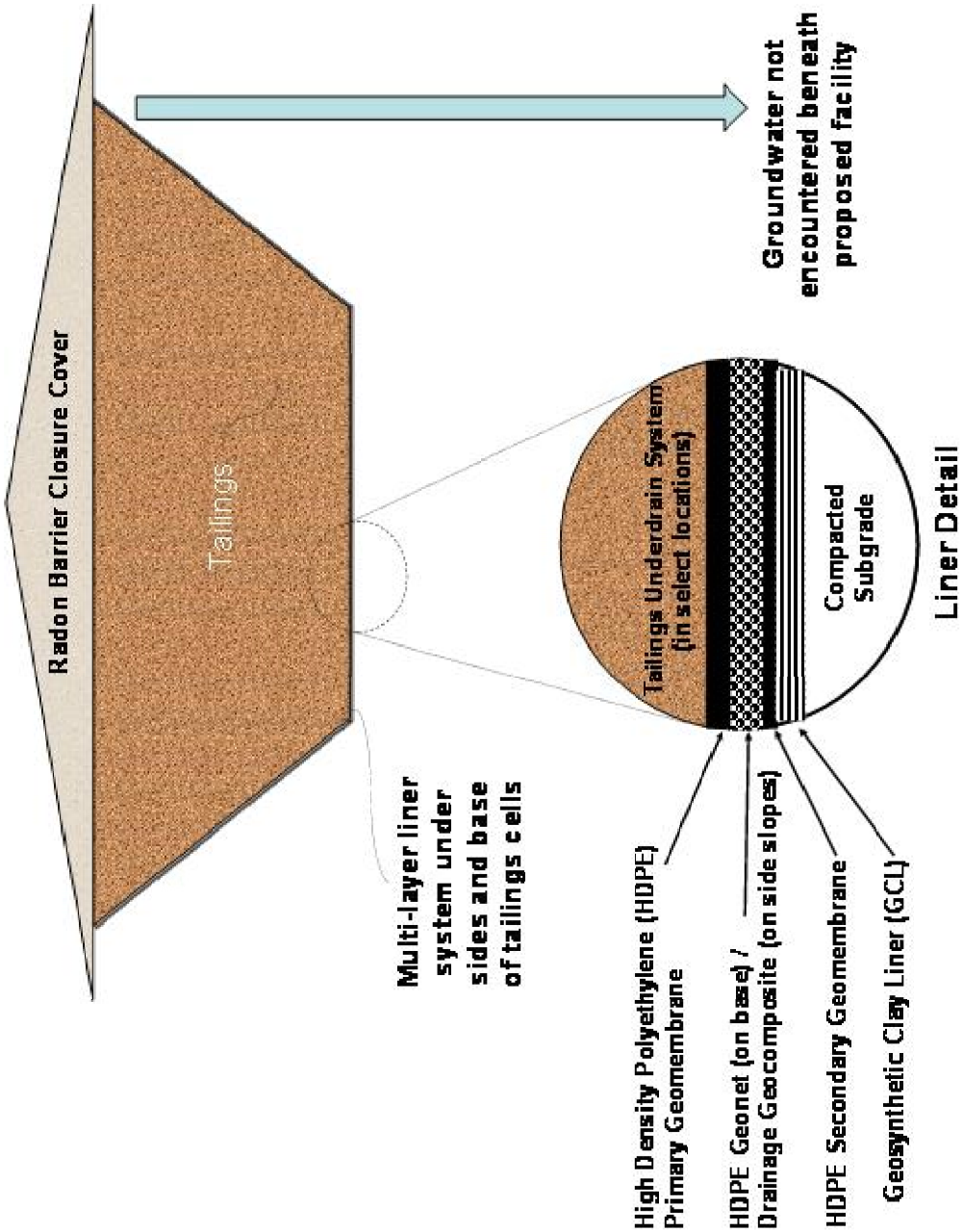


Figure 2.2-3

Tailings Cell Liner Concept

Leak Collection and Recovery System (LCRS): An important feature of the tailings cell liner system is the LCRS layer, designed per 40 CFR 264.221 (by reference from 10 CFR 40 and 6 CCR 1007-1, Part 18). The LCRS is designed to minimize the hydraulic heads on the lower geomembrane liner by utilization of HDPE geonet in the base of the tailings cells and a drainage geocomposite on the side slopes. In the event that leakage occurs through the upper geomembrane liner, it would be collected in the LCRS layer and routed (via gravity flow) to a LCRS sump. The LCRS sump would be inspected and pumped out, as needed, on a routine basis.

Lower (Secondary) Composite Liner System: Beneath the LCRS layer is a 60 mil HDPE geomembrane liner. This liner provides secondary containment of process solutions should leakage occur through the upper primary geomembrane liner. Because of the LCRS, minimal hydraulic head would be expected on the secondary liner.

Geosynthetic Clay Line (GCL): The lower secondary geomembrane liner would be underlain by a GCL, which consists of a layer of sodium bentonite encapsulated between two geotextiles with an upper woven geotextile and lower nonwoven geotextile, needle-punched together to form a hydraulic barrier material. The GCL would have a very low hydraulic conductivity of $5x10^{-9}$ centimeters per second (cm/sec) and would be constructed on top of a smooth and compacted subgrade. Compatibility testing of the proposed GCL with strong acid solutions (pH less than 2 standard units) indicated that tailings leachate would not significantly increase the permeability on the liner system.

Evaporation Ponds. The portion of the solution that remains after the vanadium minerals have been recovered (i.e., the barren raffinate solution) would be pumped to the CCD circuit to decrease the density of the tailings, which would enable pumping of the tailings to the tailings cells. Excess raffinate solution (an estimated 63 gpm) would be pumped to a series of connected, shallow pond cells for evaporation. The raffinate solution would contain high levels of salts that could not be economically recycled. The initial, total lined evaporation pond area would be 40 acres. Evaporation of the raffinate solution would be enhanced by mechanical means (i.e., the use of bubblers, fountains, or misters) within the central area of the ponds. As evaporation ponds fill with salts, new ponds would be constructed thus increasing the evaporation pond area to 80 acres over the life of the Mill Facility. Filled ponds would be closed by placing the liners and pond contents in a tailings cell.

The evaporation pond liner systems would be identical to the tailings cell liner systems with a LCRS between a primary and secondary liner, all underlain by a GCL on a prepared subgrade. Each of the 4-acre ponds would be equipped with its own LCRS that would be checked on a routine basis, and pumped out as necessary (Golder, 2008a). In the event that one or more ponds lose their water cover from evaporation during the summer months, raffinate solution from the other ponds would be sprayed over the exposed salts to keep them from drying out. The ponds would be covered with woven bird netting to exclude access to birds and bats.

2.2.3.5 Ancillary Facilities

Access. The access point to the Site is located near milepost 23 on SH 90. A road would be constructed to provide access to the Mill Facility from SH 90. The first 150 feet of the road would be asphalt and the remainder would be gravel. Gravel roads branching off the main access road would provide access to the ore pad and Administration Building. Secondary dirt or gravel roads would be constructed to provide access to all facility locations (e.g., tailings cells, evaporation ponds, water well field, etc.).

Energy Fuels commissioned a study to assess future traffic conditions at the Site access point along SH 90 in consideration of new traffic during construction and operation (TurnKey Consulting, LLC – TurnKey, 2008). Based on the results of the assessment and in accordance with CDOT criteria, a left-turn deceleration lane for westbound traffic on SH 90 would be constructed so that the Proposed Action would provide for safe ingress and egress. A 10-foot wide shoulder would be constructed along the south side (eastbound side) of SH 90, east of the Site access point. SH 90 would be widened along a length of approximately 2,175 feet to accommodate these improvements. Additional warning signs may be placed along the highway on either side of the access point to warn vehicles of the truck traffic.

Buildings and Parking. The following discussion describes the preliminary designs for the proposed on-site buildings and parking facilities. Detailed building and parking designs would be submitted to the Montrose County Building Department for review and approval prior to construction.

Administration Building Energy Fuels would construct a 9,000 ft^2, single-story building to house its office facilities for both milling and mining personnel. The building would be configured to allow for a 5,000 ft^2 future expansion if necessary. The Administration Building would accommodate approximately 26 offices/work areas, three conference rooms, a training room, break room, storage, and restroom facilities. The building design includes a garage for the on-site ambulance.

Secondary Mill Buildings Several metal buildings located next to the primary process facilities would support milling operations. These buildings include the Warehouse (10,000 ft^2), Laboratory/Change Room/Mill Offices Building (22,000 ft^2) and the Truck Maintenance Building (6,000 ft^2).

Access to the Mill Facility would be limited to mill employees and authorized visitors. All personnel would be required to enter and exit the Mill License Boundary through the Laboratory/Change Room/Mill Offices Building, where they would receive necessary information and training and would formally check in and check out. Radiation screening of all personnel and visitors would be required upon check out.

Parking Montrose County development standards require 62 spaces for a “professional office” building having 9,000 ft^2 of gross floor area, and four disabled accessible spaces, including one van-accessible space, for a parking lot with 51 to 75 regular spaces. Therefore, the preliminary parking lot design for the Administration Building provides 62 regular spaces, three disabled accessible spaces, and one van-accessible space. The parking lot would be surfaced with gravel with the exception of the disabled accessible parking area, which would be paved with asphaltic concrete.

Power and Heating Systems. Electric power to the Mill Facility would be supplied via an existing 69 kilovolt (kV) overhead transmission line or an existing 26.5 kV distribution line paralleling SH 90. A new overhead powerline connecting the existing line to the Mill Facility would be installed via the utility corridor on the east edge of the Property Boundary. The power company would construct and own the required on-site substation, from which power would be transformed to 4.16 kV for the Mill and 13.8 volts for the Administration Building. A 4.16 kV (2,000 kilowatt) diesel-powered generator, located at the Mill, would provide backup power to operate the critical mill facilities during line outages.

Small (500 to 2,000 ft^2) concrete block electrical rooms would be constructed at each of the primary mill buildings to house the electrical breakers for the various pumps, mixers and other mill equipment. These rooms would be equipped with air conditioning units to maintain positive pressure in the rooms.

Propane would be used to heat the Administration Building and mill buildings, and either propane or electricity would be used to heat the steam boilers used in the processing circuit. A natural gas line may be installed to the mill later if the operating income of the Mill justifies the added capital cost of installing 6 to 7 miles of new feeder line.

Fueling Station. Diesel and gasoline would be stored north of the Truck Shop and just outside the Mill License Boundary. The diesel and gasoline storage tanks would have 12,000-gallon and 2,000-gallon capacities, respectively. The double-walled storage tanks would be situated within a common concrete containment area (reinforced concrete pad and walls) provided with a floor sump. Concrete aprons would extend out from the concrete containment on both the east and west sides. The aprons would drain back into the containment area and provide secondary containment during transfer of fuel into and out of the storage tanks.

Transfer pumps, located within the concrete containment, would transfer diesel from the storage tank to the day tanks provided for the standby generator and the firewater pump and to two fueling stations (one inside the Mill License Boundary and one outside the Mill License Boundary). A third pump would transfer gasoline to two gasoline fueling stations that would be co-located with the diesel fueling stations. The gasoline and diesel fueling stations would be located within the concrete apron areas and would be used to refuel vehicles, heavy equipment (including the front-end loader), and miscellaneous small equipment. In most cases, a maintenance truck would be filled at the pump station and used to transport fuel to the larger pieces of equipment. System controls at the gasoline storage area would focus on the safe unloading of fuel, and preventing and containing spillage during offloading activities in accordance with the *Material Containment Plan* (Energy Fuels, 2009c) and the *SPCC Plan* (Energy Fuels, 2009b).

Water Supply. The estimated average water requirement for the Proposed Action is 144 gpm to support the milling process, dust suppression requirements, washrooms, truck wash, fire suppression systems, and other miscellaneous uses. Of this, it is estimated that 130 gpm would be required for mill process water, 11 gpm would be required for dust suppression/truck was/fire suppression, and 3 gpm of potable water would be required. Most of the water would be used for processing purposes even though process water would be recycled wherever feasible to minimize consumption.

<u>Primary Water Supply</u> Energy Fuels plans to pump water from five or more production wells located on the south end of the Site and on adjoining private property to the west. The sustainable pumping rate for these wells has been estimated to be between 100 to 175 gpm. Water would be pumped from the supply wells to a 320,000-gallon raw water storage tank which would supply water to process components, dust suppression systems at the ore pad facility, the truck wash, fire hydrants, and water trucks. Three of the planned wells have been permitted and completed. Eastern Paradox Valley, where the Site is located, is designated by the Colorado Division of Water Resources as a non-critical area; therefore, neither augmentation nor a water right is required to use the water. However, Energy Fuels applied for water rights for the existing and future production wells in November 2009 to secure a priority for these wells (Energy Fuels, 2009a). Surface water rights for the direct precipitation falling on the zero-

discharge portions of the Site (see stormwater above) were also included in the water rights application.

The groundwater in the production wells is suitable for most processing and dust suppression applications as it has a pH between 7 and 8 standard units and a total dissolved solids (TDS) concentration between 800 and 1,000 parts per million (ppm). The groundwater does not meet state and federal drinking water standards and would need to be treated before it could be used for potable purposes.

Naturita Non-Potable Contingency Water Supply A contingency water supply has been identified in the event that the on-site water supply cannot sustain the required 141 gpm of non-potable water needed for mill operations. An agreement has been made with the Town of Naturita to purchase raw untreated water from the town. The Town of Naturita's water originates from the San Miguel River and is of relatively good quality (neutral pH and low TDS levels) and would be suitable for mill use. The agreement allows for the purchase of up to 150,000 gallons per 24-hour period (equivalent to 104 gpm) for a period of 40 years, commencing in 2011, the anticipated start-up date of the Mill Facility. The untreated water would be obtained from the Old Water Treatment Plant and trucked to the mill in 5,500-gallon water trucks. The proposed haul route from Naturita to the Mill Facility is 14 miles in length.

Potable Water Potable water would be stored in a tank at the Administration Building and at the Mill. The tanks would be constructed of suitable material and would be appropriately sized for the expected usage. Treated potable water would be purchased and loaded out at the Naturita Town Hall, located on SH 141, and trucked to the Site. Assuming an average consumption of 30,000 gallons of potable water per week and a load limit of 5,500 gallons of water, an average of 5 to 6 truckloads of water would be required per week.

Septic Systems. The Administration Building would have restroom and shower facilities and the Mill would have a restroom, shower facilities, and laboratory sinks. The shower stalls would be located in the Administration Building and Mill change rooms. Effluent from the commodes and urinals would flow by gravity to engineered leach field septic systems designed according to state and county health and sanitation requirements for sewage disposal. Separate septic systems would be required for the Mill and Administration Building. Effluent from sinks and other drain systems would, if approved by the county and state, be recycled as part of a gray water system.

Stormwater Systems. The Mill, ore pad, tailings cells, and evaporation ponds would be designed as "zero discharge" facilities. Precipitation and stormwater runoff that would contact these areas would be contained on-site in lined ponds or cells and recycled for use in the Mill. Precipitation and runoff from the surrounding undisturbed/unimproved areas would be diverted around these areas into the existing drainage network. Stormwater runoff from the Administration Building and other site structures not within the footprint of the zero-discharge area (e.g., monitoring stations, water supply well field, secondary roads) would be handled using best management practices (BMPs) for stormwater and erosion control. These measures may include surface water diversion channels, energy dissipating structures, slope protection and sediment catchment basins. The CDPHE Water Quality Control Division regulates stormwater discharges during construction and requires that a Stormwater Management Plan be prepared and implemented during construction under a general construction discharge permit. A discharge permit is not required for operations because Energy Fuels has designed the Mill Facility so that all direct precipitation and runoff is contained on site and recycled or evaporated. Energy Fuels has, however, prepared and would implement measures included in

their *Stormwater Management Plan* for the Site (Golder, 2009a), which includes monitoring of contained and diverted stormwater.

Security Systems. The Property Boundary would be fenced with barbed wire and posted with no-trespassing (and no-hunting) signs to allow for livestock grazing on adjacent property. CDPHE would require that the portion of the Site that is licensed for uranium processing (the Mill License Boundary) be surrounded by chain-link fence topped with barbed wire. This security fence would be posted with warning signs indicating that unauthorized access is not allowed and points of access would be strictly controlled. A secondary road would be constructed around the perimeter of the fence to allow for daily security inspections. Energy Fuels has prepared and would follow their *Security Plan* (Energy Fuels, 2009i) which described security procedures for the Site.

A guardhouse would be installed near the entrance of the Site for the inspection and control of traffic entering the Mill Facility. The guardhouse would be manned 24 hours per day, 7 days per week. Only authorized personnel and vehicles would be allowed to continue beyond the gate to the mill area. Visitors would be directed to the Administration Building where they would receive training and instruction regarding on-site procedures and potential hazards, prior to being escorted on site by mill personnel. Ore deliveries would be directed to a truck scale and then to either the ore pad dumping platform or directly onto the ore pad. Delivery of process reagents and fuel would be directed to the south and west sides of the mill to either the Reagent Unloading Areas or warehouse, as appropriate. These vehicles would not be allowed to enter the area within the Mill License Boundary, which corresponds to the licensed portion of the site where access is controlled and potential radiation exposure is closely monitored.

Access to the area within the Mill License Boundary would be limited to mill employees and authorized visitors. All personnel would enter the Mill through the Laboratory/Change Room/Mill Offices Building where they would be required to check in and put on radiation badges before entering the area within the Mill License Boundary. Upon exiting the Mill License Boundary, employees and visitors would be scanned with a handheld gamma meter before they could check out. If the scanned readings indicate radioactivity above background levels, the individual would be required to clean their clothes (typically shoes) and/or shower before being rescanned.

Emergency Management. A firewater system, with hydrants and wheel-mounted hose reels at key locations would be constructed as a component of the overall fire protection system. The raw water storage tank or a separate tank dedicated to fire protection would feed the firewater system. Buildings would be equipped with sprinkler systems and fire extinguishers in accordance with building codes and county requirements.

Energy Fuels has prepared an *Emergency Response Plan* (Energy Fuels, 2009e) in accordance with 6 CCR 1007-1, Part 3 (CDPHE, 2005a) and the Federal Mine Safety and Health Act of 1977 (as amended by the Improvement and New Emergency Response Act of 2006 - Public Law 109-236). Because of potential radiation emissions associated with an emergency, Energy Fuels anticipates that most emergency response actions would be handled by trained employees under the direction of the Mill Incident Commander (typically the shift Mill Foreman). The facility's Radiation Safety Officer (RSO) and other members of the Safety Department would provide health and safety support during an emergency. The preliminary *Emergency Response Plan* (Energy Fuels, 2009e) has been developed in consultation with local law enforcement agencies and fire departments and would be further refined with local agency input prior to facility startup so that the roles of all involved personnel would be clearly defined, potential chemical and radiation risks would be quantified and adequate equipment would be

available to support emergency response efforts. Additional information regarding local law enforcement and fire department capabilities is provided in the Section 3.10, Socioeconomics.

The trucking companies transporting ore, chemical reagents, and fuel to the Mill Facility and yellowcake and vanadium oxide from the Mill Facility to other processing facilities would be required under USDOT regulations to have an emergency response plan in place for responding to accidents and cargo spills. As part of its contracting program, Energy Fuels would verify that these plans are in place and anticipates that carriers of ore, yellowcake. and other low-level radiation shipments would incorporate the Energy Fuels emergency response teams into their emergency management planning. The Energy Fuels response teams would have expertise in radiation control and would have the necessary specialized monitoring equipment that is generally not available to most law enforcement agencies, fire departments, and other first responders. In the event of a cargo spill of ore or yellowcake, Energy Fuels would also provide post-remediation sampling to verify that the spill cleanup met appropriate regulatory standards.

2.2.4 Schedule

Pending approval by Montrose County and CDPHE, construction would begin in the third quarter of 2010 and continue for 21 months through the first quarter of 2012. Any construction occurring prior to license approval would be limited to the portion of the property outside of the Mill License Boundary (e.g., improved highway access, main access road, well field). The Mill is scheduled to begin operations in the first quarter of 2012 and has an expected operational life of 40 years. Upon termination of operations, the Mill would be decommissioned and closed in compliance with CDPHE requirements and relevant NRC guidance. Once NRC concurs with the State of Colorado's determination that decommissioning is complete, the Site would be transferred to either DOE or the State of Colorado for long-term surveillance and monitoring. Decommissioning activities would continue for approximately 3 years and post-closure monitoring would be conducted for approximately another 5 years until final license termination.

2.2.5 Workforce

Construction of ancillary site facilities during the first two quarters of construction would require between 25 and 45 workers. Mill construction would begin in the first quarter of 2011 and continue through the end of the year, requiring between 125 and 200 workers. Upon opening in the first quarter of 2012, the Mill would employ 25 workers working a straight-day (8-hour) schedule 5 days per week. The Mill would employ another 60 shift workers. Four 15-man crews would work 8-hour shifts, 24 hours per day, 7 days per week.

2.2.6 Traffic

Traffic to and from the Mill Facility would consist of employees traveling to and from work and trucks hauling ore and other materials to the Site. During the first 6 months of construction, between 13 and 23 light vehicles, and 13 trucks hauling materials and equipment, would access the Site per day. During peak construction periods, approximately 100 light vehicles and between 10 and 17 trucks would access the Site daily (see Table 2.2-2).

During operations, between 21 and 29 trucks ore-hauling trucks and approximately 28 light vehicles with commuting workers would access the Site daily. Additional traffic during operations would include water trucks, miscellaneous deliveries, and visitors. Table 2.2-3 shows the average number of vehicles that would travel to the site daily during operations.

Table 2.2-2
Workforce and Traffic Associated with Mill Construction
(Number of Workers and Vehicles per day)

Calendar Quarter	Work Quarter	Construction Workers[1]	Construction Traffic	
			Light Vehicles[2]	Heavy Vehicles[3]
3rd Qtr 2010	1	25	13	13
4th Qtr 2010	2	45	23	13
1st Qtr 2011	3	125	63	9
2nd Qtr 2011	4	200	100	17
3rd Qtr 2011	5	200	100	10
4th Qtr 2011	6	150	75	12
1st Qtr 2012	7	10	5	1

[1] *Construction Plan* (Golder, 2009b).
[2] Light vehicle traffic includes one vehicle for every two workers (Filas, 2009).
[3] Based on material deliveries per quarter – *Construction Plan* (Golder, 2009b).

Table 2.2-3
Workforce and Traffic Associated with Mill Operations
(Number of Workers and Vehicles per day)

Traffic Type	Days/ Week	Operational Workers[1]	Light Vehicles	Heavy Vehicles
Ore deliveries[2]	7	NA	0	21 to 29
Straight-day workers[3]	5	25	13	0
Shift workers[4]	7	60	15	0
Water trucks[5]	5	NA	0	11
Misc. delivery traffic[6]	5	NA	3	0
Reagent and Fuel Deliveries[7]	5	NA	0	8
Visitor traffic[8]	5	NA	10	0

[1] Worker traffic estimates apply to direct mill employees only. NA = not applicable.
[2] *Mine Operations Plan* (Energy Fuels, 2009d).
[3] Assumes one light vehicle for every two workers (Filas, 2009).
[4] Assumes three 15 man shifts per day, and one light vehicle for every three workers (Filas, 2009).
[5] Assumes six deliveries per week of potable water and seven deliveries per week of non-potable from Naturita - *Water and Wastewater Plan* (Energy Fuels, 2009f)
[6] Includes smaller shipments of materials and parts *Special Use Permit Application* (Visus, 2009).
[7] *Special Use Permit Application* (Visus, 2009).
[8] Filas, 2008.

2.2.7 Closure

Once the Mill is no longer operating, closure and reclamation of the Mill Facility would begin. Closure and reclamation activities would take place approximately over a 3-year period. It is expected that post-closure monitoring and maintenance would be required for a period of approximately 5 years beyond reclamation before the site can be transferred to the State of Colorado or the DOE for long-term surveillance and monitoring.

The closure objectives for the Mill Facility are to establish a long-term stable land configuration with a self-sustaining ecosystem and to provide for environmental protection and public safety. The majority of the Site would be returned to rangeland use, with the exception of the tailings

cells, which would be capped with an engineered soil cover and transferred to the State of Colorado or DOE for long-term surveillance and monitoring pursuant to Section 83 of the Atomic Energy Act, as amended. Energy Fuels would provide adequate financial assurance in accordance with the closure and reclamation plans approved by the State of Colorado as required by 6 CCR 1007-1, Part 18, Appendix A (CDPHE, 2001).

A preliminary *Mill Decommissioning Plan* (Kleinfelder, 2009b) has been prepared and a detailed Decommissioning Plan would be prepared prior to closure based on the site-specific conditions and the regulatory requirements that exist at that time. The Site would be decommissioned in accordance with applicable State of Colorado regulations and the NRC technical guidance documents. State requirements for decommissioning are contained in 6 CCR 1007-1, Part 3, RH 3.16.4 and in 6 CCR 1007-1, Part 18, RH18.3.1.5, RH 18.8 (Decommissioning Requirements) and in Criteria 5A, 6(6) and 6(7) of Appendix A thereto. Beyond these general requirements for decommissioning, the State of Colorado has no additional regulatory guidance of its own for mill decommissioning. More detailed guidance for decommissioning plans is provided by the NRC in NUREG-1757, Vol. 1 (NRC, 2006) and in NUREG-1620 (NRC, 2003b), as well as Regulatory Guide 4.14 (NRC, 1980a).

The *Tailing Cell Closure Design Report* (Kleinfelder, 2009c) addresses the requirement to design and construct a cover over the mill tailings that would satisfy the criteria contained in Appendix A of 6 CCR 1007-1, Part 18 (Criteria Relating to the Operation of Mills and the Disposition of the Tailings or Wastes from these Operations – CDPHE, 2001). The tailings cells area would be decommissioned to provide long term stability for the tailings in accordance with 6 CCR 1007-1, Part 18, Appendix A, Criterion 6(6). The tailings cells would be covered to limit the release of radon to 20 picoCuries per meter squared per second (ρCi/m^2/s) averaged over the individual cell. All other areas within the Site would be restored to radium concentration limits above background of 5 picoCuries per gram (ρCi/g) in the top 15 centimeters (cm) of soil and 15 ρCi/g in 15 cm intervals below 15 cm depth. If required by CDPHE at the time of closure, Energy Fuels would also sample for other radionuclides. An evapo-transpiration (ET) cover would be constructed over the top of each tailings cells to limit the infiltration of precipitation and runoff. The ET cover would be constructed with gentle slopes (5 horizontal to 1 vertical (5H:1V) to 10H:1V) that would be armored with rock to provide “reasonable assurance of control of radiological hazards to be effective for 1,000 years, to the extent reasonably achievable, and, in any case, for at least 200 years (Appendix A, Criterion 6(1)).”

The Mill Facility is expected to operate for 40 years, but potentially could operate for a longer period depending on future market and other conditions. Decommissioning would begin after cessation of milling and is expected to be completed in 2.5 to 3 years. Post-decommissioning monitoring and maintenance would be conducted for a period of time after completion of decommissioning activities to verify that the site is stable and meets the State of Colorado’s and NRC’s requirements for the long-term surveillance and monitoring of the Site.

2.2.7.1 Detailed Decommissioning Plan

Energy Fuels would prepare a detailed Decommissioning Plan prior to decommissioning activities. The detailed plan would include the following: facility operating history, permits, work plans, waste handling plans, radiological surveys and sampling plans, health and safety operating protocols (both radiological and non-radiological), environmental monitoring and control, quality assurance, and completion reports.

2.2.7.2 Uncontaminated Systems, Equipment, and Structures

Upon permanent cessation of milling, the inventory and radiological assessment (surveying) of mill systems and equipment would be updated, following the procedures described in the *Decommissioning Plan* (Kleinfelder, 2009b) to show the levels of contamination. Based on the results of these surveys and the radiological release limits in effect at the time of decommissioning, the systems and equipment would be classified as uncontaminated or contaminated. Before any equipment, materials, and structures could be removed from the Mill Facility, appropriate screening procedures would be performed to demonstrate that such items are uncontaminated (radiological levels below release limits) and could be removed from the Mill Facility and sold, recycled for off-site use, or disposed of in accordance with regulatory requirements in effect at that time. Uncontaminated systems and equipment could include electrical controls, communications, water tanks and pumps, and similar equipment that have not been exposed to radiological materials. Equipment in the Reagents Area, Utilities and Buildings Area, and the General Plant are expected to be uncontaminated. All facilities outside of the Mill License Boundary, including the Administration Building, meteorological towers, air monitoring stations, the guard house, well field, and the main access road, are expected to be uncontaminated and to remain in service during and after decommissioning to support decommissioning activities and post-closure environmental monitoring.

After uncontaminated and decontaminated systems and equipment are removed from the Mill Facility, the systems and equipment that are known or very likely to be contaminated above release limits would be removed from the mill area and placed into the vault in Tailing Cell C, described in the *Tailing Cell Closure Design Report* (Kleinfelder, 2009c). Contaminated materials removed from the mill area would be transported within the Mill License Boundary over a temporary haulage/service road along the west side of the tailings cells. This road, originally a two-track dirt road used to access the Mill License Boundary fence and to service the pipeline from the west stormwater pond to the evaporation pond, would be improved as needed to support heavy equipment and trucks during all weather conditions. Improvements could include placement of additional granular fill, which could be obtained from uncontaminated fill used originally in the ore pad or mill pad. This fill could also be reused again in the closure of the vault in Tailing Cell C.

2.2.7.3 Contaminated Systems, Equipment, and Structures

Decontamination of equipment and removal and disposal of contaminated equipment would be done in accordance with written procedures documented and controlled by standard procedures or Radiation Work Permits (RWPs). Based on radiological surveys of these systems and equipment, it may be determined that some decontamination can be performed cost effectively, considering the remaining market value for re-use or sale. This would typically occur with equipment that has smooth surfaces that could be more easily cleaned. Such decontamination would be at Energy Fuels' discretion; otherwise, the contaminated system or equipment would be disposed of in the vault in Tailing Cell C.

The structures in the following areas are expected to be contaminated: ore storage pad, Grinding and Leach Building, CCD Thickener Building, SX Building, and Precipitation and Packaging Building. These structures would be decontaminated as necessary to facilitate safe handling and would be demolished using primarily mechanical methods, with specific equipment selected by the demolition contractor and Energy Fuels based on considerations of worker safety, protection against release of contaminants using As Low As Reasonably Achievable (ALARA) principles, and cost-effectiveness. Scaling and high-pressure washing might be employed to remove surface contamination. Large hydraulic shears and claws mounted on

crawler excavators are commonly used and are most likely to be selected by a contractor. As necessary for dust suppression, water sprays would be used; run-off (if any) from this activity would be collected in the stormwater ponds and discharged to the evaporation ponds.

Contaminated materials and equipment that are intended to leave the Site, both salvaged mill materials as well as equipment used in decommissioning, would be decontaminated before being released from the Site. Decontamination would occur at the truck decontamination station located at the northeast corner of the mill pad. Contaminated equipment and other materials remaining on the Site for disposal would be transported by truck along the service road to the vault for disposal. Foundations of structures and equipment would be removed and disposed of in the vault. The exception would be those foundations below uncontaminated structures and located in areas where the mill pad was cut or excavated below natural grade; these foundations may be left in place and covered during final site grading. Trucks and heavy equipment used for this purpose would remain within the Mill License Boundary until no longer needed, then the trucks and heavy equipment would be decontaminated and scanned before leaving Site.

2.2.7.4 Sequence of Removal of Systems, Equipment, and Structures

The sequence of removal of systems, equipment, and structures would be included in the detailed Decommissioning Plan, but in general, the sequence would be: waste materials, uncontaminated and decontaminated systems and equipment, uncontaminated structures, contaminated systems and equipment, contaminated structures, stormwater ponds and pipeline, and evaporation ponds. The truck decontamination station would remain in operation for this purpose for as long as necessary, and then would be removed with all materials going into the vault. A temporary decon station would be used as needed after the truck decontamination station is removed.

2.2.7.5 Soil Remediation

Soil remediation would occur in the following sequence after all equipment and structures have been removed: initial survey, soil clean-up, verification survey, final soil clean-up, and final closure of Tailing Cell C (cells A and B closed previously).

After demolition and removal of the Mill Facility (except for the environmental monitoring equipment, Administration Building, access roads, and well field), an initial gamma (direct radiation) survey would be performed (in accordance with 6 CCR 1007-1, Part 18, Appendix A, Criterion 6(6)) to evaluate potential areas where soil contamination might exceed background radium levels, based on gamma-radium correlations established in the *Baseline Radiological Investigation Report* (Environmental Restoration Group - ERG, 2009). This survey would occur on grids with 10-meter spacing across the “contaminated” systems and equipment areas, the evaporation ponds, main road, and the route of the haulage/service road along the west side of the tailings cells according to NUREG CR-5849 guidance (NRC, 1993). The haulage/service (service) road would follow the track of the dirt road used during operations for security patrol and maintenance of the pipeline to the evaporation pond.

Soil samples would be collected and tested at locations that register gamma readings that correlate with Radium-226 concentrations of more than 5 ρCi/g above background in the top 15 cm of soil and 15 ρCi/g in 15 cm intervals below 15 cm depth. Samples would be tested for concentrations in depth intervals of 0 to 15 cm and from below 15 cm. These locations would be cleaned up and resurveyed as needed to achieve levels not exceeding 5 ρCi/g of Radium-226 above background. The GPS-based gamma survey and soil sampling would occur along

transects spaced at approximately 10-meter intervals over and adjacent to: the ore storage pad, the grinding and leach building, the CCD thickeners and tailings pipeline, the Solvent Extraction Building, the Precipitation and Packaging Building, and the evaporation ponds.

The survey and sampling intervals would be 98 feet (30 meters) over other areas within and adjacent to the Mill License Boundary. Closer survey and sampling intervals would be applied to delineate the extent of contamination if detected within the 98-foot sampling intervals. If needed to assess potential doses from contaminated soil as a basis for making decisions about the extent of soil clean-up, the RESRAD Code would be used to estimate radiation doses and risks from residual radioactive materials in soils.

After soil clean-up has been performed and before final closure of Tailing Cell C, a verification survey would be performed on those areas that were used, and possibly contaminated, during decommissioning or that were found to have excessive Radium-226 levels in the soil during the initial surveys. The survey would be conducted on a 10-meter grid over the last evaporation pond not previously surveyed, the west service road from the Mill to Tailing Cell C, and any other areas over which demolition debris or contaminated soil was hauled.

With the precautions taken in the mill design, the *Facility Operating Plan* (Visus and Energy Fuels, 2009a), the *Operational Monitoring Plan* (Visus and Energy Fuels, 2009b), and the *Material Containment Plan* (Energy Fuels, 2009c), it is unlikely that conditions would develop during operations or upon decommissioning that would necessitate radium benchmark dose modeling, as described in NUREG-1620, Appendix H (NRC, 2003b). Therefore, radium benchmark dose modeling is not planned but would be performed in conjunction with the initial radiological survey, if required.

2.2.7.6 Tailings Cells

The *Tailing Cell Closure Design Report* (Kleinfelder, 2009c) addresses the requirement to design and construct a cover over the mill tailings that would satisfy the criteria contained in Appendix A of 6 CCR 1007-1, Part 18 (CDPHE, 2001). The tailings cell closure design is based primarily on performance objectives which include:

- Provide containment of 11e.(2) byproduct material for 200 years and, to the extent practicable, 1,000 years with no active maintenance or controls (Criterion 6(1)(i));
- Limit Radon flux from the entire cover surface to an average of <20 pCi/m^2/s (Criterion 6(1)(ii)); and
- Limit infiltration of moisture into, and release of contaminated liquid from, the tailings (Criteria 5B(1), 5E(3), 6(7), 7).

Secondary objectives include limiting the area of exposed tailings and facilitating progressive and expeditious closure (Criterion 6A (1)).

Tailings Cover Components. The tailings cover was designed to achieve the closure criteria and design objectives described above and in accordance with Appendix A of 6 CCR 1007-1, Part 18 (CDPHE, 2001). It would consist of multiple layers of natural earth materials, each layer designed for a particular function. The layers of the cover, from top to bottom, and the function of each is described below and is shown in Figure 2.2-4:

This figure is based on the Tailing Cell Closure Design Report (Kleinfelder, 2009c).

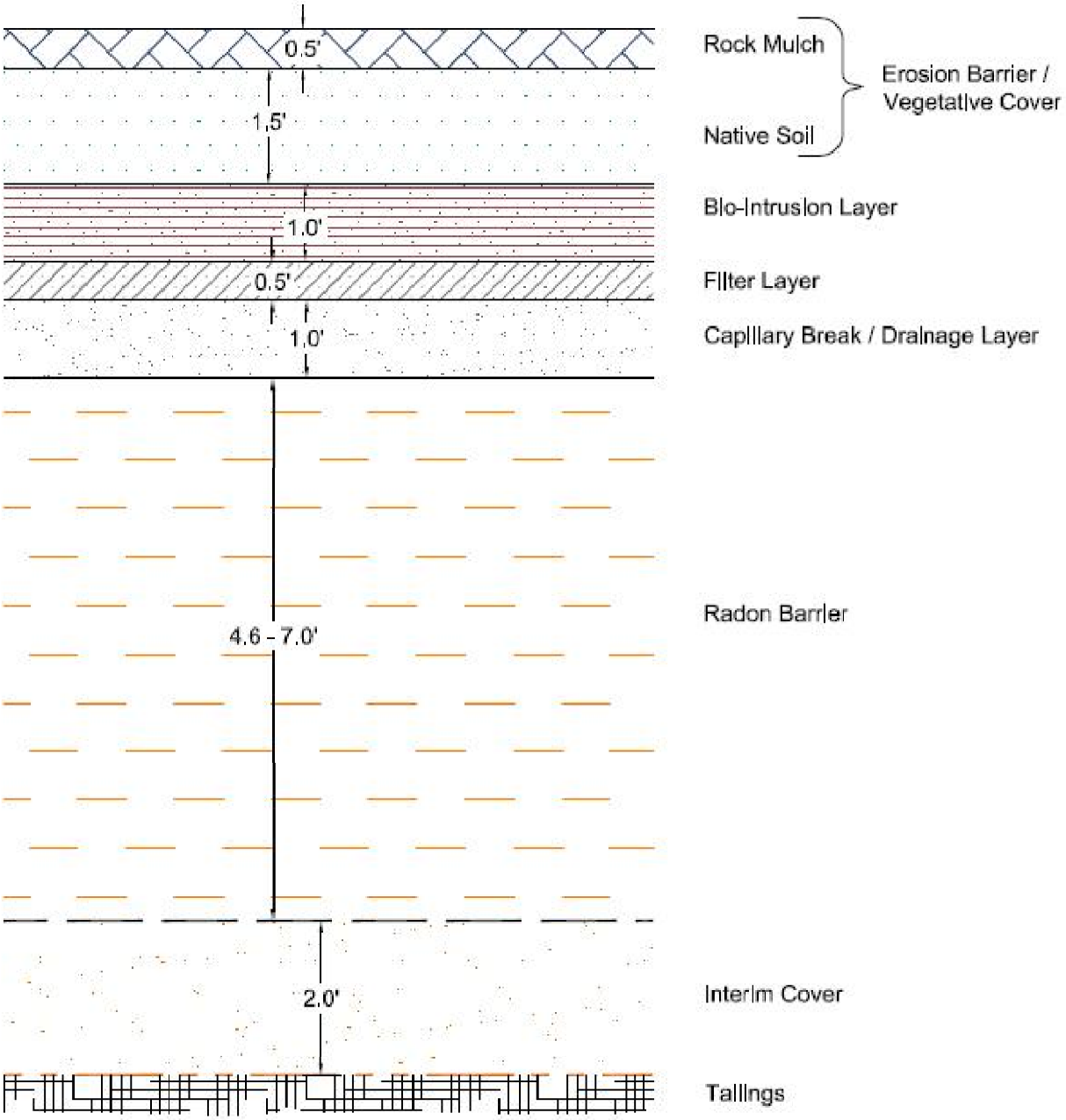


Figure 2.2-4

Typical Section of Tailing Cell Cover

- Erosion barrier/vegetative cover – provides protection against erosion and wind and water (runoff), limits infiltration. The topmost element of the cover system is the erosion barrier/vegetative cover. This layer is designed to resist erosion by wind and runoff and to provide a growth medium for the vegetative cover. It would be the primary barrier to infiltration of precipitation. The erosion barrier/vegetative cover has been designed according to guidelines suggested by the NRC in NUREG-1623 (NRC, 2002) Design of Erosion Protection for Long-Term Stabilization, Appendix A for design of soil covers. This cover would consist of 2.0 ft of native soil compacted to 85 percent Standard Proctor dry density with rock mulch (min. d50 = 0.5 inch durable rock) mixed with soil in the top 0.5 ft. The cover surface would be revegetated. The rock would meet the durability scoring criteria in Appendix D of NUREG-1623 (NRC, 2002). The finished cover would be sloped at a grade of 0.02 away from the center of each cell toward the cell perimeter. The tailings cell erosion barrier/vegetative cover has been designed to withstand the Probable Maximum Flood (PMF) across this 0.02 slope resulting from the Probable Maximum Precipitation (PMP), addressing Criterion 6(1)(i) of Appendix A, 10 CFR 40, for containment for a 200 to 1,000-year period. The erosion barrier/vegetative cover would extend over the entire final area of the tailings terminating against, and transitioning into, the outslope rock blanket.
- Bio-intrusion barrier – provides a barrier against burrowing animals. The bio-intrusion layer would protect underlying layers of the tailings cell cover from burrowing animals. It would consist of 1.0 ft of native soil matrix with nominal 3-inch rock (sound cobbles) and would be compacted to 85 percent Standard Proctor or approximately 100 pounds per cubic foot dry density. The cobbles would be placed so that they overlap within the soil matrix. The bio-intrusion layer would extend laterally beyond the outside edge of the underlying radon barrier and terminate at the rock blanket on the outslope.
- Filter layer – protects against downward migration of fine soil particles, contributes to limitation of percolation to the radon barrier. The filter layer would consist of 0.5 ft of granular soil (sand) meeting the specified d15/d85 particle size ratio with the bio-intrusion barrier and would be compacted to not less than 90 percent Standard Proctor dry density per ASTM D-698. It would terminate at the rock blanket on the final outslope and above the original cell berm. The filter layer would work in combination with the capillary break/drainage layer to limit infiltration. The filter layer would protect the capillary break/drainage layer from migration of soil fines from the overlying native soil in the bio-intrusion barrier, thus preserving the hydrologic properties of the capillary break/drainage layer. The filter layer would also provide a firm base for placement of the cobble-size particles of the bio-intrusion layer.
- Capillary break/drainage layer – provides the primary barrier to infiltration of water, provides a pathway to drain moisture laterally to the edges of the tailings cell. The capillary break/drainage layer would consist of 1.0 ft of granular soil (sand and gravel) satisfying a d15/d85 particle size ratio with the filter layer material. This granular soil would be imported from an off-site source. The layer soil would be compacted to 50 percent relative density, or about 115 to120 pounds per cubic foot dry unit weight, to make it essentially incompressible under design loads but preserving substantial effective (drainable) porosity. The capillary break/drainage layer would intercept most moisture infiltrating downward from the cover surface and drain it laterally along this layer to the top of the tailings cell berm crest, where the moisture would discharge to the rock blanket covering the tailings cell outslope. The capillary break/drainage layer would also limit root penetration by concentrating available soil moisture and encourage roots

to advance along this layer rather than penetrating deeper into the drier underlying radon barrier.

- Radon barrier – provides the primary barrier to radon release from the tailings cell. The radon barrier would consist of 4.6 ft to 7.0 ft of compacted native soil, based on the results of numerical modeling using the RADON code (the Visual Basic version of the RAECOM code). The radon barrier would extend across the interim cover and would terminate laterally against the geomembrane liner on the inside slope of the tailings cell impoundment berm. The radon barrier thickness varies as a function of the thickness of underlying tailings. The radon barrier would be 4.6 ft thick at the cell margin, where the tailings would be 1.0 ft or less, then thicken progressively to 7.0 ft over tailings that are 15 ft or more in thickness. Due to the attenuation of radon in the upper 15 ft of tailings, no additional radon barrier is needed over tailings exceeding 15 ft of thickness. However, in order to establish the 0.02 grade needed in the overlying layers of the cover, the top surface of the radon barrier will be completed at a 0.02 grade towards the cell perimeter. As a result, the radon barrier may be more than 7.0 ft thick toward the center of the cells. The bounding limits of radon barrier thicknesses were determined using the RADON code and the analytical procedures described in NRC Regulatory Guide 3.64, Calculation of Radon Flux Attenuation by Earthen Uranium Mill Tailing Covers (NRC, 1989). The radon barrier cover soil would be placed in lifts of not more than 8 inches uncompacted thickness, moisture conditioned to within 2 percent of optimum moisture content, and compacted to not less than 95 percent maximum dry density per ASTM D-698 (Standard Proctor).
- Interim cover – provides immediate protection against windborne release of tailings after cessation of cell operation and prior to placement of radon barrier, serves as a firm base for radon barrier construction. The cover would consist of not less than 2.0 ft of uncontaminated native soil placed in lifts over the regarded tailings surface and compacted to not less than 85 percent maximum dry density per ASTM D-698 (Standard Proctor). This compaction requirement takes into account the expected condition of the underlying tailings; although dewatered of free-draining moisture, the tailings are expected to retain substantial moisture content and remain uncompacted at the time of interim cover construction. These conditions are likely to make moisture-conditioning of the native soil impractical and to limit the size of equipment used for interim cover placement to small dozers with low ground pressure treads. Consequently, the lift thickness, estimated initially at 1.0 ft, would be determined in the field under initial placement conditions dictated by tailings density and retained moisture. The interim cover would extend across the final tailings surface, terminating laterally against the geomembrane liner on the inside slope of the tailings cell impoundment berm.

Modeling. The design of the cover layers was an iterative process focused on optimizing the function of each layer and satisfying the design objective of the cover system as a whole. The design was based in part on the properties of the available borrow soil (primarily the native soil) and on regulatory agency guidelines. Layer thicknesses were initially selected based on experience and engineering judgment, then evaluated and refined through numerical modeling of the cover performance against the three design objectives. Details of radon modeling and runoff and erosion modeling are provided in the *Tailing Cell Closure Design Report* (Kleinfelder, 2009c).

Closure Construction. The cover for each tailings cell would be constructed within several years after cessation of that cell's operation. The time of cover construction after cessation of cell operation would depend on the rate of dewatering of each cell; the first step in cover

construction would be preparation of the cell surface for placement of interim cover and would begin as soon as the tailings surface is dry and firm enough to support earthwork equipment in accordance with 6 CCR 1007-1, Part 18 Appendix A Criterion 6A (CDPHE, 2001). This criterion requires that the final radon barrier must be completed as expeditiously as practicable considering technological feasibility after the pile or impoundment ceases operation in accordance with a written approved reclamation plan.

Several steps are required for preparation of the tailings cells for closure. These steps are described in detail in the *Tailing Cell Closure Design Report* (Kleinfelder, 2009c) and include: dewatering, regrading, and installation of settlement monitoring points. Once these steps are accomplished, construction of the cover layers would begin. Cover construction would be performed in accordance with earthwork specifications in the *Specifications for Closure and Reclamation for Mill Facilities* (Golder, 2009c).

Interim Cover Construction Construction of the interim cover would begin as soon as possible after regrading of the tailings has started. Interim cover would be placed progressively from the edges of each tailings cell toward the center, following tailings regrading as closely as surface stability and safety considerations would allow. To build out the interim cover from the tailings berm, native soil from stockpiles or other on-site sources would be dumped along the crest and inside slope of the tailings berm. From there, the soil would be moved by dozer and spread in lifts (estimated to be 1.0 ft thick on average) across the tailings surface. Compaction effort would be provided by multiple passes of the dozers. Moisture would be added only if needed for dust control; the underlying tailings are expected to have high moisture content at the time of interim cover placement. The minimum final thickness of the interim cover would be 2.0 ft, with actual thickness likely to be greater over the more compressible fine tailings in the center of the cell.

During interim cover placement, settlement monitoring points would be installed on a grid pattern over the top of the tailings. The interim cover is designed to provide protection against windborne release of tailings until the radon barrier can be constructed. The latter event would occur only after tailings dewatering and the resulting settlement of tailings are essentially complete, as indicated by the results of settlement monitoring. The time required for this condition to develop cannot be predicted with certainty but would likely be 1 to 3 years, based on experience with previous tailings cells.

Radon Barrier Construction The radon barrier of each cell would be constructed in a continuous operation. Allowing for reasonable interruptions due to inclement weather, the radon barrier should be started and completed within one annual construction season. Radon barrier would not be placed when temperatures are likely to drop below freezing on a daily basis. The top surface of the radon barrier would be completed at the elevations and grades required to achieve the final cover configuration, less the thickness of the ET cover. The top surface would slope at a uniform grade of 0.02 from the west-east centerline of the cell toward the tailings cell berms.

Radon barrier construction in each cell would begin after the settlement monitoring data indicate that primary settlement (settlement resulting from consolidation of tailings due to dewatering) has reached approximately 90 percent of the asymptotic value on the log time-settlement curve. Native soil to be used in the radon barrier would be drawn from the soil stockpile or from excavation of future tailings cells if these activities are occurring at the same time.

Evapo-transpiration Cover Construction The layers of the ET cover (capillary break/drainage layer, filter layer, bio-intrusion layer, and erosion barrier/vegetative cover) would be constructed for each cell as soon as practicable after construction of the radon barrier. Each layer may be constructed across the entire cell before the next, or the layers may be constructed in stair-step order progressively across the cell. It may not be feasible to construct both the radon barrier and the ET cover in the same construction season. If placement of the ET cover does not occur during that same year, the surface of the radon barrier would be scarified, moisture conditioned and re-compacted prior to construction of the overlying ET cover.

Rock materials needed for the capillary break/drainage layer, filter layer, and top lift of the erosion barrier as well as the cobbles in the bio-intrusion layer would be imported from an off-site borrow source. Larger rock needed to cover the outslopes of the tailings cells and the drainages between the tailings cells would also be imported to the Site. Rock sources in the nearby San Miguel River valley were used for the durable rock layers at the nearby Durita site and are expected to be available for this project. The Cotter limestone quarry in La Sal, Utah has also been identified as a potential source of durable rock. Samples of rock material would be obtained for durability testing in accordance with NRC guidelines (NRC 1982b, 2002, 2003b) to demonstrate that the selected rock would meet NRC performance standards. The selected material would be produced off-site and transported by truck to the site for either temporary stockpiling or direct placement in the ET cover.

The rock mulch in the top lift of the erosion barrier/vegetative cover would be applied after the last lift of native soil is placed, then mechanically mixed into the soil before final finish grading. Seeding of this finished surface would occur during the same year as ET construction and at the end of the season, before first snowfall. A rock blanket would be placed on the outslopes of each tailing cell from the toe of slope to the top of slope to provide protection against erosion of the underlying tailing cell dike and outer edge of tailing cell cover. The rock blanket would consist of 1.0 ft of graded durable rock (average diameter of 2.5 inches) placed over a sand/gravel bedding layer on a gradual 10H:1V slope. The rock blanket protecting the 5H:1V slopes between cells A and B and between cell B and C would consist of the same rock but with a larger average diameter of 3.5 inches. Run-out rock aprons and the rundown channels between tailings cells would consist of much larger rock, average diameter of 8 inches and 18 inches, respectively, to provide erosion protection against the 1,000-year storm event.

2.2.7.7 Surface Restoration

After contamination has been removed from the mill area and the evaporation pond area and the verification survey has confirmed that these areas meet the standards for Radium-226 and other radionuclides described in Section 14 of the *Mill Decommissioning Plan* (Kleinfelder, 2009b), the Mill License Boundary would be contracted to include only the capped tailings cells. The remaining boundary (Restricted Tailings Cell Area) would enclose the tailings cells for long-term protection against byproduct (tailings) release as required by 6 CCR 1007-1, Part 18 (CDPHE, 2001); the other portions of the Mill License Boundary would be released for unrestricted use.

With the exception of the Restricted Tailings Cell Area, the area within the Property Boundary would be reclaimed by regrading to approximately the original (pre-construction) configuration, as illustrated in the *Mill Decommissioning Plan* (Kleinfelder, 2009b). The previous removal of liners, foundations, and contaminated soils from the ore pad and mill pad area would result in a non-uniform surface area. These areas would be regraded to approximate the pre-construction contours with additional subsoil and topsoil brought in, as necessary, from the soil stockpiles to

achieve final grades. A similar approach would be used in the evaporation pond area after the removal and sequestering of pond sediments, pond liners, and any contaminated soil within the final tailings cell. The surface water diversions constructed for the Mill Facility would be left in place to divert runoff away from the tailings cells. The regraded surfaces would be revegetated using the procedures and seed mixes described in *Specifications for Closure and Reclamation of Mill Facilities* (Golder, 2009c).

The Site Access Road would be left in place for the subsequent user of the land surface outside of the final license boundary as well as for access to monitoring wells and air monitoring stations. At the time of surface restoration, the two meteorological towers would be taken out of service except for the air monitoring components.

Surface water drainages on the Site experience intermittent flow following large precipitation events. After decommissioning, the tailings cells would be the only mill features remaining that could be impacted by, or cause impact to, surface water. Surface water control structures originally constructed to divert sheet flow away from the mill and the tailings cells would be left in place and protected with riprap as described in the *Site Drainage Analysis and Design Report* (Kleinfelder, 2009d). The *Tailing Cell Closure Design Report* (Kleinfelder, 2009c) addresses erosion control measures, including grading and rock cover, to protect the tailings cells against erosion by surface water runoff. Those erosion control measures are designed to protect the tailings from release for 1,000 years, accomplished by designing for erosion protection against the peak runoff from the probable maximum precipitation (PMP) event, as required by 6 CCR 1007-1, Part 18, Appendix A (CDPHE, 2001). Runoff from the restored mill area would flow to the north, toward Tailing Cell A, where it would be intercepted and diverted to the east and west by a diversion berm constructed in front of (south of) the south outslope of Tailing Cell A as described in the *Tailing Cell Closure Design Report* (Kleinfelder, 2009c).

2.2.8 Monitoring

Operational Monitoring. Energy Fuels has developed an *Operational Monitoring Plan* (Visus and Energy Fuels, 2009b) that outlines the methods to be used for ongoing monitoring of environmental resources, process waste attributes and controls, and health and safety aspects during operation of the Mill Facility. Specifically, the *Operational Monitoring Plan* provides monitoring schedules and procedures to assess radiation doses and determine the concentrations of radionuclides and other constituents in the Mill effluents and environment during operations. In addition to radiation dose monitoring and the monitoring of certain process controls, monitoring programs are provided for the following environmental resources:

- Soils;
- Biota (flora and fauna);
- Surface Water;
- Groundwater; and
- Air.

Uranium mill operators are required by NRC regulations and license conditions to conduct radiological effluent and environmental monitoring programs. Regulations applicable to uranium milling are contained in 10 CFR Part 20, “Standards for Protection Against Radiation,” and Part 40 “Domestic Licensing of Source Material;” however, CDPHE is the sole regulator of radioactive material in Colorado. In accordance with these applicable regulations, the monitoring programs provided in the *Operational Monitoring Plan* are designed to provide accurate

information on the specific radionuclides in effluents from the Mill Facility, its ore piles, its tailings retention systems, its evaporation ponds, and in the surrounding environment.

NRC Regulatory Guides are issued to describe, and make available to the public, acceptable methods of implementing specific parts of the applicable regulations, to delineate techniques used by the regulatory staff in evaluating specific problems or postulated accidents, or to provide guidance to applicants. The *Operational Monitoring Plan* incorporates the relevant NRC Regulatory Guides into the specific monitoring programs and procedures, including:

- Regulatory Guide 3.63 – Onsite Meteorological Measurement Program for Uranium Recovery Facilities - Data Acquisition and Reporting (NRC, 1988a);
- Regulatory Guide 4.13 – Performance, Testing, and Procedural Specifications for Thermoluminescence Dosimetry; Environmental Applications (NRC, 1977);
- Regulatory Guide 4.14 – Radiological Effluent and Environmental Monitoring at Uranium Mills (NRC, 1980a); and
- Regulatory Guide 4.15 – Quality Assurance for Radiological Monitoring Programs (Inception through Normal Operations to License Termination) – Effluent Streams and the Environment (NRC, 2007).

Table 1-1 in the *Operational Monitoring Plan* (Visus and Energy Fuels, 2009b) provides a summary of the monitoring requirements to be conducted during construction and after the beginning of operations of a typical uranium mill according to Regulatory Guide 4.14. Each monitoring program provided in the *Operational Monitoring Plan* contains an individual table summarizing the specific monitoring conducted for that particular environmental resource and/or Mill Facility component. The results of this operational monitoring program would be compiled quarterly and submitted to CDPHE semiannually, annually, and at times of license renewal as required by specific license conditions.

Closure Monitoring. Operational monitoring would continue during the closure period. Additional monitoring would also be implemented during closure according to the *Tailings Cell Closure Design Report* (Kleinfelder, 2009c) and *Specifications for Closure and Reclamation for Mill Facilities* (Golder, 2009c). Closure monitoring would include:

- Radiological surveys and soil sampling to identify contaminated soils for excavation and placement in the final tailings cell.
- Settlement monitoring designed to evaluate settlement and determine the appropriate time for placement of various cover materials.
- Dewatering sump monitoring designed to measure the rate of liquid released during tailings consolidation.
- Geotechnical sampling and testing of cover materials prior to and during placement including soils, rock, and aggregate.
- Radon canister measurements on the final cover to verify compliance with Criterion 6(2) of 6 CCR 1007-1, Part 18 Appendix A (CDPHE, 2001) for radon flux levels.
- Periodic visual inspection of the cover during and after construction to identify and mitigate, as necessary, potential areas of concern including subsidence, erosion, burrowing animals, and areas of poor vegetation.

2.2.9 Post-Closure Monitoring

Post-closure monitoring and maintenance would continue after conclusion of closure and reclamation activities. Monitoring would be established based on site-specific conditions at the time of closure; however, it would likely include carryover of some of the operational monitoring of environmental media (air, surface water, groundwater, soils, and biota) as well as radiation levels on-site. Maintenance would consist of repairing areas of erosion, reseeding as necessary, and inspecting and repairing the fence around the Restricted Tailings Cell Area.

2.3 ALTERNATIVES CONSIDERED BUT NOT ANALYZED IN DETAIL

2.3.1 Site Location Alternatives

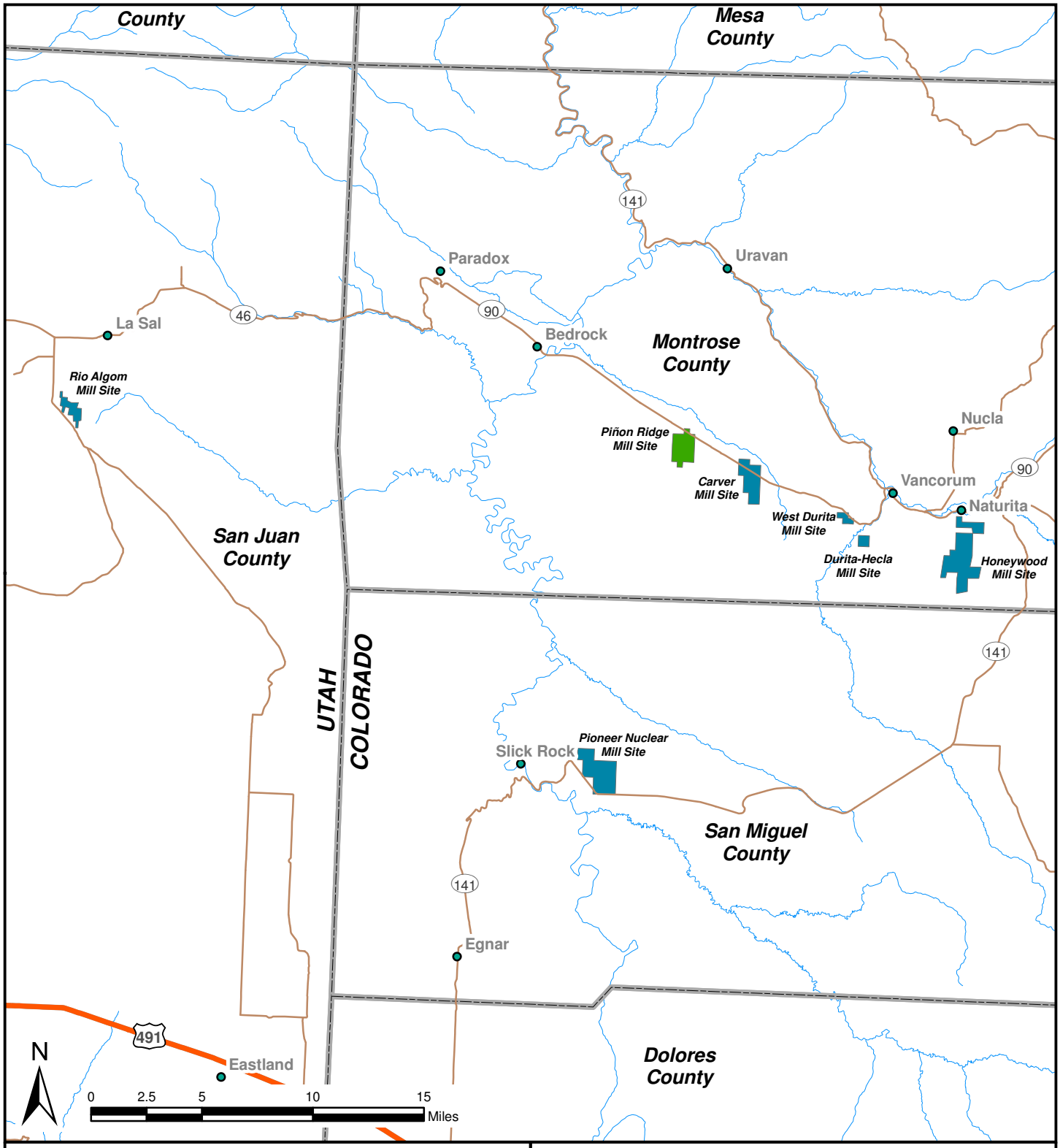
Seven potential site locations, including the Piñon Ridge Site, were evaluated in detail as potential candidates for the location of the Mill Facility. Descriptions of the six sites that were eliminated and the reasons for their elimination are described below. In conformance with 6 CCR 1007-1, Part 18, Appendix A, Criterion 2 (CDPHE, 2001), two of the six sites were considered because they were previously used for uranium recovery and waste disposal operations. The other former mill sites in the region (e.g., Uravan) did not meet NRC and State of Colorado siting criteria. Figure 2.3-1 provides the locations of the alternative sites.

2.3.1.1 Former Rio Algom Mill Site

The Rio Algom Mill site is located on approximately 758 acres in San Juan County, Utah, four miles south of La Sal and 10 miles from the Colorado/Utah border (portions of Sections 21, 22, 27 and 28, Township 29 South, Range 24 East). The site is accessed via SH 46 at La Sal Junction then south on the Lisbon Valley County Road. It is a reclaimed, former conventional carbonate-leach uranium ore refining plant which included underground mine and surface milling operations. Most of the infrastructure has been removed and reclamation was completed in December 2006, with the completion of a rock cover over the tailings area. The site had power at that time, but water rights and supply wells were either traded away or sold. The available area for a new mill is to the north of the reclaimed site; however, sufficient land is not available and it is within close proximity to existing residences that could be impacted by tailings disposal activities. Additionally, regulatory issues associated with pre-existing groundwater contamination were a concern at this site. The State of Utah had recently acquired regulatory authority over uranium milling and 11e.(2) byproduct material from the NRC and objected to the size of the Alternate Concentration Limits (ACL) plume that was previously approved by the NRC. ACLs are risk-based groundwater corrective action standards. The ACLs currently in place at the Rio Algom mill site requires monitoring through 2015. Due to the unavailability of sufficient land, proximity of residential housing, and the regulatory issues associated with the groundwater contamination, this site was eliminated from further consideration.

2.3.1.2 Pioneer Nuclear Site

The Pioneer Nuclear site is located on 1,425 acres in San Miguel County, Colorado, approximately 4 miles west of the former town of Slick Rock (Sections 26, 27, 34, and 35, Township 44 North, Range 18 West). The site is accessed via SH 141. In the late 1970's this was a previously permitted mill that proposed burying dewatered tailings in a series of trenches. The permit was approved; however, the project never started due to depressed uranium prices. The site was determined to be suitable, is fenced and surrounded by BLM-administered land, and is outside areas prone to flooding. Power is readily available near the site; however, the property does not convey any water rights. Pioneer Nuclear proposed obtaining water rights on



Potential Mill Sites
Selected Mill Site

Figure 2.3-1

Alternate Sites

the Dolores River and pumping via pipeline across BLM-administered lands. Shallow groundwater could also limit the depth of potential tailings cells that could be constructed below grade. The site was eliminated from further consideration primarily due to lack of public acceptance. Although the residents in the west end of San Miguel County would probably support the mill, the majority of the population of this county is centered in Telluride, which is currently strongly opposed to natural resource development. The site is also located in the extreme south end of the Uravan Mineral Belt, which would result in higher haul distances and, there are no towns or cities in close proximity that could supply the labor force needed to operate the mill.

2.3.1.3 Durita-Hecla Site

The Durita-Hecla Site is located on 160 acres approximately 4 miles west of Naturita in Montrose County, Colorado (Section 34, Township 46 North, Range 16 West). The north end of the site is accessed via SH 90 then south on County Road GG25 to County Road EE21. The site is currently closed and contains existing reclaimed uranium tailings heaps and ponds. The land is owned by a mining company but would eventually be transferred to the DOE under the long-term surveillance program once the site meets all closure requirements. Adjacent land includes BLM-administered land to the east and private land to the west. The site is underlain by low permeable Mancos shale. Water rights can be obtained from the nearby San Miguel River and power is readily available in the area. This site is limited in size and in the availability of sufficient adjacent useable land for facility construction and potential site expansion. Much of the adjacent fee land (Anderson property) is bottom land and is not suitable for tailings disposal due to flood concerns. Due to the lack of sufficient land area and the flood concerns, this site was eliminated from further consideration.

2.3.1.4 West Durita Site

The West Durita Site is located on 160 acres near Naturita in Montrose County, Colorado, (Sections 27 and 28, Township 46 North, Range 16 West) just northwest of the Durita-Hecla Site and the Anderson property mentioned above. Access to the site is from the intersection of SH 90 and County Road EE22. The site is currently undeveloped and is privately owned by George Glasier, President and CEO of Energy Fuels. The site was preferred based on expected permitability and general community acceptance. The property does not have water rights, but like the Durita-Hecla site, water rights could be obtained from the San Miguel River. Power is readily available. This site was eliminated due to its relatively small size, close proximity to a ranch house on adjoining property, and that adjacent land to the south is not available for purchase.

2.3.1.5 Honeywood Site

The Honeywood Site is located on a plateau immediately southeast of Naturita in Montrose County, Colorado (Sections 27, 28, and 34, Township 46 North, Range 15 West and Sections 3, 4, 5, and 9, Township 45 North, Range 15 West). The main access to the site is from SH 141 just east of its intersection with SH 145 and an unnamed county road approximately 3 to 4 miles east of Naturita. This 1,200-acre site includes a reclaimed surface coal mine and approximately 112 acres have been backfilled, graded to approximate original contours, and topsoiled. The site is surrounded by a mixture of private and BLM-administered land parcels of various sizes. The local landfill is located about 1 mile southeast of the Honeywood Site. Shallow groundwater is present over the entire site; however, it would be necessary to gain surface water rights from the San Miguel River basin or groundwater rights from deeper formations to meet the daily fresh water requirements for mill operations. The site is underlain by low permeability bentonitic

shales that would provide additional protection of groundwater resources from the construction and operation of the tailings disposal facilities. Broad Canyon Landfill, southeast of the mill site, was permitted without a synthetic liner due to the existence of this shale layer. The property is currently in an active state of reclamation. This site was eliminated due to its proximity to Naturita, transfer of regulatory responsibility (and bond release) of the site from the Colorado Division of Reclamation, Mining and Safety (DRMS) to the CDPHE, and because it would be necessary to drill and blast to place tailings cells below ground level.

2.3.1.6 Carver Site

The Carver Site is located in the Paradox Valley on 900 acres approximately 10 miles southeast of Bedrock and 9 miles west of Naturita in Montrose County, Colorado, (Sections 10, 11, 14, and 23, Township 46 North, Range 17 West). Access to the site is from SH 90. The site is bordered on its west side by BLM-administered land and on its other three sides by a mixture of private and BLM-administered land parcels. Two residences are located in close proximity, one immediately east of the site on adjacent land. A reclaimed underground uranium mine is located on adjacent BLM-administered land south of the site near the toe of Monogram Mesa. The site and most of the surrounding property is used to graze cattle during the winter and early spring. The site is characterized by numerous dry washes or arroyos that carry surface water runoff from Monogram Mesa after precipitation and snow melt events. This site was eliminated due to the proximity of residences, the lack of usable land due to the numerous drainages, and long-term geomorphology concerns. Due to the abundance of surface water runoff at the site, reclamation of tailings cells to the 1,000-year standard could be difficult to achieve.

2.3.2 Technical Alternatives

The alternatives for processing uranium are limited to conventional acid- or alkaline-leach milling, heap leaching, and in-situ leaching. In the case of the Uravan Mineral Belt ores, which comprise the majority of the feed for this project, conventional-acid leach milling (Proposed Action Alternative) provides the highest recovery rate of uranium and vanadium at the lowest price per pound recovered. The disadvantages of the other three recovery technologies for this specific application are discussed below.

2.3.2.1 Conventional Alkaline-Leach Milling

Alkaline leach mills, such as the former Rio Algom Mill, use carbonate compounds (i.e., sodium bicarbonate, sodium carbonate or carbon dioxide) rather than sulfuric acid to leach the ores. Alkaline leach circuits require longer retention times than acid circuits and result in lower recoveries of uranium and vanadium. They are typically employed when the ore feed has high limestone content (i.e., 12 percent or more carbonate content), which would result in excessive consumption of sulfuric acid in a conventional-acid leach circuit. Although some of the mines in Utah that could supply ore to the mill have ore bodies with higher carbonate concentrations, most of the mines in the region including all of the Uravan Mineral Belt mines have relatively low carbonate concentrations.

2.3.2.2 Heap Leaching

Heap leaching consists of crushing and placing the mined ore on a lined pad and then spraying the top of the ore pile with leach solution. As the solution percolates through the ore, it dissolves the uranium from the crushed rock. The solution is collected in lined ponds located at the base of the heap and is then either shipped to a mill for further processing or is processed in an on-site precipitation and packaging facility. The uranium recovery percentage using heap leaching is much lower than those attained in conventional mills, which typically average more than 90

percent recovery; however, the capital cost to build a heap leach facility is substantially less than for a mill. This method has been used successfully where mining costs are low and vanadium recovery is not required. The Durita Heap Leach site near Naturita is a good example of this type of facility. Tailings from a historic vanadium mill were trucked to the site and then leached to recover uranium. This resulted in minimal mining costs (i.e., surface excavation and trucking) and adequate recovery of some of the uranium content with a relatively small capital investment.

Heap leaching is, in most cases, an uneconomical option for processing ores from the Uravan Mineral Belt and the other mining districts in eastern Utah. The sandstones from these formations break down into very fine-grained sands that plug off and do not allow for good percolation through the crushed ore. Underground mining costs using split-shooting methods are also high and require good recoveries of both uranium and vanadium during processing to be economical. In addition, this method results in much higher water consumption rates due to evaporation when compared to conventional milling.

2.3.2.3 In-Situ Leaching

In-situ leaching (ISL), also known as in-situ recovery (ISR), consists of injecting a leaching solution into porous uranium-bearing strata through a series of injection wells. Once in contact with the mineralization, the leach solution or lixiviant oxidizes the uranium minerals, which allows the uranium to dissolve in the groundwater. Production wells, located between the injection wells, intercept the uranium-bearing lixiviant and pump it to the surface. At the surface, a centralized ion-exchange facility extracts the uranium from the lixiviant. Once the ion-exchange resin is fully loaded with uranium, it is stripped or eluted. The uranium is then precipitated from the eluate as a yellow cake slurry, dried, and packaged.

Although a sulfuric acid solution is allowed and used as the lixiviant in some countries, ISLs in the United States typically add dissolved oxygen and carbon dioxide to the native groundwater to produce a weak alkaline lixiviant. This results in less environmental impact to the groundwater. ISL systems are considerably less expensive to install and operate than a conventional mining and milling operation. They are also much safer than extracting the uranium ore using surface or underground mining methods.

ISL methods are not applicable to the majority of the ore bodies found in western Colorado and eastern Utah. These ore bodies are very fine-grained and do not have the necessary permeability for injecting and extracting lixiviants.

Section 3.0
Affected Environment

3.1 LAND USE

3.1.1 Site Location

The Site is located in Paradox Valley of western Montrose County, approximately 7 miles east of the unincorporated community of Bedrock and 12 miles west of the Town of Naturita. The Site's legal description is the Southwest ¼ of the Southeast ¼ of Section 5, all of Section 8, the North ¼ of Section 17, and the Southeast ¼ of the Northwest ¼ of Section 17, Township 46 North, Range 17 West, of the New Mexico Principal Base and Meridian.

3.1.1.1 Regional Land Use Patterns

NRC Guidance for Environmental Reports for Uranium Mills requires that a proposed project's potential impacts on the surrounding population be evaluated for all areas within 50 miles (80 kilometers - km) of the Site (NRC, 1982a). To provide for consistency with this analysis, which is addressed in Section 3.10 of this ER, the current section evaluates existing land-use conditions within 50 miles (80 km) of the Site. The analysis emphasizes land-use patterns in Montrose County because this is where the Site is located and where potential impacts to land-use patterns associated with the Proposed Action would occur.

The majority of land in the vicinity of the Site is public land that is administered by the Bureau of Land Management (BLM) and the U.S. Forest Service (see Figure 3.1-1). BLM lands include DOE uranium lease tracts in the Gateway area of Mesa County, Uravan and Paradox Valley areas of Montrose County, and the Slick Rock Area of San Miguel County (DOE, 2007). Private lands comprise 30 percent of the land within 50 miles (80 km) of the Site. Portions of the San Juan National Forest, Uncompahgre National Forest, Manti-LaSal National Forest, Lizard Head Wilderness Area, Black Canyon of the Gunnison Wilderness Area, Gunnison Gorge National Conservation Area, Arches National Park, and Canyonlands National Park are located within 50 miles (80 km) of the Site as is the U.S. Bureau of Reclamation's (BOR's) Paradox Valley Unit (PVU) desalinization plant. The Ute Mountain Indian Reservation covers a portion of Montezuma County, Colorado, and the Navajo Indian Reservation covers a portion of San Juan County, Utah. These tribal lands are located over 50 miles (80 km) away from the Site.

3.1.1.2 Local Land Use Patterns

NRC Guidance for Environmental Reports requires the evaluation of land use within a 5 mile (8 km) radius of the Site (NRC, 1982a). Based on information provided by the Montrose County GIS Department, 88 percent of the land within 5 miles (8 km) of the Site is undeveloped land that is administered by the BLM and 12 percent is privately owned (Montrose County, 2009b). As shown in Figure 3.1-2, some lands within the vicinity of the Site, including the site itself, are currently used to graze livestock. Grazing lands in the vicinity of the Site are zoned as general agricultural districts, which allow for the placement of on-site-built or manufactured single family home on the property. Therefore, some grazing lands near the Site include residences and some are vacant (Waller, 2009). A small portion of land in the immediate vicinity of the Site is used for residential and other agricultural purposes. All land uses are subject to valid existing rights, which may be conveyed by title, deed, right-of-way, permit, withdrawal, or any other legally recognized instrument (Visus, 2009).

Bureau of Land Management
Bureau of Reclamation
Forest Service
National Park Service
Private Lands
Department of Energy Uranium Lease Tracts
US Census Populated Places (areas)

Figure 3.1-1

Land Management within 50 miles (80 km) of the Site

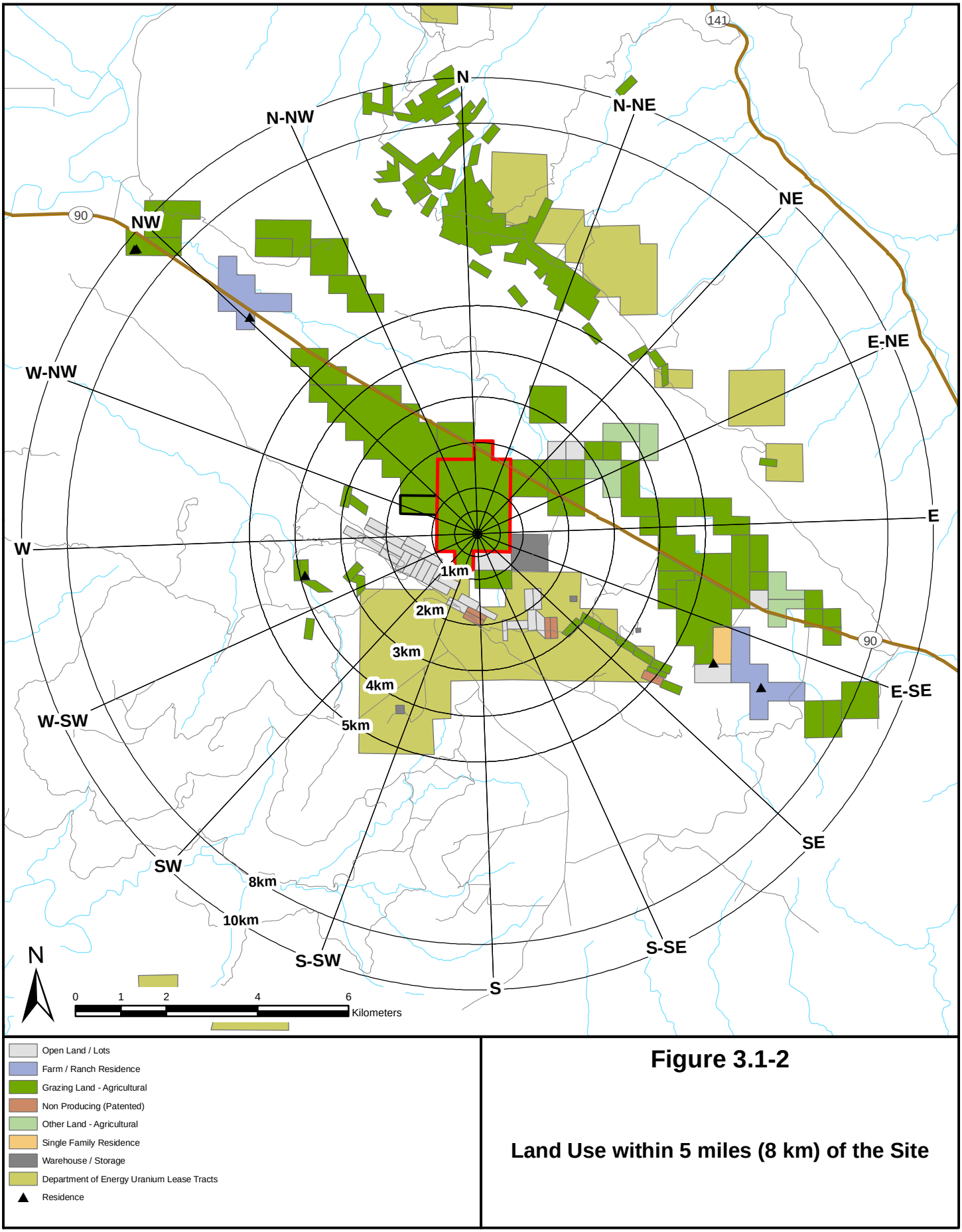


Figure 3.1-2

Land Use within 5 miles (8 km) of the Site

3.1.2 Surrounding Land Uses

Montrose County, which includes the Site, covers approximately 2,200 square miles of southwest Colorado. Most of the land in the county is publicly owned. The BLM is the dominant federal land management agency in Montrose County, overseeing 44 percent of the county's surface area. DOE uranium lease tracts overlap with approximately 2 percent of BLM-administered lands in the county. The DOE has jurisdiction over activities related to uranium and vanadium mining on lease tracts, and the BLM has jurisdiction and authority over all other surface and subsurface uses (DOE, 2007). National Forest System (NFS) lands cover 23 percent of Montrose County, National Park lands cover 1 percent, and State lands cover another 1 percent. Private lands cover 31 percent of the county.

The BOR's Paradox Valley Unit is located approximately 7.5 miles (12 km) west of the Site. As part of the Colorado River Basin Salinity Control Project, the Paradox Valley Unit is designed to prevent natural salt loads from entering the Dolores River and degrading the quality of water flowing into the Colorado River. The Paradox Valley Unit intercepts brine groundwater before it enters the Dolores River and disposes of the brine by deep well injection. Major project facilities include a brine production well field, brine surface treatment facility, injection facility, a 15,932 foot deep injection well, and associated roads, pipelines, and electrical facilities (BOR, 2009).

Major land uses in Montrose County include agriculture, mining, and recreation. Public lands provide the public with multiple use opportunities. Areas of urban concentration are limited to the City of Montrose and Town of Olathe, both of which are located on the eastern side of the county. The only other incorporated jurisdictions are the towns of Naturita and Nucla, both of which are located on the western side of the county.

3.1.2.1 Agriculture

Farming. According to the U.S. Department of Agriculture's 2007 Census of Agriculture, farmland covers approximately 23 percent of Montrose County. Between 1997 and 2007, the county lost approximately 50,000 acres of farmland (see Table 3.1-1). Most farmland losses are due to encroaching residential development. Farms in Montrose County are decreasing in size. Although the average farm size was 307 acres in 2007 (down from 429 acres in 1997), most farm holdings are much smaller. In 2007 the median farm size in Montrose County was 46 acres (down from 83 acres in 1997) (U.S. Department of Agriculture, 1999 and 2009).

Table 3.1-1
Agricultural Statistics for Montrose County, 1997, 2002 and 2007[1]

Agricultural Indicator	1997	2002	2007
Number of farms	866	915	1,045
Acreage			
Land in farms	371,881	334,747	322,105
Average farm size	429	366	307
Median farm size	83	73	46
Total cropland	89,191	106,613	93,262
Harvested cropland	65,276	60,890	60,094
Irrigated land	85,040	75,459	85,656
Land in orchards	NA	295	318
Organic production	NA	NA	154
Vegetable crops	NA	3,870	2,878
Dry edible beans	NA	7,063	4,208
Grain crops	12,344	8,688	11,089
Hay	37,437	35,748	38,467

Agricultural Indicator	1997	2002	2007
Livestock inventory (number)			
Cattle and calves	60,599	48,435	47,388
Hogs and pigs	1,180	1,618	675
Sheep and lambs	35,427	18,366	19,792
Goat inventory	86	96	1,486
Farmland as percent of county area	25.9%	23.3%	22.5%
Harvested cropland as percent of total cropland	73.2%	57.1%	64.4%
Irrigated land as percent of total farmland	26.6%	22.5%	22.9%
Percent of farms with cattle/calving operations	57.6%	43.0%	45.2%
Percent of farms with sheep/lambs	11.8%	8.3%	6.0%
[1] Source: U.S. Department of Agriculture, 1999, 2004, and 2009.			

Approximately 25 percent of Montrose County farmland is irrigated. Over 60 percent of the county's harvested cropland is used to produce hay, which is the county's primary crop. Other commercial crops produced in the county include grain crops (barley, corn, oats, and wheat), which cover 19 percent of harvested cropland; dry edible beans, which cover 7 percent of harvested cropland; and vegetables, which cover approximately 5 percent of harvested cropland.

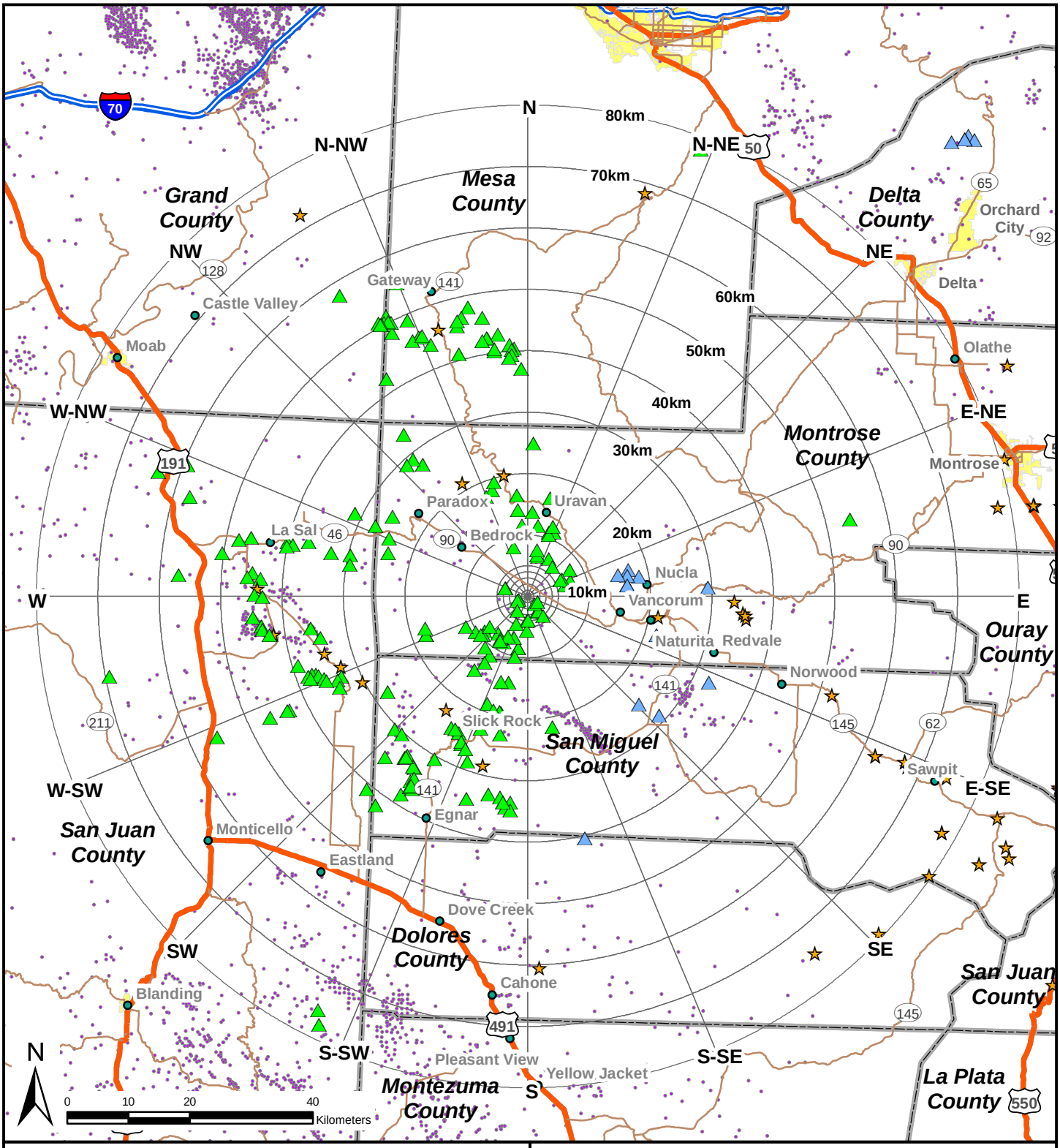
Grazing. Cattle and calves are the predominant livestock in Montrose County. In 2007, 45 percent of the county's farms had cattle/calving operations (down from 58 percent in 1997). Although the Census of Agriculture does not provide data on farm lands not used for cropland, it is likely that most agricultural land not in croplands is used to graze livestock.

The Site contains 880 acres that have historically been used to graze cattle during the winter. The BLM's East Paradox Common Allotment, which is adjacent to the Site, contains 15,003 acres that are permitted for 2,107 animal unit months (AUMs) between December 18 and February 28 (Stindt, 2009). The BLM allotment has a seasonal carrying capacity of 7.12 acres per AUM. The carrying capacity of public lands near the site has been improved through seeding and vegetation treatment (*e.g.* sagebrush removal, grass replacement) over the past several years (Stindt, 2009). BLM grazing allotments encompass public and private lands, but only public lands are included in determining active AUMs.

Forestry. Trees conducive to commercial forestry (*e.g.* ponderosa pine, Douglas fir, Engelmann spruce) are extremely limited in western Montrose County due to minimal rainfall, steep topography, and relatively low elevations; however, there is limited harvesting of pinyon pine and juniper trees for firewood and fenceposts on public lands in western Montrose County in the vicinity of the Site (Berger, 2009 and DOE, 2007).

3.1.2.2 Mineral Resources and Mining

Mineral resources in southwest Colorado and southeast Utah include oil, natural gas, coal, gold, copper, silver, uranium, vanadium, and zinc. Based on information provided by the Colorado Division of Reclamation, Mining and Safety (DRMS); the Utah Division of Oil, Gas and Mining (DOGM); and the Colorado Oil & Gas Conservation Commission (COGCC), Figure 3.1-3 shows permitted mines and oil and gas wells that are within 50 miles (80 km) of the Site (Colorado Department of Natural Resources - CDNR, 2009a; Smith, 2009a; and COGCC, 2009a). Areas with intense uranium and vanadium mining are largely within 30 miles (50 km) of the Site. Areas with intense oil and natural gas drilling tend to be along the periphery and outside the Site's 50 mile (80 km) radius.



Coal

Copper; Gold; Silver

Uranium; Vanadium; Zinc

Oil & Gas Wells

Figure 3.1-3

Permitted Mines and Oil & Gas Wells within 50 miles (80 km) of the Site

Uranium. The Site is located in the Uravan Mineral Belt - a zone of uranium and vanadium deposits in San Miguel, Montrose, and Mesa counties in Colorado and Grand County in Utah that contains a substantial portion of the nation's known uranium ore reserves (DOE, 2007). This mineralized zone is the oldest uranium mining region in the United States. Historically, almost 1,200 mines were located within the Uravan Mineral Belt, which produced over 63 million pounds of uranium and 330 million pounds of vanadium between 1948 and 1978 (CDNR, 2009b). Due to falling uranium prices, uranium production in Montrose County halted in the mid-1980s. Improving market conditions in the early 2000s resulted in the resumption of limited mining operations.

According to the CDNR, as of September 2009, there were 35 actively permitted uranium mining projects, including four producing mines, in Colorado. As shown in Table 3.1-2, all four producing mines (Sunday, West Sunday, St. Jude, and Topaz mines) are in San Miguel County, and all but two of the permitted projects are in Montrose, San Miguel, and Mesa counties (CDNR, 2009b).

Table 3.1-2
Active Uranium Mining Permits in Colorado, September 2009[1]

Site Name	Operator	County	Status
October Ore Pile Reclamation	Nuvemco, LLC	Mesa	Active
Whirlwind Mine	Energy Fuels Resources	Mesa	Active– standby Nov 2008
C-JD-5	Gold Eagle Mining, Inc.	Montrose	Active
C-JD-7	Cotter Corp.	Montrose	Active
C-JD-8	Cotter Corp.	Montrose	Active- standby Nov 2005
C-LP-21 Mine	Cotter Corp.	Montrose	Reclaimed
CM-25 Mine	Cotter Corp.	Montrose	Reclaimed
Club Mines	Umetco Minerals Corp.	Montrose	Reclaimed
J Birds	Rimrock Exp. & Dev.	Montrose	Active
JD-6 Mine	Cotter Corp.	Montrose	Active- standby Nov 2005
JD-7 Pit	Cotter Corp.	Montrose	Active
JD-9 Mine	Cotter Corp.	Montrose	Active- standby Nov 2005
Last Chance #3 & #4	Nuvemco, LLC	Montrose	Permit review
Mineral Joe Claims	Cotter Corp.	Montrose	Active
Monogram Mines	Nuvemco, LLC	Montrose	Conversion approved
Monogram-JoDandy	Nuvemco, LLC	Montrose	Active
SM-18 Mine	Cotter Corp.	Montrose	Active- standby Nov 2005
Tramp Mine	Bluerock Energy Corp.	Montrose	Active
Van 4 Shaft	Denison Mines (USA)	Montrose	Active
Wright Group	Cotter Corp.	Montrose	Active
Burros Mine	Gold Eagle Mining, Inc.	San Miguel	Active
Carnation Mine	Denison Mines (USA)	San Miguel	Active
Centennial	B-Mining Co.	San Miguel	Active
Deremo-Snyder	Umetco Minerals Corp	San Miguel	In reclamation
Ellison Mine	Gold Eagle Mining, Inc.	San Miguel	Active
Hawkeye Mine	Gold Eagle Mining, Inc.	San Miguel	Active
Ike No. 1 Mine	Cotter Corp.	San Miguel	Reclaimed
Sego Mine	Sutherland Drilling	San Miguel	Active
SR-13A Mine	Cotter Corp.	San Miguel	Active
St. Jude Mine	Denison Mines (USA)	San Miguel	In ore production
Sunday Mine	Denison Mines (USA)	San Miguel	In ore production
Topaz Mine	Denison Mines (USA)	San Miguel	In ore production
West Sunday	Denison Mines (USA)	San Miguel	In ore production
Schwartzwalder	Cotter Corp.	Jefferson	In reclamation
Pitch Project	Homestake Mining Co.	Saguache	In reclamation

[1] Source: CDNR, 2009b.

As shown in Figure 3.1-3, there are several uranium/vanadium mines in Utah that are within 50 miles (80 km) of the Site. The Beaver, Energy Queen, Pandora, and Rim mines are all located in the La Sal region of San Juan County. With the exception of the Energy Queen Mine which is operated by Energy Fuels, all of these mines are operated by Denison. As of March 2009, the Beaver and Pandora mines were producing ore, and the Rim Mine was on temporary standby (PayDirt Magazine, 2009). Energy Fuels' Energy Queen Mine is currently being rehabilitated.

In May 2009, the BLM Monticello Field Office approved White Canyon Uranium Ltd's plans to develop an underground uranium mine approximately 35 miles east of Blanding, in San Juan County, Utah (BLM, 2009a). The Utah DOGM approved the project, known as the Daneros Mine, in July 2009 (Baker, 2009). The Daneros Mine which is expected to produce 100,000 tons of uranium over seven years is located more than 50 miles (80 km) away from the Site. The nearest uranium and vanadium processing plant, the White Mesa Mill, is located in Blanding, Utah, which is more than 50 miles (80 km) from the Piñon Ridge Site.

Coal. The New Horizon Mine is the only coal mine within 50 miles (80 km) of the Site. The New Horizon is a surface coal mine that supplies coal to the Nucla Station, a 100 megawatt power plant located near the Town of Nucla. Table 3.1-3 shows annual production from the New Horizon Mine between 2001 and 2008. Colorado's top producing coal mine, Bowie #2, is located more than 50 miles (80 km) from the Site in eastern Delta County. Production from the New Horizon Mine is approximately 10 percent that of Bowie #2 (CDNR, 2009c).

Table 3.1-3
New Horizon Mine Coal Production, 2001 – 2008[1]

Year	Tons	Year	Tons
2001	370,725	**2005**	420,730
2002	386,366	**2006**	405,611
2003	352,859	**2007**	406,279
2004	413,332	**2008**	403,230

[1] Source: CDNR, 2009c.

Oil and Gas. Oil and gas production in southwest Colorado is concentrated in the Paradox Basin areas of Montezuma and San Miguel counties along the Colorado-Utah border. Natural gas is also produced in northern Mesa County, and proven oil and gas reserves are located south and east of the Slick Rock area in San Miguel County. According to the COGCC, there are currently no producing oil or natural gas wells in Montrose County (COGCC, 2009b). Most of the region's oil production is in San Juan County, Utah, and most natural gas production is in Montezuma County, Colorado. As shown in Figure 3.1-3, most oil and gas drilling within the region occurs outside the 50 mile (80 km) range of the Site.

3.1.2.3 Recreation

Rafting. The Dolores River flows from its headwaters in the San Juan Mountains through Dolores, San Miguel, Montrose, and Mesa counties into Grand County, Utah, where it converges with the Colorado River. Although the Dolores River does not have federal designation as a Wild and Scenic River, the BLM manages it as such (DOE, 2007). The segment of the Dolores River between McPhee Reservoir, in Dolores County, and Bedrock is a BLM-designated Special Recreation Management Area (SRMA) that is managed for destination recreation-tourism targeting visitors from the southwestern United States and local residents who participate in rafting along the Dolores River, fishing, mountain-biking and jeeping (San Juan Public Lands, 2007). The section of the Dolores River between Slick Rock and Bedrock is a popular rafting destination. Motorized watercraft are prohibited on this section of the river.

Because no water from McPhee Reservoir is allocated for recreational purposes, adequate flows for boating depend on spillwater releases which limit the length of the river season. The peak period for river activity is from April 30 to June 15 during spring runoff. Between Slick Rock and Bedrock, the Dolores River is seldom navigable between July and April due to insufficient water and cold temperatures (Ryan, 2009).

According to the BLM Durango Field Office, people typically launch at Slick Rock and float to Gypsum Valley or Bedrock. Because of the river's proximity to SH 141 north of Bedrock and the lack of established take-out points between Bedrock and Gateway, Bedrock is more popular as a take-out point rather than a launch point (Fonze, 2009). The BLM Durango Field Office maintains registration records for launches in San Miguel County. Because registering is voluntary, the records reflect approximately 60 to 70 percent of river usage (Ryan, 2009). Although the BLM Uncompahgre Field Office does not have comparable data for launches in Montrose County, launch data from San Miguel County are reflective of river usage within the vicinity of the Site.

Table 3.1-4 shows Dolores River launch data between 2005 and 2008. At the time this report was written, 2009 launch data were not available. A single launch typically includes multiple people. Due to inadequate releases from McPhee Reservoir, there were no boating seasons in 2006 and 2007. Of the 630 launches that were recorded in 2008, there were 121 launches in April, 451 launches in May, and 58 launches in June (Ryan, 2009).

Table 3.1-4
Dolores River Launch Summary[1]

Launch Site	County	River Mile	2005	2008
Bradford Bridge	San Miguel	0	288	303
Dove Creek Pump Station	San Miguel	20	69	74
Slick Rock	San Miguel	47	71	139
Gypsum Valley	Montrose	61	95	114
Coyote Wash	Montrose	85	NA	NA
Bedrock	Montrose	97	NA	NA
Gateway	Mesa	141	NA	NA

[1] Source: Ryan, 2009.

Floating is also popular on the San Miguel River, which flows from the San Juan Mountains above Telluride into the Dolores River west of Uravan. According to the BLM Uncompahgre Field Office, the section of the river below Placerville to Norwood is the most popular section of the San Miguel River to float. The section of the river between Norwood and the river's confluence with the Dolores River is not a popular rafting destination because the scenery is not as spectacular as farther upstream (Fonze, 2009).

Hunting. Big-game hunting is popular on public lands in Montrose County. Hunting is also allowed on private land with permission from the landowner. Hunting areas within the region of the Site include the Colorado Division of Wildlife's (CDOW's) Game Management Units (GMU) 61, 62 and 70. Table 3.1-5 shows the number of hunters and the harvested deer and elk in these areas in the 2008 hunting season. Most of the deer and elk in GMU 70, where the Site is located, are found in wooded, mountainous areas that provide suitable habitat.

Table 3.1-5
Regional Deer and Elk Harvest Statistics in the Vicinity of the Site, 2008[1]

GMU	Area	Game	Harvest	Hunters	Success Rate
61	Uncompahgre Plateau	Deer	364	603	60.4%
62	Delta and Montrose counties, east of Uncompahgre Plateau	Deer	928	1,635	56.8%
70	San Miguel County, southwest Montrose County	Deer	1,372	2,015	68.1%
61	Uncompahgre Plateau	Elk	610	1,275	47.8%
62	Delta and Montrose counties, east of Uncompahgre Plateau	Elk	1,203	6,233	19.3%
70	San Miguel County, southwest Montrose County	Elk	1,184	4,356	27.2%

[1] Source: CDOW, 2009a.

Other. In addition to hunting, most of the BLM and NFS lands in Montrose County are accessible to the public for off-highway vehicle use, mountain biking, hiking, and other recreational uses (DOE, 2007). Fishing is popular on the Dolores and San Miguel rivers, and road cycling is popular on State Highways 141 and 145 along the Dolores River. The Gateway area and surrounding Unaweep Canyon in Mesa County, 80 miles north of the Site, has been targeted for recreation-related development. The John Hendricks family began developing the Gateway Canyons Resort in 2005 as a center for outdoor recreation and adventure. The development currently includes 56 guest rooms, a spa, automobile museum, restaurant, grocery store, gas station, and an outdoor recreation-gear store. An events center is under construction and there are plans to build three additional luxury lodges in the next few years (Gateway Canyons Resort, 2009).

In December of 2007 the BLM Grand Junction Field Office (GJFO) initiated a process to amend the 1987 Grand Junction Resource Area Resource Management Plan (RMP) by designating a Gateway SRMA. The amendment intended to incorporate recreation needs, travel routes, and recreation management objectives on public lands in the Gateway area into the 1987 RMP. According to the BLM GJFO, in early 2009 the BLM halted its efforts to amend the 1987 RMP and designate a Gateway SRMA. Instead, BLM decided to incorporate recreational uses in the Gateway area into a revised RMP, which is scheduled to be completedi in 2011 or later (Ham, 2009).

3.1.3 Land Use Planning Issues

Montrose County is currently updating its Master Plan. This process, which began in October 2008, is expected to be completed by December 2009. The county master plan update identifies targeted urban growth areas and sites for commercial and industrial development. Naturita and Nucla are targeted urban growth areas in western Montrose County. On September 30, 2009, the Montrose County commissioners approved a Special Use Permit for the Piñon Ridge Site (Montrose County, 2009a).

3.2 TRANSPORTATION

3.2.1 Transportation Routes

Figure 3.2-1 shows the major regional transportation routes in western Colorado and eastern Utah that are within the vicinity of a 50 mile (80 km) radius around the Site. U.S. Highway 50 is the primary roadway traversing eastern Montrose County. To the north, U.S. Highway 50 connects Montrose County with Delta and Mesa counties, and intersects Interstate-70 near Grand Junction. From the City of Montrose, U.S. Highway 50 heads east into Gunnison County. South of the City of Montrose, U.S. Route 550 parallels the Uncompahgre River through Ridgway in Ouray County and Durango in La Plata County to connect with U.S. Highway 160 near Durango. U.S. Route 550 is a National Scenic Byway (the San Juan Skyway) between Ridgway and Durango.

SH 141 is the primary north-south highway in western Montrose County. From the north, the highway enters Montrose County paralleling the Dolores River. The Dolores and San Miguel rivers merge near Uravan, and SH 141 follows the San Miguel River through Vancorum and Naturita. SH 141 continues south into San Miguel County, connecting the area surrounding the Site with the Slick Rock and Egnar areas of western San Miguel County. Approximately 4 miles east of Naturita, SH 141 intersects SH 145. SH 145 travels through the Redvale community into Norwood and Telluride in San Miguel County. SH 141/145 is a Colorado Scenic Byway (the Unaweep/Tabeguache Scenic and Historic Byway) between Whitewater in Mesa County and the junction of SH 145 and SH 62 near Placerville in San Miguel County.

SH 90 is the primary east-west highway through Montrose County. It enters the county as Utah SH 46 and passes through the community of Bedrock before intersecting with SH 141 near Vancorum. East of Nucla, SH 90 crosses the Uncompahgre Plateau to connect with U.S. Highway 550 and the City of Montrose. Approximately 35 miles of SH 90 is unpaved across the Plateau, and adverse weather conditions frequently close this portion of the roadway, known as the Tabeguache Trail, during the winter. Consequently, residents of western Montrose County typically travel to the Town of Montrose via SH 145 and SH 62 over the Dallas Divide to Ridgway and up U.S. Highway 550 during winter and spring months. In March 2009, the Montrose County Commissioners applied for federal funding to pave the remainder of SH 90 across the Uncompahgre Plateau. The project is not included on CDOT's list of American Recovery and Reinvestment Act Projects dated July 17, 2009 (CDOT, 2009a). Region 5 of the CDOT maintains all U.S. and state highways in Montrose County.

Utah SH 46 crosses approximately 21 miles of northeastern San Juan County, Utah to intersect with U.S. Highway 191 at La Sal Junction. U.S. Highway 191 runs north to south, from its intersection with Interstate-70 at Crescent Junction, through the towns of Moab, Monticello, and Blanding into Arizona. Region 4 of the UDOT maintains both of these highways.

3.2.2 Roadway System in Vicinity of the Site

Figure 3.2-2 shows the roadway systems in the vicinity of the Site. Access to the Site would be located near milepost 23 on SH 90. The existing intersection of the site access point and SH 90 is a four-leg layout. The access opposite the Site is a dirt road with little to no observed traffic volume. There are no physical features (*e.g.* signs, walls, berms, plants, etc.) within the sight zones of the intersection of SH 90 and the site access point (TurnKey Consulting, LLC - TurnKey, 2008).

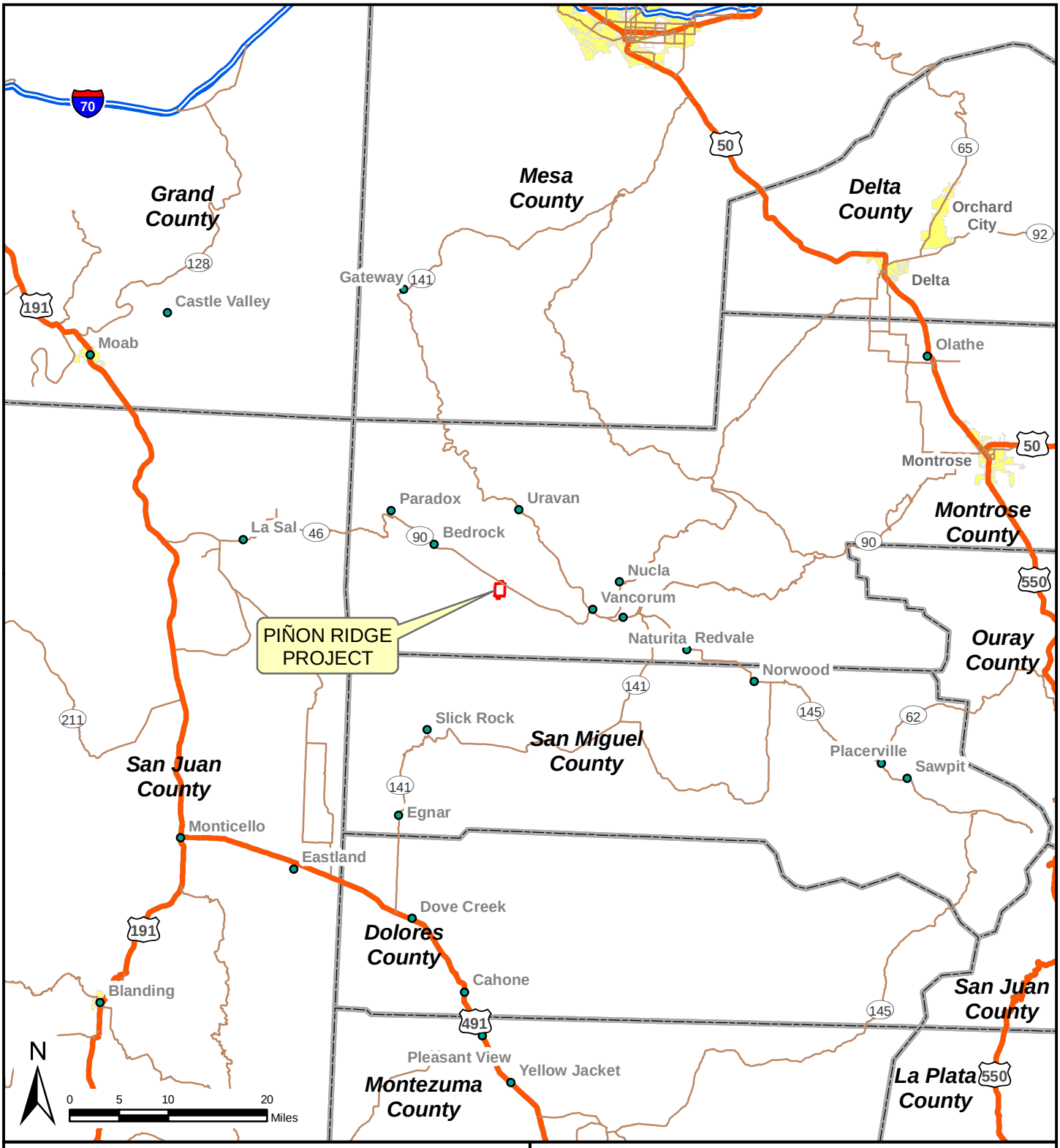


Figure 3.2-1

Major Regional Transportation Routes

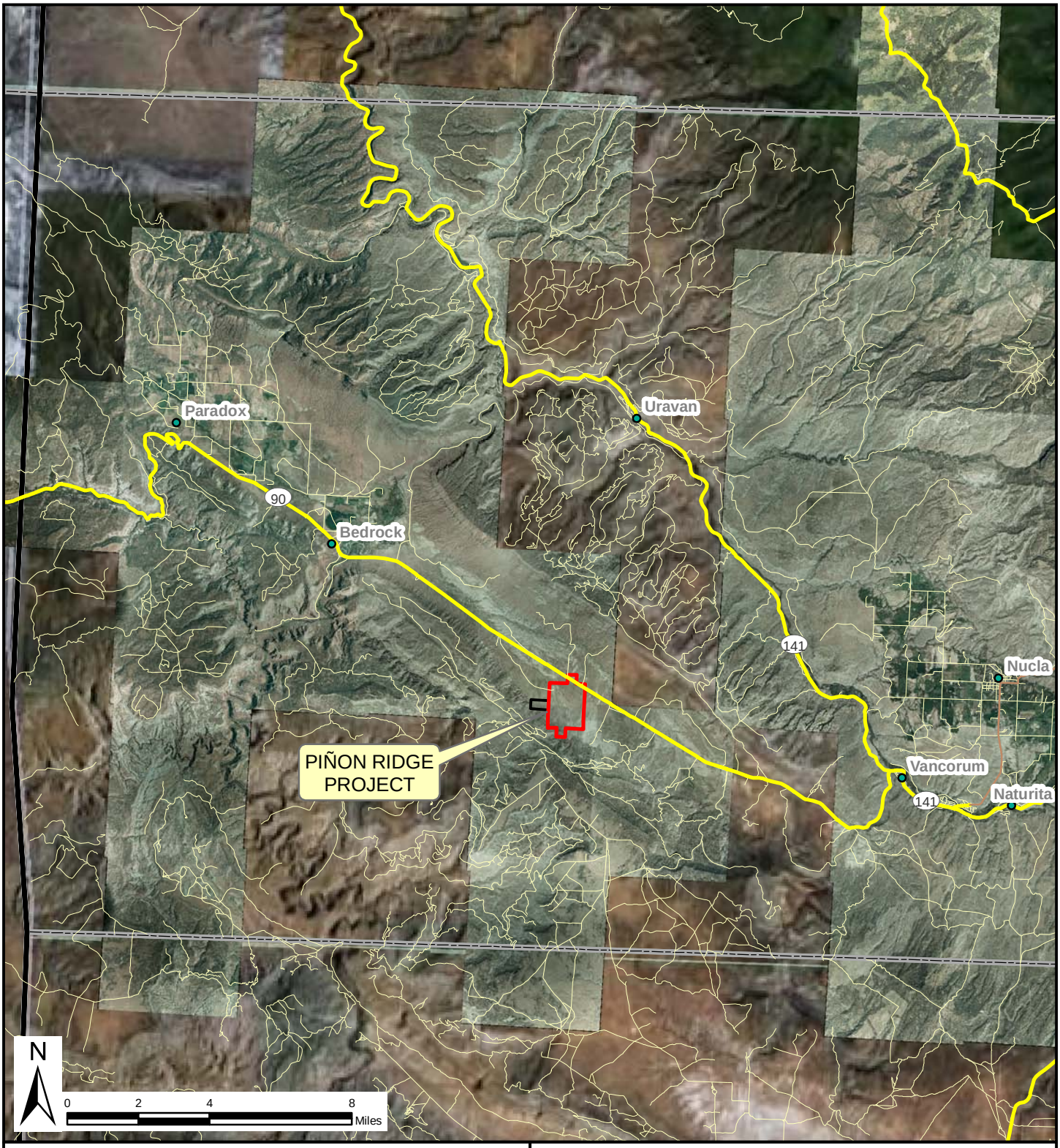


Figure 3.2-2

Minor Roads Near the Site

There are several unimproved roads in the vicinity of the Site. Many of these roads were built on public lands by ranchers and miners before the BLM developed road construction and usage regulations, and are currently maintained by county agencies or the BLM (TurnKey, 2008). Private roads in the area lead to residences and ranching operations.

3.2.3 Traffic Patterns

Table 3.2-1 shows 2008 annual average daily traffic volumes on roadways within the vicinity of the Site.

Table 3.2.1
Annual Average Daily Traffic on Roads within the Vicinity of the Site, 2008

Segment Description	Mileposts		All Vehicles	Trucks
	Start	End		
Colorado State Highway 90[1]				
County RD 5.75 to Paradox	0.000	9.493	200	40
Paradox to Bedrock	9.493	14.797	NA	NA
Bedrock to Vancorum	14.797	33.874	530	82
Colorado State Highway 97[1]				
SH97 (Nucla Road) to County Road EE28 in Naturita	0.000	0.320	2,000	146
Naturita to Nucla	0.320	3.932	1,600	85
Colorado State Highway 141[1]				
US491/SH141 junction to Egnar	0.000	9.381	730	127
Egnar to K8 Road	9.381	11.271	730	173
K8 Road to southeast of SH141/145 junction	11.271	44.124	480	129
Southeast of SH141/145 junction to northwest of SH145	44.124	55.505	590	176
NW of SH145 to Naturita	55.505	60.213	1,500	222
East of SH97 (Nucla Road) to west of SH97 in Naturita	60.213	60.452	1,700	173
West of SH97 to Main Street in Naturita	60.452	60.701	2,400	228
Main Street to West 2nd Ave in Naturita	60.701	60.801	1,200	132
Naturita to junction of SH141 and SH90 at Vancorum	60.801	62.436	660	121
2 miles north of SH141/SH90 junction	62.436	64.395	340	46
2 miles north of SH90 junction to Gateway	64.395	110.525	460	91
Foy Road intersection to Gateway	110.525	153.767	680	121
Gateway to Whitewater	153.767	154.109	1,400	336
U.S. Highway 491[1]				
Junction of US491 and SH141 to County Road	63.272	67.947	2,400	562
County Road 6 to Utah border	67.947	69.602	2,100	573
Colorado State Highway 145[1]				
West of Lone Cone Road to Market Street in Norwood	99.494	101.066	2,800	274
Market Street to Spruce Street in Norwood	101.066	101.561	2,600	200
Spruce Street to Summet Street in Norwood	101.561	102.596	2,000	194
Norwood to Redvale	102.596	110.107	1,300	126
Redvale to SH145/SH141 intersection	110.107	116.879	1,200	110
Utah State Highway 46[2]				
Junction of SH 46 & SH 191 to La Sal Junction Post Office	0.000	9.052	600	210
La Sal Junction Post Office to Colorado state line	9.052	21.595	335	118
U.S. Highway 191[2]				
SR95 junction to Blanding	47.255	50.412	2,760	735
800 South to 200 North in Blanding	50.412	51.656	6,915	2,187
Blanding to Verdure	51.656	65.162	2,120	744
Verdure to 400 South in Monticello	65.162	71.460	2,455	946
400 South to US491 in Monticello	71.460	71.857	2,610	1,039
US491/US191 junction to 600 North in Monticello	71.857	72.395	3,160	1,341
600 North in Monticello to SR211	72.395	86.136	3,415	1,538
SR211 to La Sal Junction (SH46)	86.136	103.446	3,735	1,703
La Sal Junction to Old Airport Road	103.446	117.890	3,705	1,709
Old Airport Road to La Sal Loop	117.890	123.194	5,030	2,096

Segment Description	Mileposts		All Vehicles	Trucks
	Start	End		
La Sal Loop to 400 East Moab	123.194	124.484	9,635	3,586
400 East to Center Street in Moab	124.484	125.702	14,510	4,753
Center Street to 500 West in Moab	125.702	126.981	9,185	2,599
500 West, Moab to SR128	126.981	128.180	9,240	2,202
SR128 to Colorado River	128.180	129.798	8,225	1,593
Colorado River to SR279	129.798	130.262	6545	2043
SR279 to SR313 (Arches National Monument Road)	130.262	136.733	4835	1958
SR313 to I-70 Crescent Junction	136.733	157.193	5140	2623
Interstate 70[2]				
SR24 Hanksville Buckmaster Draw	149.198	157.939	4,085	1,601
SR6 West SR191 North	157.939	160.410	8,090	3,573
SR19 West Green River	160.410	164.547	8,870	4,359
SR19 East Green River	164.547	175.585	8,765	4,744
Ranch exit (Floy)	175.585	182.170	8,465	5,003
SR191 Crescent Junction, Moab	182.170	187.420	6,800	3,882

[1] Source: CDOT, 2009b.
[2] Source: Butterfield, 2009.

The junction of SH 90 and SH 141 is the nearest highway intersection to the Site. This junction is a three-leg configuration. Table 3.2-2 shows the results of a traffic count conducted at this intersection by TurnKey on October 19, 2007. The table includes an adjusted count to consider peak time of year traffic (July).

Table 3.2-2
Peak Hour Traffic Volume at Junction of SH 141 and SH 90, 2007[1]

	Eastbound			Northbound			Southbound		
Hourly traffic count	Lft	Thru	Rt	Lft	Thru	Rt	Lft	Thru	Rt
Raw count	1	NA[2]	13	18	12	NA	NA	17	1
Peak season adjustment	1	NA	15	21	14	NA	NA	20	1

[1] Source: TurnKey, 2008.
[2] NA=not available.

CDOT estimates that, over the next 20 years, traffic on SH 141 will increase 3.85 percent annually, and traffic on SH 90 will increase 3.4 percent annually (TurnKey, 2008).

3.2.4 Traffic Crashes

Table 3.2-3 shows the number of traffic crashes involving fatal and non-fatal injuries in counties near the Site for the years 2000 through 2008. Crash data for Colorado counties were obtained from the Colorado State Patrol (CSP), which reports crash data for CSP enforcement activity only. Statewide, the CSP investigates approximately 30 percent of traffic crashes, including 70 percent of all crashes involving fatalities. The CSP investigates most of the traffic crashes that occur in western Colorado (Allbee, 2009). Crash data for Utah counties reported by the Utah Department of Public Safety (UDPS) include crash reports completed by all law enforcement officers throughout the state.

Table 3.2-3
Traffic Crash Injuries and Fatalities in Surrounding Counties[1]

Year	Injury Type	County				
		Mesa CO	Montrose CO	San Miguel, CO	Grand UT	San Juan, UT
2000	Injury	401	131	58	NA	NA
	Fatal	14	2	3	NA	NA
2001	Injury	418	116	40	NA	NA
	Fatal	21	6	3	NA	NA
2002	Injury	423	108	37	119	115
	Fatal	18	3	2	8	6
2003	Injury	391	104	41	195	158
	Fatal	6	2	1	7	4
2004	Injury	400	87	48	185	169
	Fatal	14	6	7	11	7
2005	Injury	370	95	32	135	126
	Fatal	11	5	1	8	8
2006	Injury	377	80	41	153	106
	Fatal	16	5	2	8	0
2007	Injury	206	41	30	134	141
	Fatal	20	4	1	5	16
2008	Injury	212	44	15	NA	NA
	Fatal	8	9	4	NA	NA

[1] Sources: CSP, 2009; Allbee, 2009; and UDPS, 2009.
[2] NA=not available.

Fatality rate data provide additional information on fatal traffic crashes. Table 3.2-4 shows highway fatality rates in counties near the Site. According to CDOT, the 2008 highway fatality rate, expressed as fatalities per million vehicle miles traveled (MVMT), was 0.0114 across the State of Colorado, 0.0452 in Montrose County, 0.0173 in Mesa County, and 0.0521 in San Miguel County (CDOT, 2009c). Comparable highway fatality rates are not available for Utah counties. In 2007, the highway fatality rate in Utah was 0.0111 per MVMT on all highways and 0.0234 on rural roads in the state (National Highway Traffic Safety Administration - NHTSA, 2009).

Table 3.2-4
Fatality Rates per Million Vehicle Miles Traveled

Area	2007	2008
Colorado – all roads[1]	0.0114	0.0114
Colorado - rural roads[1]	0.0202	NA[3]
Mesa County[1]	0.0359	0.0173
Montrose County[1]	0.0226	0.0452
San Miguel County[1]	0.0130	0.0521
Utah – all roads[2]	0.0111	NA
Utah – rural roads[2]	0.0234	NA

[1] CDOT, 2009c.
[2] NHTSA, 2009.
[3] NA=not available.

3.3 GEOLOGY AND SOILS

3.3.1 Geology

Paradox Valley has been studied as part of the Paradox Basin by geologists since the nineteenth century from the perspectives of uranium/vanadium deposits, later exploration of oil and gas reservoirs and the more academic interest in the salt anticlines per se. A 1981 guidebook put out by the Rocky Mountain Association of Geologists (RMAG, 1982) stated in the Preface that the lack of petroleum exploration at that time was probably due to the complexity of the Paradox Salt. Since then, the literature of oil and gas, uranium, and pure geology of the region has proliferated.

Evaluation of the Site's conformance with mill and tailings siting criteria outlined in Appendix A, Part 18 of 6 CCR 1007-1 (CDPHE, 2001) requires a detailed knowledge of the local and regional geology. NRC Guidance for Environmental Reports for Uranium Mills also requires that there is a geologic characterization of the Site (NRC, 1982a and 2003a). Kleinfelder conducted extensive on-site field investigations to characterize baseline geology of the Site, as desribed below.

Geologic characterization began with a literature review in USGS, Colorado Geological Survey, and New Mexico Bureau of Mines and Mineral Resources sources. Aerial photographs of the area were obtained and reviewed to assist in the identification of larger scale geologic features. Geologic mapping was conducted in August 2007 on a topographic base map using a scale of 1 inch = 200 feet and a contour interval of 2 feet. Soils were classified according to the Unified Soil Classification System (USCS). The geologic mapping was conducted in accordance with the *Amendment No. 2, Geological Investigations Work Plan* (Kleinfelder, 2008a).

Supplemental geologic reconnaissance and mapping was conducted in December 2008 in the northern half of the Site and on the adjacent property to investigate any sinkholes or other karst features. The investigation included field reconnaissance of an observed sinkhole north of the Property Boundary, field observations of multiple circular-shaped clearings observable in aerial photographs, and reconnaissance of the contact between the alluvial valley fill deposits to the south and the weathered surface of the Paradox member of the Hermosa Formation to the north. The work was conducted in accordance with *Amendment No. 2, Geological Investigations Work Plan* (Kleinfelder, 2008a).

A refraction and reflection geophysical survey was conducted in 2007, to determine if faults could be detected in the Quaternary deposits, and if any evidence could be obtained regarding groundwater in the area. The seismic survey methodology and results are summarized in the *Geologic Report* Kleinfelder (2009e). In addition, two pilot tests using electromagnetic methods were conducted in February and March 2008 to further investigate an anomalous soil feature later identified in a trench. This work was performed in accordance with the Work Plan for Additional Geophysical Investigations (Sunbelt Geophysics, 2008). The results of the two pilot tests were provided in the *Geologic Report* by Kleinfelder (2009e).

Three trenches were excavated and mapped in December 2007 over possible subsurface faults inferred from the seismic refraction and reflection surveys. The purpose of the trench excavations was to assess if fault rupture or displacement has occurred in Quaternary alluvium overlying the inferred faults (to see if faults have been recently active). The trench mapping was completed in accordance with *Amendment No. 2 Geological Investigations Work Plan* (Kleinfelder, 2008a). During the trench mapping activities, organic samples were collected for

radiocarbon analysis to help establish the ages of the alluvium. The radiocarbon analysis methodology and results prepared by the Paleo Research Institute, Inc. were reported in the *Geologic Report* (Kleinfelder, 2009e). In total, the trenches totaled approximately 3,150 feet of linear excavation.

Several drilling programs were conducted at the Site for purposes of geotechnical characterization, general site geology, groundwater characterization and monitoring, and water resources development. These include:

- Phase 1 geotechnical investigation consisting of 20 borings in support of geotechnical soil testing (Kleinfelder, 2009e);
- Phase 2 geotechnical investigation consisting of 73 borings to support additional geotechnical characterization and design of facilities (Golder, 2008b);
- Nine groundwater monitoring wells drilled to provide sampling points for the baseline characterization of groundwater quality (Golder, 2009d);
- Eighteen borings drilled for geological characterization and as a preliminary phase of the water resources investigation (Kleinfelder, 2009e);
- Three production wells and six observation wells installed to investigate available water resources (Golder, 2009c); and
- Four additional borings to assess the soil discontinuity identified in Trench 2 (Kleinfelder, 2009d).

Geotechnical and stratigraphic discontinuity drilling consisted of continuous core or hollow stem auger drilling to identify soil types, depth to bedrock, and evidence of recent fault movement or voids. These borings were generally advanced to depths of less than 100 feet. Coring in the bedrock was typically performed using wet coring methods. Samples of unconsolidated sediments were collected by split spoon sampling methods. Core samples were collected from borehole intervals selected by the rig geologist to be representative of lithologic units and stratigraphic/formational boundaries. Groundwater monitoring wells, production wells, observation borings, and EX borings were drilled to depths of up to 1,020 feet using air rotary or down-the-hole hammer methods. Cuttings were collected from discrete intervals and logged by the rig geologist.

3.3.1.1 Regional Geology

The Site is located in Paradox Valley, within the Canyonlands Section of the Colorado Plateau Physiographic Province (Cater, 1954, 1955a 1955b, 1970, and Cater et al., 1955). This province consists of desert to arid parts of Utah, Colorado, New Mexico, and Arizona, a geomorphically young terrain of largely flat-lying continental strata with mesas, pediments, and deeply incised canyons (most famously, the Grand Canyon). The physiographic province was defined and described by Hunt (1967).

Paradox Valley lies in the eastern part of the depositional Paradox Basin, a vast basin approximately 200 miles long by 80 miles wide, with a northwest axis, and flanking the Uncompahgre anticlinal uplift (Figure 3.3-1). A schematic stratigraphic section is shown in Figure 3.3-2. In Mississippian time, marine limestone was deposited on the crystalline

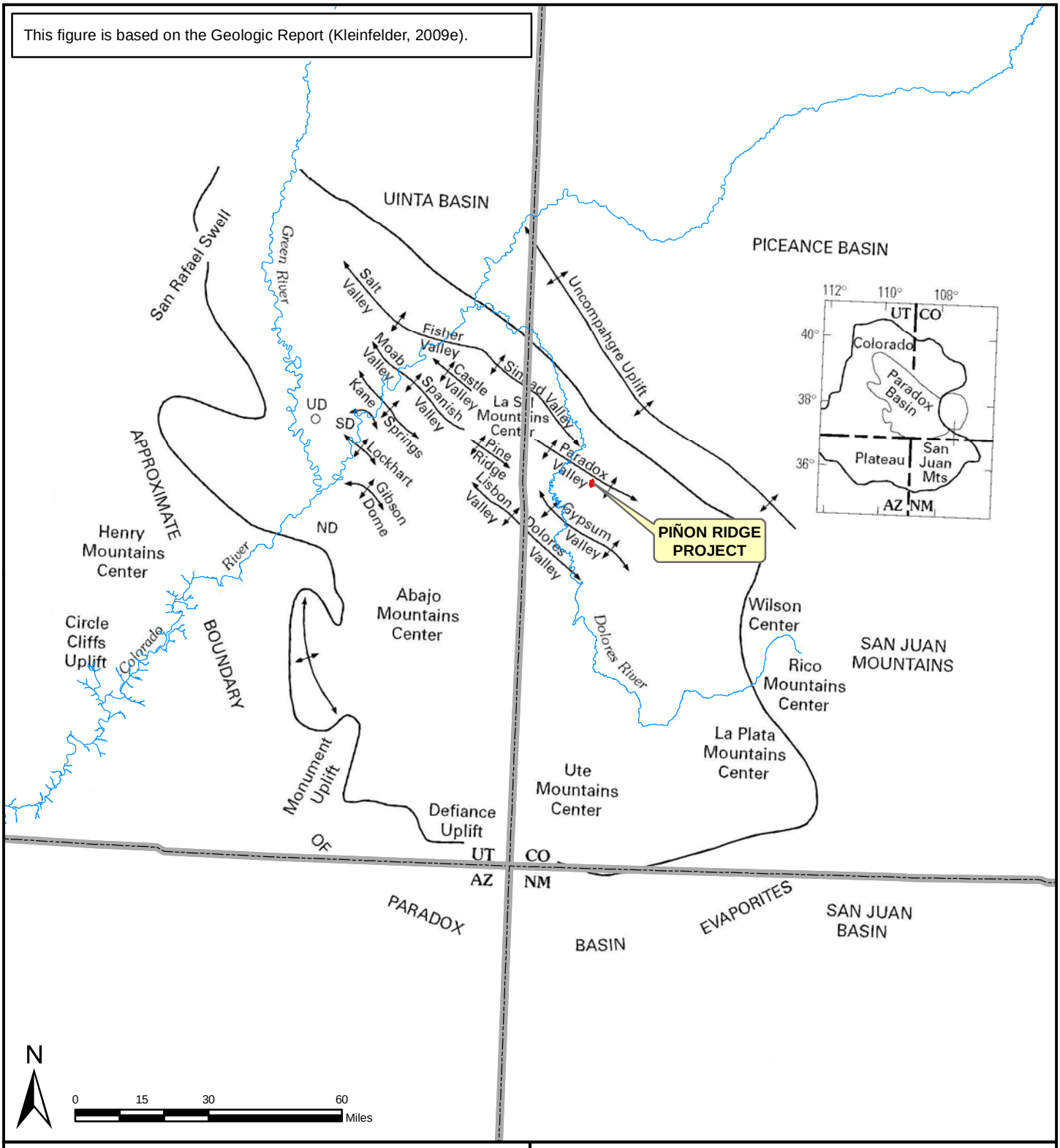


Figure 3.3-1

Regional Setting of the Paradox Basin

This figure is based on the Geologic Report (Kleinfelder, 2009e).

Era	Period	Formation and Map Unit Symbol	
Mesozoic	Cretaceous	Mancos Shale Km	
		Dakota Sandstone Kd	
		Burro Canyon Formation Kbc	
	Jurassic	Morrison Formation Jms	
		Summerville Formation Js	
		Entrada Sandstone Jec	
		Carmel Formation Jc	
		Navajo Sandstone Jn	
		Kayenta Sandstone Jk	
		Wingate Sandstone Jw	
	Triassic	Chinle Formation Trc	
		Moenkopi Formation Trm	Paradox Member Salt
Paleozoic	Permian	Cutler Formation Pc	
	Pennsylvannian	Hermosa Formation Phi	
	Mississippian	Leadville Limestone ML	

Figure 3.3-2

Schematic Stratigraphic Section Paradox Valley

basement, in Colorado called the Leadville Limestone, and at the Grand Canyon the Redwall Limestone. This limestone is overlain by upper Paleozoic sedimentary deposits including the shales and evaporites of the Paradox Member of the Hermosa Formation, regionally capped by the Honaker Trail Formation, and fluvial sandstone and conglomerate of the Permian Cutler Formation. The Paradox Member contains limestone, black shales, and gypsum, anhydrite, halite, and potash salt accumulations. Even as the Cutler Formation was deposited, the Paradox salt strata began to deform under burial load and between basin faults, to rise and flow into a series of northwesterly trending salt diapirs (intrusion of plastic, buoyant material through more competent rocks) (Chenoweth, 1987). This broad region of Paradox salt diapirs was termed the “Paradox fold and fault belt” by Kelley (1955). Up to the 1981 RMAG Guidebook (RMAG, 1982), early authors accorded formation status to the Paradox Salt.

The salt core anticlines continued to rise through the Jurassic Period, influencing the deposition of younger strata up to the Morrison Formation. The Honaker Trail and Cutler formations were tilted and thinned along the flanks of the rising salt diapirs. This continued through the Triassic period and into the Jurassic period, but diminished as the salt was lost from intervening synclines, and the diapirs stabilized. The area continued to accumulate up to 5,000 feet of younger Late Jurassic and Cretaceous formations across the upturned and truncated edges of the older formations (Chenoweth, 1987). Regional compression during the Laramide orogeny (Late Cretaceous to lower Tertiary time) accentuated these structures.

Broad uplift of the Colorado Plateau during the middle to late Tertiary, roughly 38 million to 2 million years ago, and extensive erosion in last few million years, exposed the salt diapirs to groundwater circulation via anticlinal jointing (Chenoweth, 1987), and the resulting dissolution of the salt caused collapse and removal of the anticlinal crests. Today, the anticlines have prominent sandstone bluff flanks, and broad, dry valleys exhuming the top of the Paradox Member. Paradox Valley obtains its name from the Dolores River crossing the valley perpendicular to its axis, while there is no watercourse along it (Cater, 1954, 1955a, 1955b, 1970 and Cater et al., 1955). According to Chenoweth (1987), Paradox Valley probably formed by the antecedent Dolores River cutting across the anticlinal crest and exposing the salt to rapid dissolution. Cater (1970) has estimated that the upper surface of the salt core of the anticline in Paradox Valley was at least 3,000 feet higher than the present day valley floor.

The salt core in Paradox Valley is exceptionally thick. An oil well drilled 1.5 miles north of the Town of Bedrock penetrated the base of the salt at 14,670 feet depth (Chenoweth, 1987). Cater (1954) reports that more than half the formation is composed of rock salt (halite), although this has not been encountered at the Site.

Triassic strata overlying the Cutler Formation include the red bed Moenkopi and Chinle formations. Above them lie the Jurassic Wingate Sandstone, Kayenta Formation and Navajo Sandstone (together, grouped as the Glen Canyon Series), and the Morrison Formation, famous for dinosaur fossils and uranium/vanadium deposits. To the east and west of the area, Dakota Sandstone overlies the Morrison Formation, and in turn is overlain by the Mancos Shale, deposited in the Cretaceous seaway.

Most erosion of the Colorado Plateau is thought to have occurred in upper Tertiary and Quaternary time (Pelletier, 2009), leaving the characteristic bluff-bordered valleys with relict mesas and buttes, and steeply incised river canyons. The landscape of the entire Colorado Plateau including Paradox Valley was reduced on average from 1,640 feet to 3,280 feet (500 to 1,000 meters) by erosion in that period, according to Pelletier, even as it was uplifted. Recent

deposits of sheet wash and aeolian sand sheets are widely distributed on the valley floors and on top of the mesas (Cater, 1954).

Volcanic rocks do not occur within the immediate vicinity of the Site. The nearest volcanic rocks occur at the western margin of the Oligocene (~ 20 to 30 million years old) San Juan volcanic field, approximately 60 miles east of the Site. Volcanism near Flagstaff, Arizona, some 250 miles to the southwest, began about 6 million years ago, and ended only 1,000 years ago. Other recent volcanic fields occur in and around the Grand Canyon, and near Grants, New Mexico. The La Sal Mountains at the northern head of Paradox Valley, and the Henry Mountains to the west, are igneous intrusions of Oligocene age (25 to 28 million years old), exhumed by the late Tertiary – Quaternary erosion referred to above. A small intrusive body of similar age occurs in the synclinal Disappointment Valley, some 20 miles south.

3.3.1.2 Site Geology

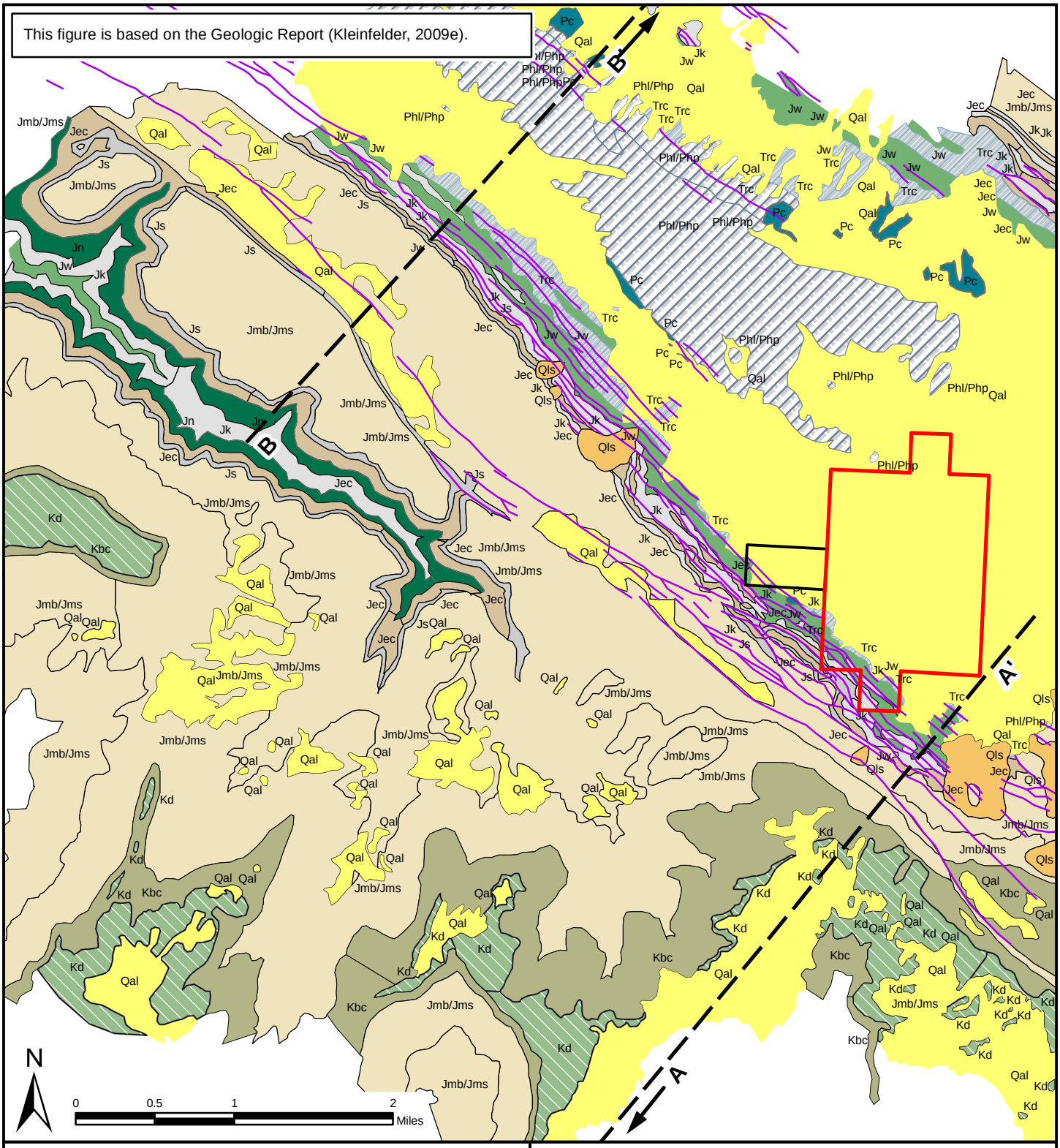
The Site is located on the south side of the southeastern end of Paradox Valley. The regional geology is shown in Figure 3.3-3. Cross sections at locations indicated in Figure 3.3-3, and taken from USGS quadrangle geology maps, are shown in Figure 3.3-4. Most of the Site is on the valley floor, but the southwest part of the Site extends onto the valley side below Davis Mesa, which consists of Triassic to Jurassic strata including Chinle, Wingate, Kayenta, Entrada, and Morrison formations. Most of the Site (the valley bottom) is covered by late Quaternary deposits of fine-grained alluvium and eolian (wind-blown) deposits with some gravelly alluvial stream channel deposits. Underlying the unconsolidated sediment cover in the valley are Chinle and Wingate sandstones and Paradox Member shales and evaporites.

Southeast of the Site is a slumped block of Morrison Formation, which is detached from the valley sides, and in which Cotter has mined uranium/vanadium ore. This block is thoroughly broken by curved faults, and shale beds are contorted (Strauss, 1982).

Paleozoic and Mesozoic strata outcropping in the flanks of Paradox Valley have been mapped and described extensively, as described in the regional geology section. The geology of the bedrock beneath the Site alluvium was explored with geophysical surveys, borings, and trenching. This work is reported in the *Geologic Report* (Kleinfelder, 2009e). The location of seismic survey lines, trenches, and borings of this program are shown in Figure 3.3-5.

Surficial Geology – Quaternary Sediments. Most of the Site is located on the floor of Paradox Valley and is underlain by deposits of unconsolidated late Quaternary eolian (wind blown) and alluvial sediments derived from the Triassic-Jurassic strata now exposed in the valley sides. The alluvial sediments pinch out against the bedrock to the south, thicken up to 140 feet thick near the center of the Site, and thin to the north near the center of the valley where the Hermosa Formation surfaces.

The Site alluvial surface consists principally of eolian, light brown to brown fine-grained sand with silt and clay. Thin alluvial fans skirt the base of the southwest valley side, and minor alluvial channel deposits of loose sand with some boulders occur along ephemeral channels which merge into valley bottom alluvial sheet wash deposits of fine-grained sand with intermixed gravel, silt, and clay. A patch of residual soils developed over the Paradox Member was mapped on the northeast portion of the Site.



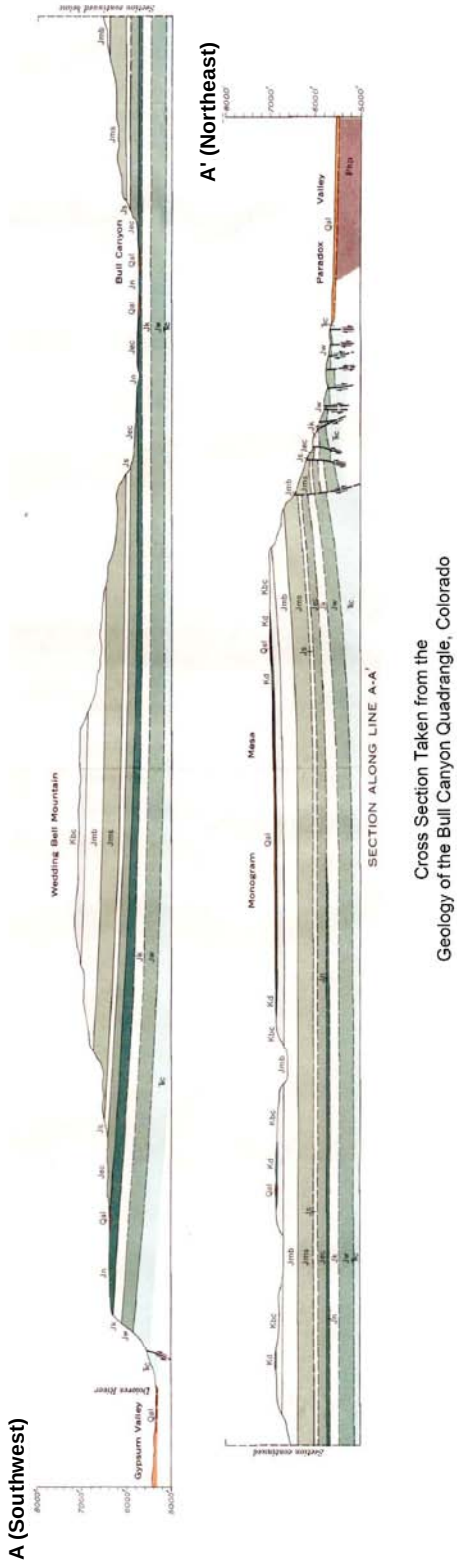
Property Boundary
Well Field Boundary
Geology Cross-Sections
Fault Trace

Geology
- Jec, Entrada Sandstone and Carmel Formation undivided
- Jk, Wingate Sandstone
- Jmb/Jms, Morrison Formation
- Jn, Navajo Sandstone
- Js, Summerville Formation
- Jw, Wingate Sandstone
- Kbc, Burro Canyon Formation
- Kd, Dakota Sandstone
- Pc, Cutler Formation
- Phl/Php, Hermosa Formation
- Qal, Alluvium
- Qls, Landslide deposits
- Trc, Chinle Formation

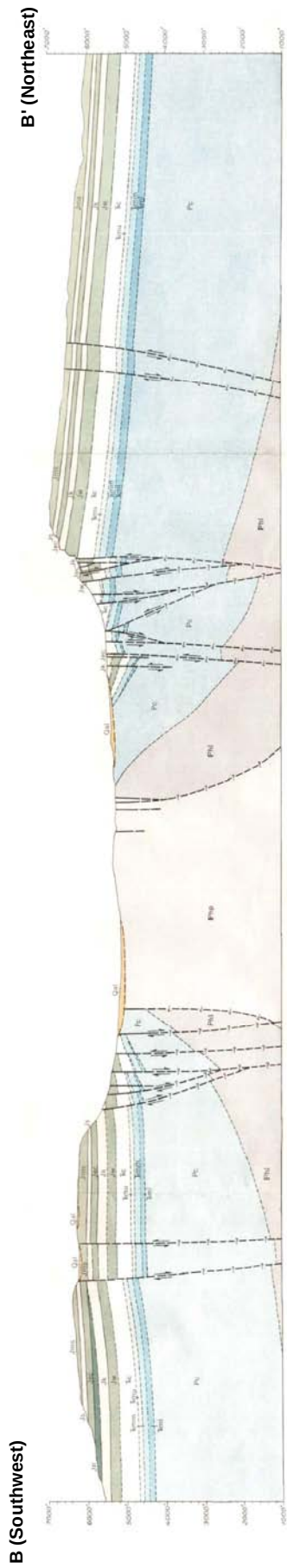
Figure 3.3-3

Regional Geology

This figure is based on the Geologic Report (Kleinfelder, 2009e).



Cross Section Taken from the
Geology of the Bull Canyon Quadrangle, Colorado
By Fred W. Cater, Jr.

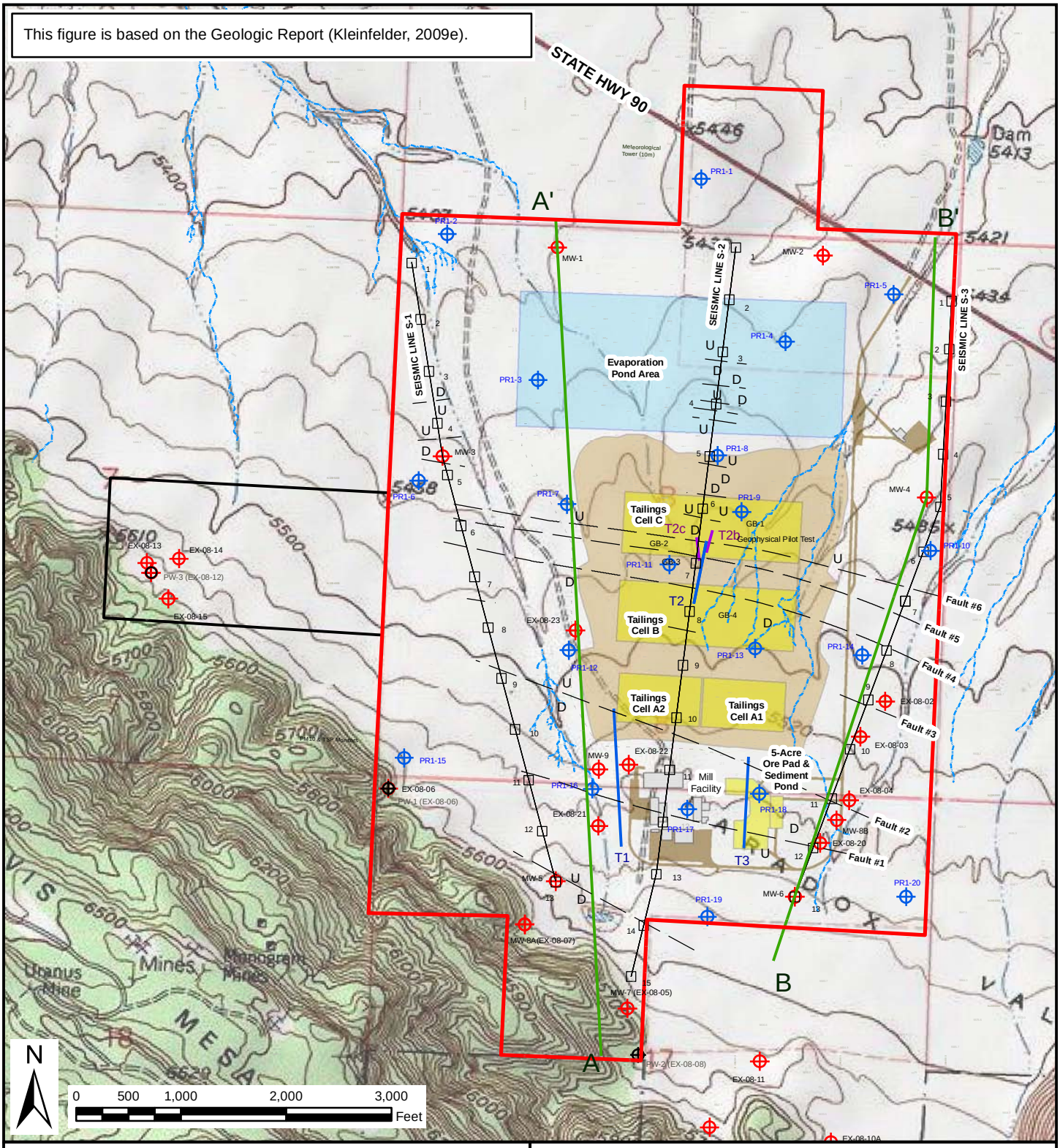


Cross Section Taken from the
Geology of the Davis Mesa Quadrangle, Colorado
By Fred W. Cater, Jr.

Figure 3.3-4

Regional Geologic Cross-Sections

See Figure 3.3-3 for Cross-Section Locations and Formation Explanantions



Property Boundary
Well Field Boundary
Monitor Wells
Production Wells
Exploratory Wells
Phase I Geotech PR Boring
Fault (Dashed where inferred)
Seismic Lines
Cross Section Lines
Trenches (Excavated & Mapped 12/07)
Trenches (Excavated & Mapped 05/08)
Ditches

Figure 3.3-5

Seismic Lines, Trenches, and Boring Locations

Unconsolidated materials identified in the geotechnical boreholes consisted primarily of light brown to brown interbedded silty sand (SM in the USCS classification - USCS, 1966) and sandy silt (ML), with occasional interbeds of sandy and silty clay and lean clay (CL). Fine to coarse gravel and cobble-sized materials occur in lenses or as float in the fine sediments. The coarser alluvial material represents alluvial detritus deposited as sheet wash or in small channels similar to those on the surface today. Some of the beds were weakly cemented by caliche (calcium carbonate). Three trenches excavated and mapped in December, 2007, at locations shown in Figures 3.3-5 and 3.3-6 showed no displacement of any soil layers by faulting.

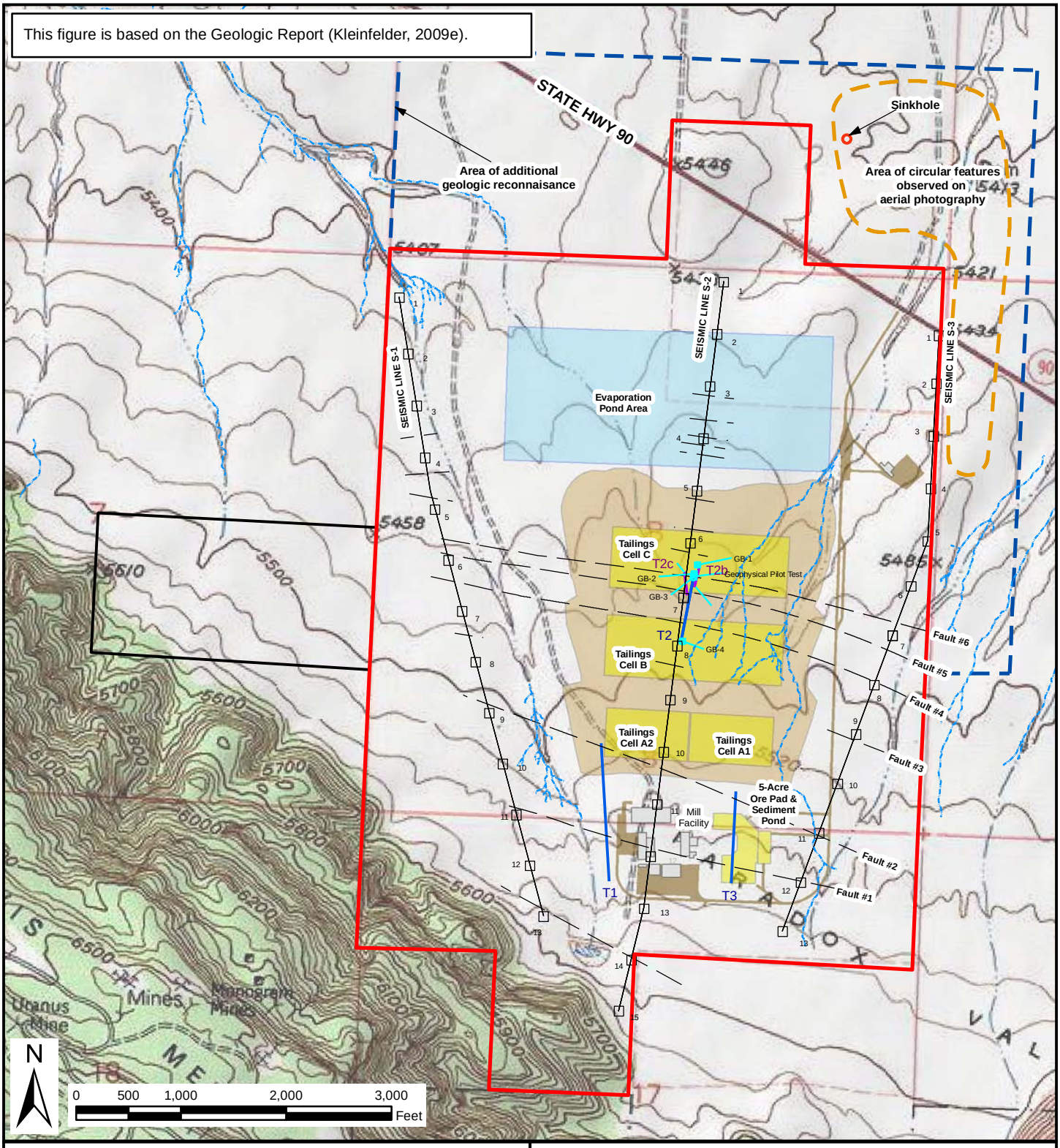
Additional investigations were conducted to more fully assess the lateral extent and the origin of a soil discontinuity feature identified in Trench 2, and the possibility it might be associated with a bedrock sinkhole. The investigations included electromagnetic survey (February/March 2008), excavation of two additional trenches (May 2008) and drilling of four boreholes (October 2008). The locations of the additional trenches and the four borings are provided in Figure 3.3-6. The conclusion of these investigations was that there is no bedrock discontinuity associated with the soil feature, and the latter is likely a channel cut-and-fill.

Bedrock Geology. Triassic and Jurassic strata outcrop in the valley side at the southwest of the Site below Davis Mesa. Rocks exposed there include siltstone, sandstone, shale, and conglomerate of the Chinle and Wingate formations. Rocks encountered in drill holes below the unconsolidated Quaternary sediments in the valley floor include Moenkopi, Chinle, and Wingate formations underlain by the Paradox Member. The Cutler Formation was not penetrated in any of the boreholes and appears to be absent at the Site, consistent with deposition of this formation being interrupted by the diapiric rise of the Paradox salt. The weathered surface of the Hermosa Formation is exposed in the valley floor north of the Site. Figures 3.3-7 and 3.3-8 show fence diagrams of lithology encountered in site borings.

Where the Paradox Member is intercepted in site borings, it consists of interbedded dark brown-dark gray-black shale, white to dark gray anhydrite, white to gray gypsum and minor carbonaceous limestone, siltstone, and sandstone. Occasionally, the cuttings have a sulfide odor. All known surface occurrences of the Paradox are remnants of the salt diapir and the beds are typically highly contorted.

Hermosa Formation evaporites are prone to dissolution and possible karst development, and additional investigations and mapping were conducted to look for solution features along the north and east margins of the Site where the Hermosa Formation is near the surface or is exposed. The area covered in these additional investigations is shown in Figure 3.3-6. A single sinkhole was identified in the weathered surface of the Hermosa Formation just north of the Site boundary (Figure 3.3-6). This sinkhole was approximately 5 feet in diameter and 4 feet deep with halite (sodium chloride salt) intermixed with soil in the walls. An aerial photography assessment of the northern part of the Site identified numerous circular features, 35 of which were located and inspected in the field. These features were concluded to be caused by “cryptogamic” soil development associated with radial propagation of algae-lichens. These are soil crusts rimmed by remnants of the lichens that formed them (Belnap and Lange, 2001). They are not indicative of any subsurface dissolution or other structure.

All of the Triassic strata and the Cutler Formation thin onto the southwest anticline flank, and in the valley the Moenkopi overlies the Hermosa. Only the uppermost Moenkopi has been identified in site boreholes. This section consists of interbedded sandstone, siltstone, and mudstone, varying from light gray to buff to brown and reddish-brown. In general, the sandstone



Property Boundary
Well Field Boundary
Fault (Dashed where inferred)
Seismic Lines
Trenches (Excavated & Mapped 12/07)
Trenches (Excavated & Mapped 05/08)
Geologic Investigation Borings 10/08

Figure 3.3-6

Additional Geologic Investigations

This figure is based on the Geologic Report (Kleinfelder, 2009e).

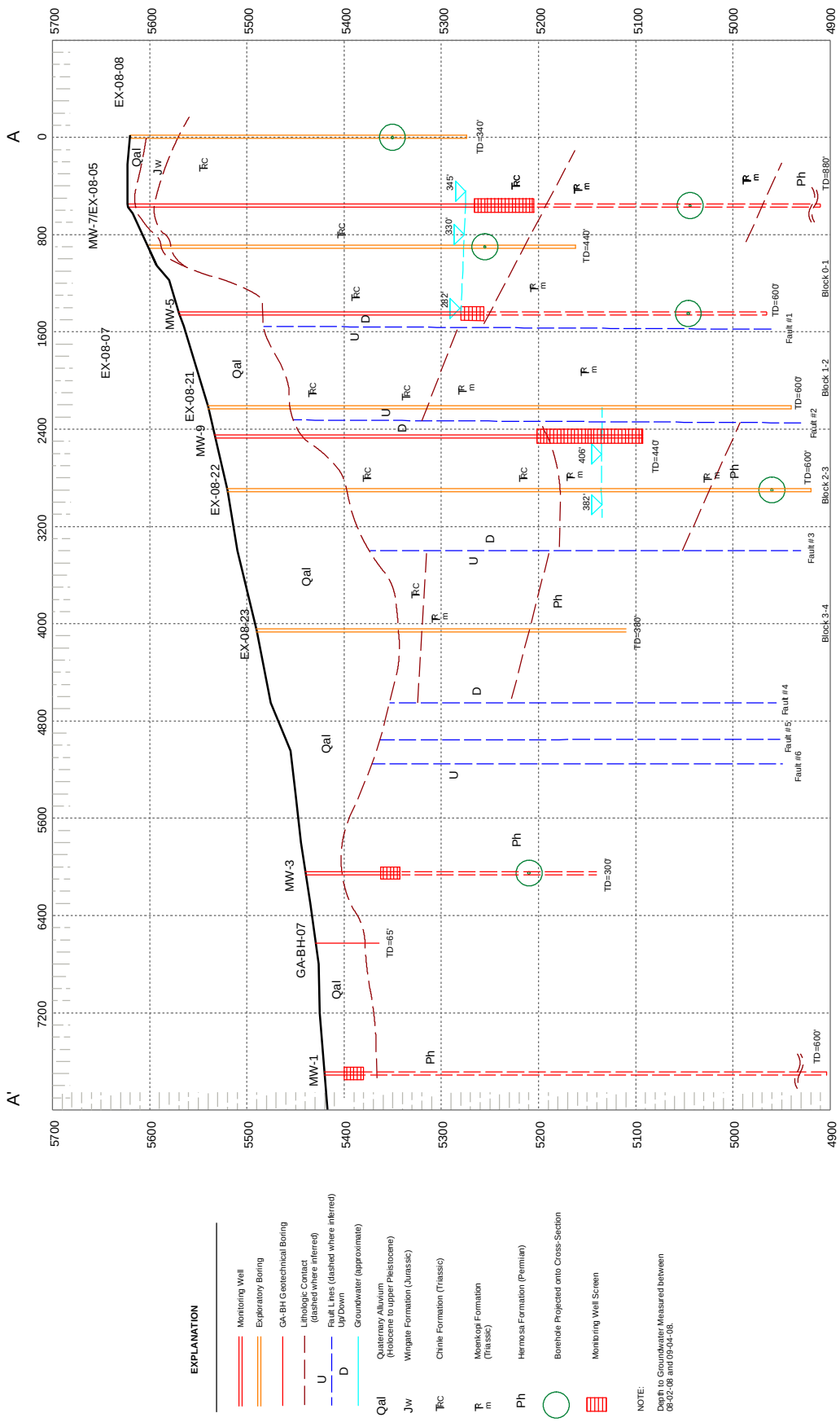
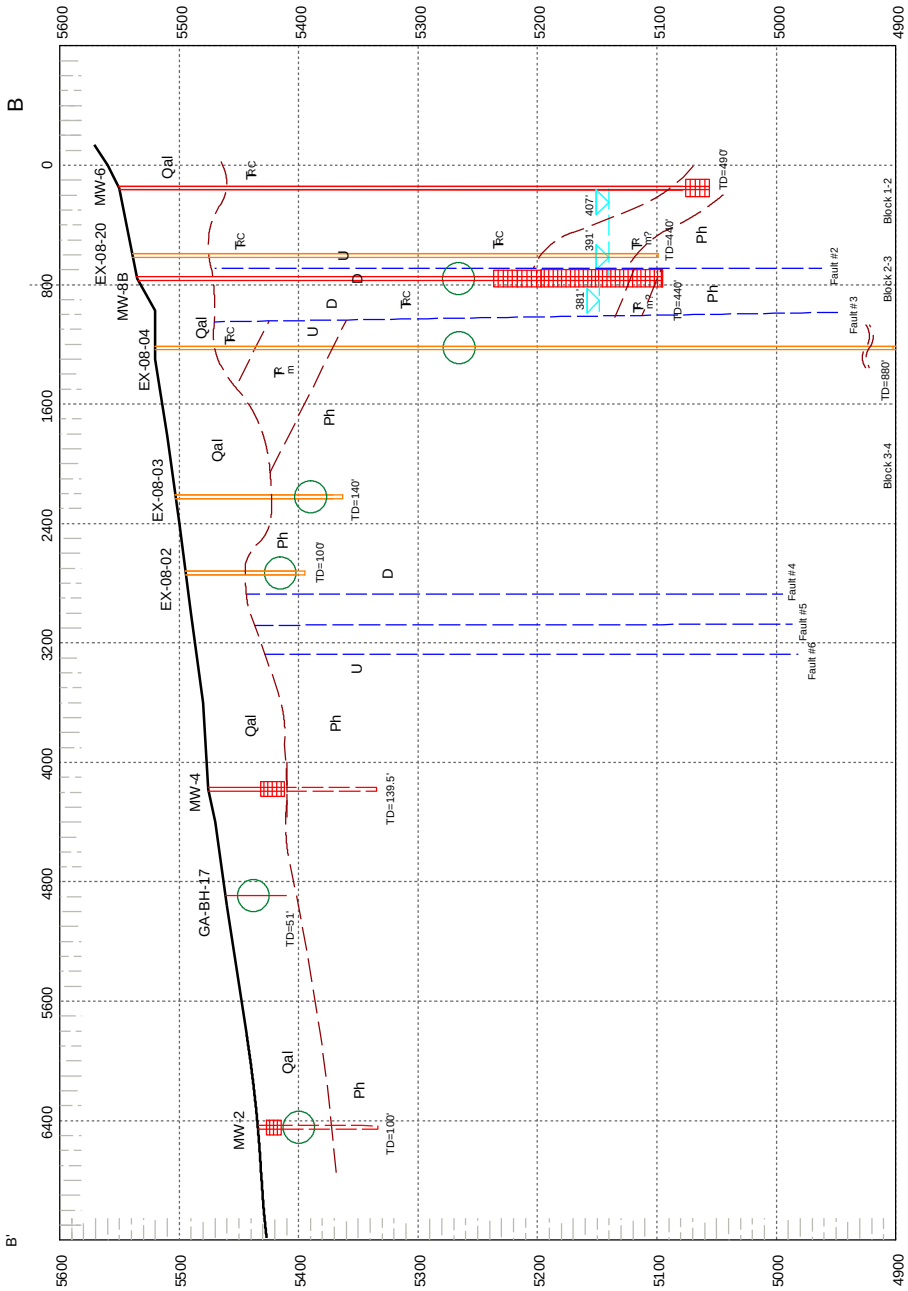


Figure 3.3-7

Geologic Cross-Section A-A'

This figure is based on the Geologic Report (Kleinfelder, 2009e).



EXPLANATION

- Monitoring Well
- Exploratory Boring
- GA-BH Geotechnical Boring
- Lithologic Contact (dashed where inferred)
- U / D Fault Lines (dashed where inferred) Up/Down
- Groundwater (approximate)
- Qal — Quaternary Alluvium (Holocene to upper Pleistocene)
- Jw — Wingate Formation (Jurassic)
- TRc — Chinle Formation (Triassic)
- TRm — Moenkopi Formation (Triassic)
- Ph — Hermosa Formation (Permian)
- Borehole Projected onto Cross-Section
- Monitoring Well Screen

NOTE:
Depth to Groundwater Measured between 08-02-08 and 09-04-08.

Figure 3.3-8

Geologic Cross-Section B-B'

is fine-grained. The top of the Moenkopi is occasionally recognizable by a clayey paleosol. Based on boreholes, the Moenkopi Formation is up to 200 feet thick beneath the southwestern corner of the Site. The Upper Triassic Chinle Formation overlies the Moenkopi Formation beneath the southern portion of the Site and consists of interbedded red to orange-red siltstone and fine-grained sandstone with interbeds of reddish-brown shale and pebbly conglomerate. The Chinle appears to be up to 400 feet thick in boreholes.

The cliff-forming Jurassic Wingate Sandstone overlies the Chinle Formation in the valley sides. The Wingate is an aeolian fine-grained, massive, light brown to buff colored sandstone composed of well-sorted quartz sand, typically brown-red in cliff faces with prominent dune cross bedding. The Wingate Formation attains a maximum thickness of 325 feet in the Davis Mesa Quadrangle (Cater, 1955b).

A slump block of Jurassic Morrison Formation sandstone and shale lies directly southeast of the Site, in which Cotter Corp has mined uranium/vanadium ore, and which the USGS mapped as a Quaternary slide (Tweto, 1979). Strauss (1982) mapped structure in this slump block.

Geological Structure. The Site is located within the salt diapiric anticlinal Paradox Valley. The crest of the anticline has collapsed and been eroded, so that the valley floor is the root of the diapir while the valley sides are the anticlinal flanks. The doming of the anticline was originally partly controlled by northwesterly striking faults, and the collapse caused extensive faulting on the limbs.

As shown in the cross section in Figure 3.3-4, major faults in the flanks of the valley parallel the anticline axis and bound the Paradox core, and stepped faults now observed in the valley sides are mostly (but not all) normal, consistent with the collapse of the arch over the upthrusting salt core. The down-slumped block of the Morrison Formation to the southeast of the Site is known from Cotter's surface and underground mine to be highly broken by faulting limited to the slide mass (Strauss, 1982).

Seismic reflection and refraction surveys show the same fault trend parallel to the anticline axis on the southeast flank of the valley beneath the Site, as shown in Figure 3.3-5. As indicated in Figure 3.3-7 and Figure 3.3-8, successive fault blocks are not necessarily regularly stair-stepped to the northeast.

A contour map of the top of bedrock based on boring logs is presented in Figure 3.3-9. The bedrock surface continues the slope of the valley sides off Davis Mesa toward the northeast, and off the Morrison Formation slump block toward the northwest, with a paleo-gully between. The bedrock surface flattens at a depth of about 80 feet. The bedrock surface does not appear to show any influence from the faults.

Seismic surveys were conducted by Geological Associates of Albuquerque in 2007 (Kleinfelder, 2009e), and exploration drilling was conducted by Kleinfelder in 2008 (Kleinfelder, 2009e). Six primary buried faults were identified as shown in Figure 3.3-5 and illustrated on the geologic cross-sections in Figure 3.3-7 and Figure 3.3-8. Several other small, closely spaced faults in the Hermosa Formation in the north of the Site were inferred from the seismic survey profiles. Interpretation in the cross section of Figures 3.3-7 and 3.3-8 of relative displacement on faults was based on borings, for which geophysical data were not useful due to similar seismic velocities in the uppermost strata. The depths of boring contacts were projected on to the cross-sections, which obscures the continuity of the displacement on these sections. Displacements

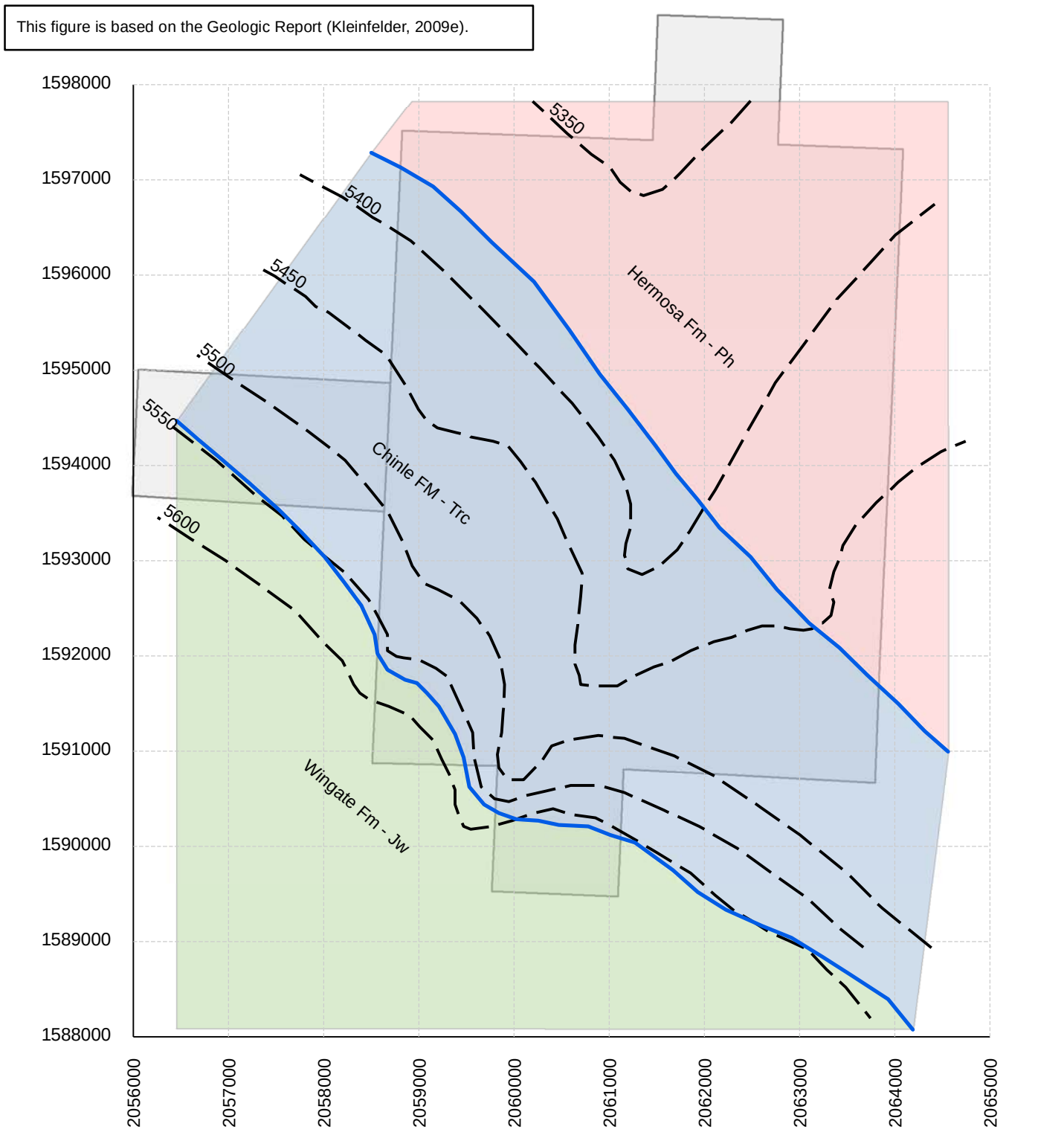


Figure 3.3-9

Top of Bedrock Contours

also vary along the faults with some rotation (scissors displacement), which is also consistent with the anticlinal limb collapsing along the axial trend, but segmented on local, curved slump faults.

From south to north, the six major inferred faults have been labeled as follows:

- Fault #1 – lying near the foot of Davis Mesa and trending WNW-ESE, normal and upthrown to the north.
- Fault #2 – lying under the footprint of the proposed Mill Facility and trending WNW-ESE, upthrown to the south.
- Fault #3 – lying under the southwest part of proposed Tailing Cell 1A and trending WNW-ESE with the north side upthrown.
- Faults #4, #5, and #6 – closely spaced and lying under proposed tailing Cells B and C, likely en echelon with displacement up to the north and probably dipping steeply to the south. This shear surface is the boundary between the salt diapir and the intruded Permian-Triassic strata.

Extensive trench mapping was conducted in December 2007 (Trenches 1, 2, and 3) and May 2008 (Trenches 2b and 2c) by Kleinfelder (2009e). The late Quaternary soil deposits overlying the buried faults showed no evidence of displacement of the soil layers, indicating an absence of post-depositional or late Quaternary surface faulting. The detailed geologic logs of the trench excavations are presented in Appendix A of the *Geologic Report* (Kleinfelder, 2009e). One apparent discontinuity in soil bedding observed in a trench was further investigated by electromagnetic survey by Sunbelt Geophysics in 2008 (in Kleinfelder, 2009e) to assess if there were any possible relationship to bedrock dissolution. Sunbelt Geophysics also evaluated a slight seismic anomaly. The soil discontinuity appeared to be less than 7 feet deep and have no traceable structure. The seismic signature appeared to correlate with a velocity contrast in Paradox Member rocks, probably related to a gypsum or anhydrite layer. Neither seems related to faulting or dissolution.

The pattern of faulting in the buried bedrock formations is consistent with the structural development of the Paradox anticline and the subsequent dissolution and collapse of the salt core. No bedrock topographic features, lineaments sought in aerial photography, or soil trenching indicate any deformation of Recent age.

3.3.1.3 Seismicity

According to the Colorado Geological Survey, more than 500 earthquake tremors have occurred in the State Colorado since 1867 (Colorado Geological Survey - CGS, 2002). The largest known earthquake in Colorado was the November 8, 1882 earthquake, of which the size and location remain uncertain (Sheehan et al., 2003). This earthquake had an estimated moment magnitude of 6.6 ± 0.6 and was located somewhere in north-central Colorado (Spence et al., 1996). It damaged the power plant in Denver and cracked buildings in Boulder. However, most of the earthquakes in Colorado have been due to induced seismicity caused by human activities. The best known examples are those induced by the disposal of waste fluids at the Rocky Mountain Arsenal near Denver and secondary oil recovery in western Colorado at the Rangely oil field (Sheehan et al., 2003). The injection of salty water in deep formations below the Paradox Valley Unit, approximately 9 miles west of the Site, by the BOR has also generated more than 3,000 minor earthquakes since the beginning of the injection process in 1995 with magnitude up to 4.3 in May 2000 (CGS, 2002). The two largest events recorded in northwest Colorado were also

man-made, being subsurface detonations of nuclear devices by the federal government to assess potential for development of tight natural gas fields (Rio Blanco and Rulison tests) (DOE, 2000).

Local and Regional Faulting. Geological studies in Colorado have discovered about 100 faults that moved during the Quaternary Period (past 2 million years). Most of these were identified by their displacement of Quaternary deposits. A few faults displace late Quaternary deposits (from approximately the last 130,000 years), including the Sangre do Cristo fault, on the west edge of the Sangre de Cristo Mountains, and the Sawatch fault, on the eastern margin of the Sawatch Range, two of the most prominent potentially active tectonic faults in Colorado. These faults are approximately 150 miles east of the Site.

The Uncompaghre Uplift east of the Paradox Valley is a large and broad tectonic anticline with a faulted margin against the Paradox Basin. These faults were active during the deposition of the Hermosa Formation, and in pulses through mid Triassic (Elston et al., 1964). Little or no seismicity is now associated with the Uncompaghre anticline or faults.

Faults in the vicinity of the Site are not tectonic faults associated with deep crustal movement. The most prominent faults in the area are the shear boundary between diapiric salt and intruded Permian-Mesozoic rocks, faults in the flanks of the anticlines raised by the diapirs, anticline collapse faults associated with salt core erosion, and valley side slump faults. Some of the faults in the flanks of the Paradox anticline may have been active in each of these phases. Valley side slump shears segment the remains of the anticline limbs. All of these faults were essentially expressions of the long term salt migration, subsequent hollowing out of the salt plug and collapse of the crest. Modern movement on the fault relics should be limited to creep of rock masses toward the valley. The only recordable seismic events in the area should be either man-made or cliff rock-falls.

Faults in the vicinity of the Site are associated by the USGS Quaternary fault database, No. 2286, 2008, with the Paradox diapiric anticline. This database shows the Paradox Valley faults as having movement as recently as Pleistocene, although no evidence of Holocene-age movement has been documented. USGS classifies faults according to three categories – A, B, or C. Class A faults show geologic evidence of Quaternary-age activity of tectonic origin. Class C faults show no evidence of Quaternary deformation. Class B faults are those that exhibit geologic evidence of Quaternary deformation, but either (1) the fault might not extend deeply enough to be a potential source of significant earthquakes, or (2) the available geologic evidence is too weak to confidently assign the feature to Class A or C. These faults are judged to be non-capable (not generators of seismicity) according to the Criterion 4E of 6CCR 1007-1, Part 18, Appendix A (CDPHE, 2001).

Significant faults within a radius of 62 miles (100 km) of the Site are listed in Table 3.3-1, with parameters reported in the USGS fault database (USGS, 2008). The first seven of these are all associated with Paradox Member salt diapirs. The State of Colorado Earthquake and Fault Map (CGS, 2002) classifies the Paradox Valley fault system as displacing middle to early Quaternary deposits (approximately 130,000 to 2 million years old); it is not recognized as displacing late Quaternary deposits (younger than 130,000 years). The Paradox Valley bedrock faults are covered by Quaternary deposits which extensive trenching showed to be undisturbed.

Table 3.3-1
Significant Faults in the Region [1]

Fault Name	Length (miles)	Distance from Site (miles)	Fault Type	Strike Angle	Slip Rate (mm/yr) [2]	Recent Deformation
Paradox Valley	35	< 1	Normal	N46W	< 0.02	Quaternary
Big Gypsum Valley	21	17	Normal	N54W	< 0.2	Quaternary
Unnamed at northwest end of Paradox Valley	3	19	Normal	N2W	< 0.2	Quaternary
Atkinson Mesa	25	19	Normal	N63W	< 0.2	Quaternary
Pinto Mesa	12	21	Normal	N43W	< 0.2	Quaternary
Sinbad Valley	20	22	Normal	N50W	< 0.2	Quaternary
Lisbon Valley	24	23	Normal	N47W	< 0.2	Quaternary
Pine Ridge	4	22	Normal	N72W	< 0.2	Quaternary
Dolores	9	25	Normal	N67W	< 0.2	Quaternary
Pine Mountain	19	28	Normal	N52W	< 0.2	Quaternary
Monitor Creek	19	39	Normal	N86W	< 0.2	Quaternary
Roubideau Creek	16	39	Normal	N74W	< 0.2	Latest Quaternary
Shay graben	25	31	Normal	N66E	< 0.2	Quaternary
Moab and Spanish Valley	42	31	Normal	N52W	< 0.2	Quaternary
Ridgeway	15	43	Normal	N87E	< 0.2	Quaternary
Log Hill Mesa graben	6	50	Normal	N32W	< 0.2	Late Quaternary
Busted Boiler	11	50	Normal	N5W	< 0.2	Late Quaternary
Red Rocks	24	56	Normal	N59W	< 0.2	Quaternary
Needles	18	59	Normal	N10E	< 0.2	Latest Quaternary

[1] Source: USGS, 2008.
[2] 1 mm is equal to 0.04 inches.

Some of the potentially active faults in Colorado have been assigned MCEs (maximum credible earthquakes) by Kirkham and Rogers (1981) based on the length of the fault, age of the latest movement, and recurrence interval of the past earthquakes. Figure 3.3-10 shows their assigned magnitudes of MCEs for the more significant faults in Colorado. Of those nearest to the Site, the Busted Boiler and Ridgway faults have been deemed to have potential to generate magnitude 6.25. The Red Rocks fault has been assigned magnitude 6.75. Kirkham and Rogers (1981) estimated the possible MCE from Paradox Basin salt anticline faults which penetrate to basement to be about magnitude 5.

Historical Seismicity. The seismicity of Colorado has been characterized as being low to moderate (Kirkham and Rogers, 1981) partly due to limited seismographic coverage in western Colorado, and to the relatively few sizable earthquakes in the recent record.

Induced Seismicity. Many recorded earthquakes in Colorado have been caused by man's activities. The best known examples of induced seismicity in Colorado are those induced by the disposal of waste fluids at the Rocky Mountain Arsenal near Denver, and secondary oil recovery by reservoir flooding with water in the Rangely oil field (Sheehan et al., 2003). Some seismicity is also caused in the northern Paradox Valley by deep injection of saline water by the BOR (Paradox Valley Unit -

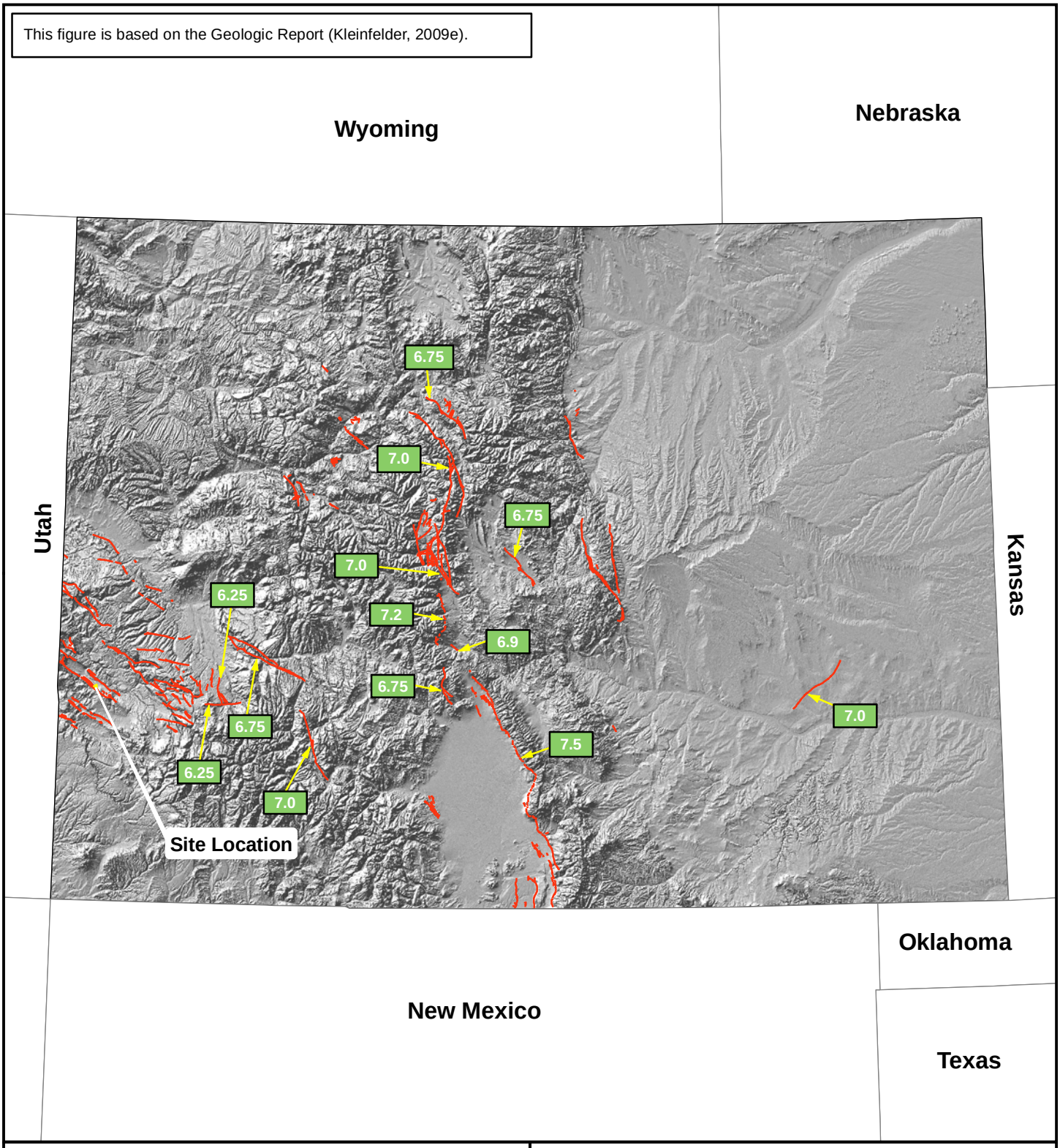


Figure 3.3-10

Magnitude of Maximum Credible Earthquakes in Colorado

PVU), as part of attempts to limit the salinity in the Colorado River as required by a 1944 U.S.-Mexico treaty, amended in 1974 to address water quality, and enacted as the Colorado River Basin Salinity Control Act of 1974. BOR installed a series of extraction wells to intercept brine flowing from the Paradox Valley into the Dolores River, and a deep (total depth about 3.0 miles) injection well as shown on Figure 3.3-11. Since 1991, the PVU has injected more than 1 billion gallons of shallow brine into deep Paleozoic and Pre-Cambrian strata (Ake et al., 2005).

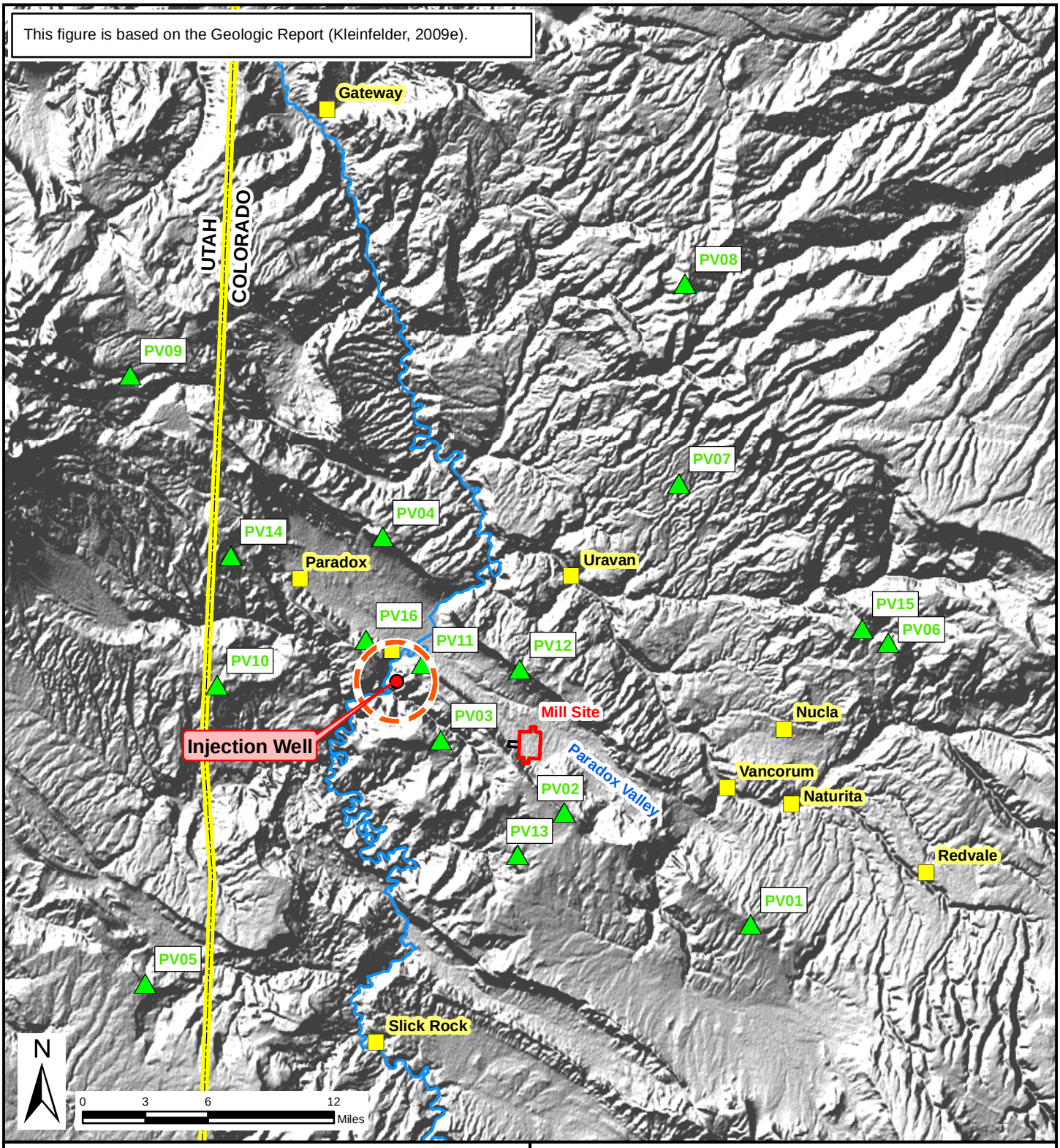
The PVU installed the Paradox Valley Seismic Network (PVSN) and began monitoring the local, reinjection seismicity starting in 1985. The PVSN has operated continuously since 1985, covering about 2,124 square miles area. Presently, the PVSN operates 15 stations, of which the two closest stations to the salt injection site have three-component sensors, while the other stations have only vertical-component sensors.

The PVU brine injection has induced over 4,000 surface-recorded seismic events since the beginning of the injection process in 1991, of which more than 3,000 occurred since the beginning of continuous injection process in 1995, with the largest event of magnitude 4.3 occurring in May, 2000 (CGS, 2002; Ake et al., 2005). More than 99.9 percent of the total 4,000 events were smaller than magnitude 2.0 and were not felt at the surface (Ake et al., 2005). The seismicity rate was much higher in the initial phases of injection, with an average rate about 82 per month, and a peak of 172 events in January, 1999. BOR modified their injection strategy in July 1999 with 20 days of shutdown every 6 months to dissipate fluid pressures, but this did not lead to a reduction to an acceptable level of events. In June 2000, the BOR modified their strategy again, dropping the pumping rate, which did lead to significant reduction to about 9 events per month, with none greater than magnitude 2.8. According to Ake et al. (2005), the induced seismicity at the PVU is closely related to the injection rate. Ninety five percent of the recorded events occur in an asymmetric zone surrounding the deep injection well, at up to 1.9 miles distance. A secondary zone of induced seismicity is located about 5 miles to the northwest of the well. By understanding the relationship between small earthquakes and injection parameters (in particular injection rate), the operations at the PVU have been modified to minimize the likelihood of future larger, damaging earthquakes (Ake et al., 2002).

Wastewater injection induces earthquakes by lubricating movement on existing faults, but mostly by reducing effective stress (the injection pressure takes some of the load off rock solids, reducing friction).

Natural Earthquakes. According to the USGS, more than 400 earthquake tremors of magnitude 2.5 or higher have occurred in Colorado since 1870 (Sheehan et al., 2003). The magnitude of Colorado's largest historical earthquake, in 1882, is estimated to be 6.6 ± 0.6, and it was located somewhere in north-central Colorado (Spence et al., 1996).

The largest known natural earthquake in the vicinity of the Site was magnitude 5.5 in 1960 earthquake near Ridgway, about 37 miles to the northeast (Sheehan et al., 2003; Blume and Sheehan, 2003). Several earthquakes of magnitude 4.0 or higher have occurred in this region with the most recent one being a magnitude 4.1 on November 7, 2004, west of Montrose. Significant historical earthquakes in the region are tabulated in Table 3.3-2.



Seismic Network
Local Municipalities
Property Boundary
Well Field Boundary
Dolores River
Approximate 3-km Radius Around Injection Well

Figure 3.3-11

Paradox Valley Unit Locations of Wells and Seismic Network

Table 3.3-2
Significant Historic Earthquakes in the Region[1]

Date	Location	Magnitude	Intensity
1913, Nov. 11	Ridgeway area	--	VI
1944, Sep. 9	Montrose/Basalt	--	VI
1960, Oct. 11	Montrose/Ridgeway	5.5	V
1966, Jan. 23	CO-NM border near Dulce, NM	5.5	VII
1966, Sep. 4	Near Montrose	4.2	--
1967, Jan. 12	East of Grand Junction	4.4	--
1967, Apr. 4	Near Montrose	4.5	--
1971, Nov. 12	South of Grand Junction	4.0	--
1994, Sep. 14	Southwest of Montrose	4.6	--
2000, May 27	West of Montrose	4.4	--
2004, Nov. 7	West of Montrose	4.1	--

[1] Source: Colorado Earthquake Hazard Mitigation Council, 2008.

A search was performed of historical earthquakes greater than magnitude 3.0 within a radius of 125 miles from the Site in the catalog maintained by Advanced National Seismic System (ANSS). This composite catalog of world-wide earthquakes covers a period from 1898 to the present, merging master earthquake catalogs from contributing ANSS member institutions. The member institutions include several regional and national seismic networks (Kleinfelder, 2009e). This search yielded 101 events in the search area between 1898 and 2008.

The Colorado Earthquake Hazard Mitigation Council (2008) states that the historical record allows that an earthquake of magnitude 6.5 to 7.3 could possibly occur somewhere in the state, but the record is too sparse to predict return periods of any size event with any confidence. All known faulting in the vicinity of the Site is associated with non-tectonic structures.

Ground Motions. Ground motion parameters, in terms of peak ground acceleration (PGA) and/or spectral acceleration, are used to design earthquake-resistant structures. Guidelines from the seismic design criteria of the 2006 International Building Code (IBC), and based on National Seismic Hazards Maps by the USGS, were used to obtain these parameters. Ground motion parameters obtained from the IBC for the design of structures are presented in detail in Kleinfelder (2009e). Under IBC guidelines, the MCE is defined as an event having a 2 percent chance in 50 years of occurring (return period of 2,475 years). The PGA associated with the MCE for the Site is 0.161g, where “g” is the acceleration of gravity. The most likely earthquake to produce these motions is projected to have a magnitude of about 4.8 at a distance of 9.6 miles from the Site.

3.3.1.4 Geologic Hazards

Geologic hazards of potential interest to the Site include slope instability, flooding and headward erosion, karst or dissolution features, faulting, seismicity, liquefaction, and collapsible soils. Volcanism is another potential geologic hazard that NRC has identified in its guidelines (NRC, 2003a). Each geologic hazard is discussed below.

Slope Instability. Natural slopes over most of the Site are flat and are not susceptible to mass movement. The southern end of the Site extends to the valley side, where steeper slopes occur. Even including the slumped block of the Morrison Formation to the southeast, bedrock strata in the vicinity of the Site show stable slopes, covered in pinyon-juniper trees of considerable age (centuries), and show no signs of recent mass movement or rock falls. Even where there are tall

cliffs of Triassic rock elsewhere in the valley, there are few evident recent rock falls or perched boulders likely to be loosed by a moderate earthquake.

Flooding and Headward Erosion. Minor flood hazard may exist in the small drainages on the southwest corner of the Site where short, steep gullies are etched on the valley side below Davis Mesa. Several of the active channels exhibit headward erosion.

Karst or Dissolution Features. No evidence of karst subsidence or active dissolution was observed on the Site or in the vicinity, except for one small sinkhole (Figure 3.3-6), approximately 0.5 mile north of the proposed evaporation pond area. This sinkhole is localized and, at the surface, is approximately 5 feet in diameter and 4 feet deep. As confirmed by additional geologic reconnaissance and mapping, no other evidence of sinkhole development was identified within the boundaries of the Site or in the adjacent areas.

Faulting. The Site is within the fault-bounded Paradox Valley; but all faulting in the area is related to diapiric salt doming and subsequent arch collapse when the salt was eroded from beneath it. Because the faulting was not tectonic but due to salt migration, which is long past, it is improbable there should be any seismicity associated with faulting in the vicinity, and faults are classified as “Class B” by the USGS, judged to be non-capable of seismicity according to the Criterion 4E of 6 CCR 1007-1, Part 18, Appendix A (CDPHE, 2001). Extensive trenching demonstrated that late Quaternary soils overlying the buried faults at the Site were not disturbed or displaced.

Seismicity. Ground motion parameters obtained from the 2006 IBC for the design of the structures indicated there is a 2 percent chance in 50 years that the Site might experience a PGA equal to or greater than 0.16g (16 percent of the earth’s gravitational acceleration). The most likely earthquake to produce these motions would have a magnitude of about 4.8, at a distance of 10 miles from the Site.

Liquefaction. Liquefaction of soils by an earthquake is improbable. Potential for liquefaction may occur where there is some likelihood of earthquakes. The primary factors affecting liquefaction potential of a soil deposit are: (1) level and duration of seismic ground motions; (2) soil type and consistency; and (3) depth to groundwater.

Collapsible Soils. The presence of collapsible soils within the upper layers of overburden soils was identified as an issue to be addressed during construction and operation of the facility in the *Amendment No. 2 Geological Investigations Work Plan* (Kleinfelder, 2008a).

Volcanism. Volcanism does not pose a credible hazard in the area. Remnants of igneous rocks in the region are either tens of millions of years old, or hundreds of miles away (and extinct).

3.3.2 Soils

In accordance with Section 5.3.3 of NUREG 1748 (NRC, 2003a), a soil survey of the Site was conducted and reported in the *Soil Survey Report* by Kleinfelder (2009f). The purpose of the survey was to characterize the soils at the Site and to determine if hydric soils were present. Hydric soils are soils formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part of the soil horizon. Under natural conditions, these soils are either saturated or inundated long enough during the growing season to support the growth and reproduction of hydrophytic vegetation, and are indicators of potential jurisdictional USACE water features. This is discussed further in Section 3.5.1.4 – Wetlands. The 1967 published soils survey for the project area (Delta-Montrose Area

Soil Survey) is out of print and not available from the Natural Resource Conservation Service (NRCS, 2009a). Therefore, updated soil survey data was acquired through the NRCS Soil Data Mart Web Site or the NRCS Web Soil Survey. Kleinfelder unitized the NRCS Web Soil Survey database (U. S. Department of Agriculture - USDA, 2008) to compare with collected field data.

3.3.2.1 USDA Web Soils Data

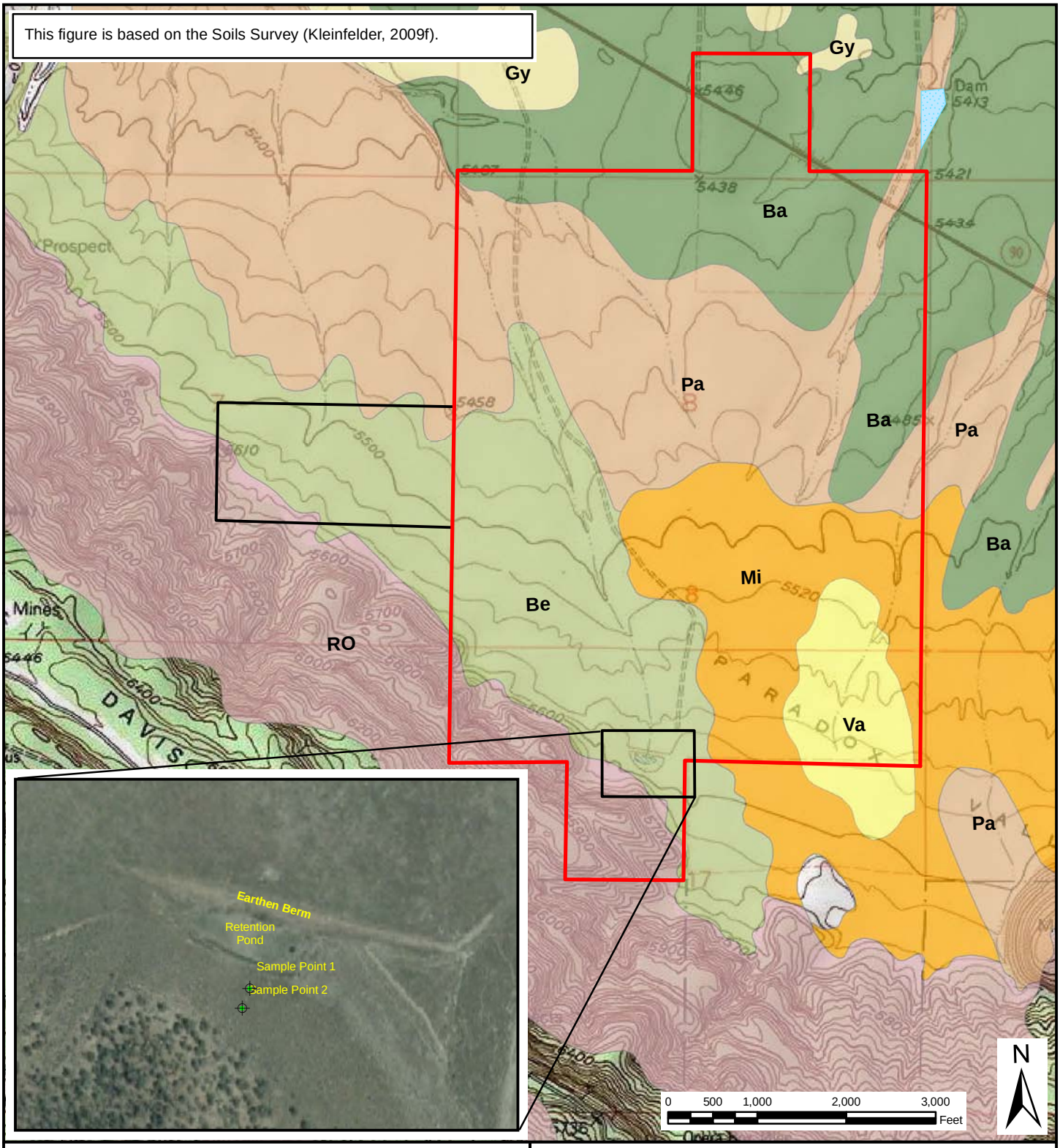
Based on the NRCS Web Soil Survey data (USDA, 2008) the soils at the Site are comprised of six soil series which include the Barx, Begay, Gypsiorthids, Mikim, Paradox, and Vananda soil series as well as the Rock Outcrop landform. Figure 3.3-12 provides a map showing the extent of these soils series within the Site. Table 3.3-3 also provides the acres of each mapping unit that is within the Site and provides a summary of the soil series general characteristics.

The soils are derived from alluvium from the surrounding sandstone and shale bluffs to the south of the valley and the majority of the soils (72.8 percent) have fine sandy loam textures (USDA, 2008). The soils are slightly sloping, and have deep profiles with restrictive layers greater than 80 inches in depth, except the Rock Outcrop landform. The soils are nonsaline to slightly saline at depths and all are considered nonsodic. The soils have moderately high to high saturated conductivities and the available water capacity varies by soil type. The water table depth is greater than 80 inches (USDA, 2008). The USACE (2006) literature did not identify hydric soils as being present at the site, although, the USDA (2008) soil survey data indicates that the Vananda Series is partially hydric in some areas. Field investigations did not identify the presence of hydric soils within the Site (see Section 3.3.2.3). The following section provides a description of each of the soils series within the Property Boundary.

Barx Series (Ba). The Barx series consists of very deep, well-drained soils that form in alluvium and reworked eolian material derived from sandstone and has between 0 to 35 percent rock fragments (gravel and cobbles) in its profile. Within the Site, Barx soils are on alluvial fans. Slopes range from 3 to 6 percent. The series has a moderate to high saturated conductivity and has a high available water capacity. This soil is natural to moderately alkaline and strongly alkaline at depth. The soil is nonsaline to slightly saline. Depth to water table is more than 80 inches, wind erodibility is low, and it is slightly susceptible to erosion. The series is considered prime farmland if irrigated.

Begay Series (Be). The Begay series consists of very deep, well-drained soil that formed in alluvium derived mainly from sandstone. In the project area the Begay soils are on alluvial fans, and have slopes of 1 to 6 percent. The series is slightly to moderately alkaline, nonsaline, and nonsodic. The series has a high saturated conductivity and the water table is greater than 80 inches in depth. The soil profile contains between 0 to 15 percent rock fragments and is moderately susceptible to wind erosion. The water erosion hazard is slight. The series is considered prime farmland, if irrigated.

Gypsiorthids Series (Gy). The Gypsiorthids series only comprises about 0.6-acre of the Site, north of SH 90. This soil consists of deep, well-drained soils that formed on valley floors. The soils consist of residium weathered from gypsum. Although the Gypsiorthids soils are typically found on slopes that range from 3 to 25 percent, within the Site the soil is nearly level. This series is moderately alkaline, very slightly saline to slightly saline and is not sodic. The soil may contain up to 85 percent gypsum. The soil has a moderately high to high saturated conductivity and has a low available water capacity. The soil susceptibility to wind erosion and water erosion is moderate. The series is not considered a prime farmland soil.



Property Boundary
Well Field Boundary

Soil Descriptions

- Ba Barx fine sandy loam, 3 to 6 percent slopes
- Be Begay fine sandy loam, 1 to 6 percent slopes
- Gy Gypsiorthids, 3 to 25 percent slopes
- Mi Mikim loam, 1 to 6 percent slopes
- Pa Paradox fine sandy loam, 1 to 4 percent slopes
- RO Rock outcrop
- Va Vananda silty clay, 1 to 6 percent slopes

Figure 3.3-12

NRCS Soils Data Map
Montrose County, Colorado

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Table 3.3-3
Soil Series and General Characteristics within the Project Area [1]

NRCS Soil Mapping Units	Soil Mapping Unit Name	Composition of Mapping Unit (percent)	Acres within Site (percent composition)	Depth to restrictive layer [2]	Saturated Conductivity [3]	Available Water Capacity [4]	Salinity (maximum - Electrical Conductivity mmhos/cm) [5]	Sodium Adsorption Ratio- SAR (maximum) [6]	Topsoil suitability Rating; limiting factors and (Optimum depth) [7]	Prime Farmland Designation [8]	Hydric [9]
15	Barx fine sandy loam, 3 to 6 percent slopes (Ba)	85	187.38 (21.3)	> 80 in	Moderately high to high (0.60 top 2.00 in/hr)	High 9.5 inches	Nonsaline to slightly saline (2.0 to 4.0)	10.0	Fair; Low organic matter content, carbonate content – Alkalinity (9-15 inches)	Prime farmland, if irrigated	No
18	Begay fine sandy loam, 1 to 6 percent slopes (Be)	85	197.41 (22.5)	> 80 in	High (2.0 top 6.00 in/hr)	Moderate 8.0 inches	Nonsaline (0.0 – 2.0)	10.0	Fair: Low organic (12-16 inches)	Prime farmland, if irrigated	No
49	Gypsiorthids, 3 to 25 percent slopes (Gy)	85	0.59 (<0.01)	> 80 in	Moderately high to high (0.60 to 2.0 in/hr)	Low 5.1 inches	Very slightly saline to slightly saline (4.0 to 8.0)	N/A	Fair; Salinity (6-12 inches)	No	No
56	Mikim loam, 1 to 6 percent slopes (Mi)	90	144.71(16.4)	> 80 in	Moderately high to high (0.60 to 2.0 in/hr)	Moderate 8.3 inches	Nonsaline (0.0 to 2.0)	10.0	Fair (9 inches)	Prime farmland, if irrigated	No
73	Paradox fine sandy loam, 1 to 4 percent slopes (Pa)	85	243.60 (27.8)	> 80 in	Moderately high to high (0.60 to 2.0 in/hr)	High 9.2 inches	Nonsaline (0.0 to 2.0)	N/A	Good (12-19 inches)	Prime farmland, if irrigated	No
87	Rock outcrop Unweathered bedrock (RO)	90	56.61 (6.4)	0 to 4 in to lithic bedrock	Very low to low (0.00 to 0.00 in/hr)	N/A	N/A	N/A	Not rated	No	No
104	Vananda silty clay, 1 to 6 percent slopes (Va)	85	49.70 (5.6)	> 80 in	Low to moderately low (0.01 to 0.06 in/hr)	Moderate 9.0 inches	Nonsaline to slightly saline (2.0 to 8.0)	15.0	Poor Clay content, Sodium and Salinity (<6 inches)	No	Partially hydric
		Total	**880.0 (100)**								

[1] Source: NRCS, 2009b.
[2] Restriction layers limit plant growth by restricting the limits of the rooting zone. They also impede or restrict the movement of soil water vertically through the soil profile. The restrictive layer hardness and thickness have a significant impact on the ease of mechanical excavation.
[3] Estimates of saturated hydraulic conductivity are based on soil properties and include texture, structure, pore size, density, organic matter, and mineralogy.
[4] Available water capacity is the volume of water that should be available to plants if the soil, inclusive of fragments, were at field capacity. It is commonly estimated as the amount of water held between field capacity and wilting point, with corrections for salinity, fragments, and rooting depth.
[5] Electrical conductivity is a measure of the concentration of water-soluble salts in soils and is used to determine saline soils. High concentrations of neutral salts, such as sodium chloride and sodium sulfate, may interfere with the absorption of water by plants because the osmotic pressure in the soil solution is nearly as high or higher than that in the plant cells. Salts may also interfere with the exchange capacity of nutrient ions, thereby resulting in nutritional deficiencies in plants. (Salinity Classes: Nonsaline = 0-2 mmhos cm^{-1}; Very slightly Saline = 2-4 mmhos cm^{-1}; Slightly Saline 4-8 mmhos cm^{-1}; Moderately Saline 8-16 mmhos cm^{-1}; Strongly Saline > 16 mmhos cm^{-1})
[6] Soils that have values for sodium adsorption ratio of 13 or more may have an increased dispersion of organic matter and clay particles, reduced saturated hydraulic conductivity and aeration, and a general degradation of soil structure.
[7] Topsoil ratings are based the upper 40 inches of the soil according to NRCS (2009) and are based on the soil properties that affect plant growth; the ease of excavation, loading and spreading the material affect the reclamation of the borrow area. Toxic substances, soil reaction, and the properties that are inferred from soil texture, such as available water capacity and fertility, affect plant growth. The ease of excavating, loading, and spreading is affected by rock fragments, slope, depth to a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, depth to a water table, rock fragments, depth to bedrock or a cemented pan, and toxic material. Onsite management is needed during salvaging operations to validate these interpretations and to confirm the identity of the soil on-site.
[8] Prime farmland is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and that is available for these uses. It has the combination of soil properties, growing season, and moisture supply needed to produce sustained high yields of crops in an economic manner if it is treated and managed according to acceptable farming methods. In general, prime farmland has an adequate and dependable water supply from precipitation or irrigation, a favorable temperature and growing season, an acceptable level of acidity or alkalinity, an acceptable content of salt or sodium, and few or no rocks. Its soils are permeable to water and air. Prime farmland is not excessively eroded or saturated with water for long periods of time, and it either does not flood frequently during the growing season or is protected from flooding.
[9] A hydric soil is a soil that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part. Hydric soils along with hydrophytic vegetation and wetland hydrology are used to define wetlands.

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Mikim Series (Mi). The Mikim series consists of very deep, well-drained soils that formed in alluvium derived from shale. Mikim soils in the project area are found on alluvial fans and in drainages and have a slope range from 1 to 6 percent. This series is slightly to moderately alkaline, nonsaline, and nonsodic. The soil has a moderately high to high saturated conductivity and the available water capacity is moderate. The soil profile may contain between 0 to 15 percent rock fragments. The soil has a slight water erosion hazard and the wind erodibility hazard is moderate. The Mikim loam is considered prime farmland, if irrigated.

Paradox Series (Pa). The Paradox series consists of deep, well-drained soils that formed in alluvium derived from red sandstone. Paradox soils are on nearly level to gently sloping broad alluvial fans and old alluvial valley floors. Slopes are from 1 to 4 percent. This series is mildly to moderately alkaline, nonsaline, and moderately permeable. The series has a high available water capacity and rock fragments range from 0 to 15 percent throughout the profile, but are usually less than 1 percent. The soil has a slight water erosion hazard and the wind erodibility hazard is moderate. This series is considered prime farmland, if irrigated.

Rock Outcrop (RO). The Rock Outcrop landform is located on slopes between 40 and 120 percent on the southwestern corner of the Site. This landform comprises approximately 6.4 percent (56.61 acres) of the Site. Unweathered sandstone bedrock is typically at a depth of 0 to 4 inches.

Vanada Series (Va). The Vanada soils are deep, well-drained soils that formed from alluvium derived from shale. Within the Site, the Vanada series are on alluvial fans and are nearly level to gently sloping with slopes of 1 to 6 percent. The soil is moderately to strongly alkaline, nonsaline and potentially slightly sodic at depths. The soil has a low to moderately low hydraulic conductivity and a moderate available water capacity. The water table depth is greater than 80 inches. The soil has a slight water erosion hazard and the wind erodibility hazard is moderate. The soil is not a considered a prime farmland soil but in some areas the soil is partially hydric. As previously noted, field investigations within the Site did not locate hydric soils.

3.3.2.2 Field Observations

The six USDA soil series identified by the NRCS Web Soil Survey (Barx, Begay, Gypsiorthids, Mikim, Paradox, and Vananda) were recognized at the Site. Rock outcropping accounts for about 6.5 percent of the Site, located in the southwest corner (Figure 3.3-12). The soil observations at the site closely represented the extent and range of characteristics described in the NRCS Web Soil Survey. The soils were observed to be well-drained. The soil profiles were observed to have little or no soil horizon differentiation in the upper 24 inches.

The soils observed in the northern portion of the Site tended to be sandy loam to fine sandy loam with typical hues in the 5YR range (MacBeth, 2000). It was observed that water from rain and snow melt events takes some time to infiltrate past the first few inches (Kleinfelder, 2009f). The soil appeared to be dry under approximately 6 inches of saturated soil during the winter and spring surveys. Drainage features across the Site were characterized as discontinuous ephemeral streams (Meyer, 2008).

Biological soil crusts, also known as crytogamic, microbiotic, cryptobiotic, and microphytic crusts (Belnap and Lange, 2001), were observed sporadically. Biological soil crusts were observed to cover less than 5 percent of the Site, with the highest concentrations located under big sage (*Artemicia tridentate*). Biological soil crusts are made up primarily of cyanobacteria (formerly blue-green algae), green and brown algae, microfungi, mosses, liverworts, and lichens (Rosentreter et al., 2007). The organisms on the soil increase soil stability, contribute carbon to

the underlying soil, convert atmospheric nitrogen into bio-available nitrogen, and retain water (Belnap and Lange, 2001).

3.3.2.3 Hydric Soil Field Investigations

Soils sample locations to determine the potential presence of hydric soils were selected based on drainage features and areas of potential ponding or inundation. Ponded or inundated areas were identified as areas where earthen berms were previously constructed to retain seasonal surface water flows related to storm events or snowmelt. Soils along the drainage features (Figure 3.3-12) were evaluated to determine whether hydric soils were present. Soils at two sample plots within identified potential wetlands were evaluated by digging 12-inch soil pits (Figure 3.3-12).

Methods used to determine if hydric soils were present were in accordance with the *Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Arid West Region* (USACE, 2006). All drainage features, and ponded or inundated areas were observed and evaluated for soil types and characterized based on USACE Waters of the U.S. Final Wetland Delineation guidance (Meyer, 2008). The sample points were dug to the depth needed to document a hydric indicator, or to confirm the absence of hydric indicators (USACE, 2006). Soils were compared to the Munsell ® Soil Color Charts (MacBeth, 2000) to evaluate the color, hue, and chroma of representative soils. Soils were also observed for oxygen reduction reactions (redox) features associated with anaerobic conditions. Redox features were characterized by their size, distinction, and frequency of occurrence.

The locations of the two soil sample points are shown in Figure 3.3-12. Sample Point 1 (SP1) is an atypical soil profile of the Site. The presence of organic material is indicative of above normal soil moisture. The soil profile consisted of the top 4 inches of clay loam with approximately 10 percent organic material. The color of the top 4 inches was dark brown (7.5YR3/4) (MacBeth, 2000). From 4 to 12 inches below ground surface (bgs), the profile changed to a sandy loam with a yellowish-red color (5YR4/6) (MacBeth, 2000). The soil profile did not exhibit hydric characteristics under the guidelines within the Pocket Guide to Hydric Soil Field Indicators (Wetland Training Institute - WTI, 2006).

Sample Point 2 (SP2) was a typical soil profile for the Site. The soil profile consisted of the top 2 inches of loam with plates of clay that restrict water infiltration (strictures), and flake off at the touch. The color of the top 2 inches was brown (7.5YR4/4) (MacBeth, 2000). From 2 to 12 inches bgs, the profile changed to a sandy loam with a yellowish-red color (5YR4/6) (MacBeth, 2000). The soil profile did not exhibit hydric characteristics under the guidelines within the Pocket Guide to Hydric Soil Field Indicators (WTI, 2006).

3.4 WATER RESOURCES

The NRC guidelines (NRC, 1982a and 2003a) for Environmental Review of Nuclear Material Safety and Safeguards, and CDPHE (2001) both require baseline characterization of water resources, comprising surface water and groundwater, their use patterns, and pathways they present to possible migration of any impacts of the Proposed Action, drawing on public documents and performing such additional work as needed to complete the characterization.

Regional hydrology reports have been published by the USGS (Robson and Banta, 1995) and the CGS (Topper et al., 2003). Other studies were conducted in the 1980s to assess the potential of the salt deposits in the project area for nuclear waste repositories (Weir et al., 1983;

Hite and Lohman, 1973). The contribution of salt to the Colorado River by the Dolores River cutting across the salt formations was investigated by the BOR, who instituted pumped interception of brines, and installed a seismic monitoring network to observe effects of deep injection.

Energy Fuels initiated baseline hydrological characterization studies in 2007, leading to surface hydrology, groundwater, and water supply reports by Golder (2008e and 2009d). These reports followed work plans (Kleinfelder, 2008b; Golder, 2008d) drafted to fulfill the requirements of the NRC guidelines (NRC, 2003a), in particular Section 6.3.4 of NUREG 1748, Description of Water Resources. Work performed to support these reports included public literature searches, installation of geotechnical borings, groundwater monitoring wells, pumping test and observation wells, monitoring those wells to determine groundwater quality and flows, and performing pumping tests to assess supply well yield, and identifying and assessing off-site wells and springs and water rights.

Water resources and the work performed to characterize them are discussed in this section. The precipitation and recharge initiating the hydrological cycle of the Site is discussed in Section 3.6, Meteorology, Climatology and Air Quality. The stratigraphic framework of the groundwater aquifer systems is presented in Section 3.3, Geology and Soils.

3.4.1 Surface Hydrology

Administratively, the Site lies in Colorado Division of Water Resources District 61, within Division 4 (Montrose). The Site lies between the Dolores and San Miguel rivers, 9 miles southwest of their confluence.

3.4.1.1 Surface Waterbodies

The Dolores and San Miguel rivers both originate in the San Juan Mountains to the southeast. The San Miguel River, with headwaters near Telluride, is un-dammed; the Dolores, which has headwaters just the other side of Lizard Head Pass from the San Miguel River, is dammed near the Town of Dolores, Colorado, in the BOR-managed McPhee Reservoir, which supplies irrigation water to Montezuma and Dolores counties and to the Ute Mountain Indian Reservation.

The San Juan Mountains, and the La Sals at the north end of Paradox Valley, gather snowpack and are heavily forested, so that they sustain some baseflows in the rivers after spring runoff through the summer months when precipitation is limited to sporadic thunderstorms. The San Miguel River is a perennial braided stream in an incised channel, the Dolores River is a highly sinuous incised stream with much less alluvial bed load, and frequently becomes a string of disconnected pools in summer when water is held for irrigation. Alluvium in the reach of the Dolores crossing Paradox Valley mostly comes from the valley itself. All of the watercourses between the two rivers within 15 miles of the Site are ephemeral and flow only in storm events.

Paradox Valley is named for the fact that the Dolores River crosses its long axis at the settlement of Bedrock, 7 miles north of the Site. The valley is in fact a collapsed anticline, a trough between the flanks of a fold, not a river-cut valley. The Site is in the southeast end of this valley, and contains shallow ephemeral channels draining northwest to the Dolores River. At the northwest end of Paradox Valley, a small stream, West Paradox Creek, drains from the south flank of the La Sal Mountains, past the settlement of Paradox, and into the Dolores River. East Paradox Creek is an ephemeral water course draining the southeast end of the valley to the Dolores. The Dolores River is similarly a divide in alluvial and bedrock groundwater. Figure 3.4-

1 illustrates the hydrologic isolation of the Site; no surface water other than storm runoff enters, leaves, or passes close to the Site. All perennial surface water is more than 7 miles from the Site.

3.4.1.2 Surface Water Quality

There is no perennial surface water in the immediate vicinity of the Site, and description of surface water quality requires sampling infrequent snow melt and storm runoff events. Energy Fuels installed water samplers in some of the larger drainages, and was able to collect samples from some storms and snowmelt events.

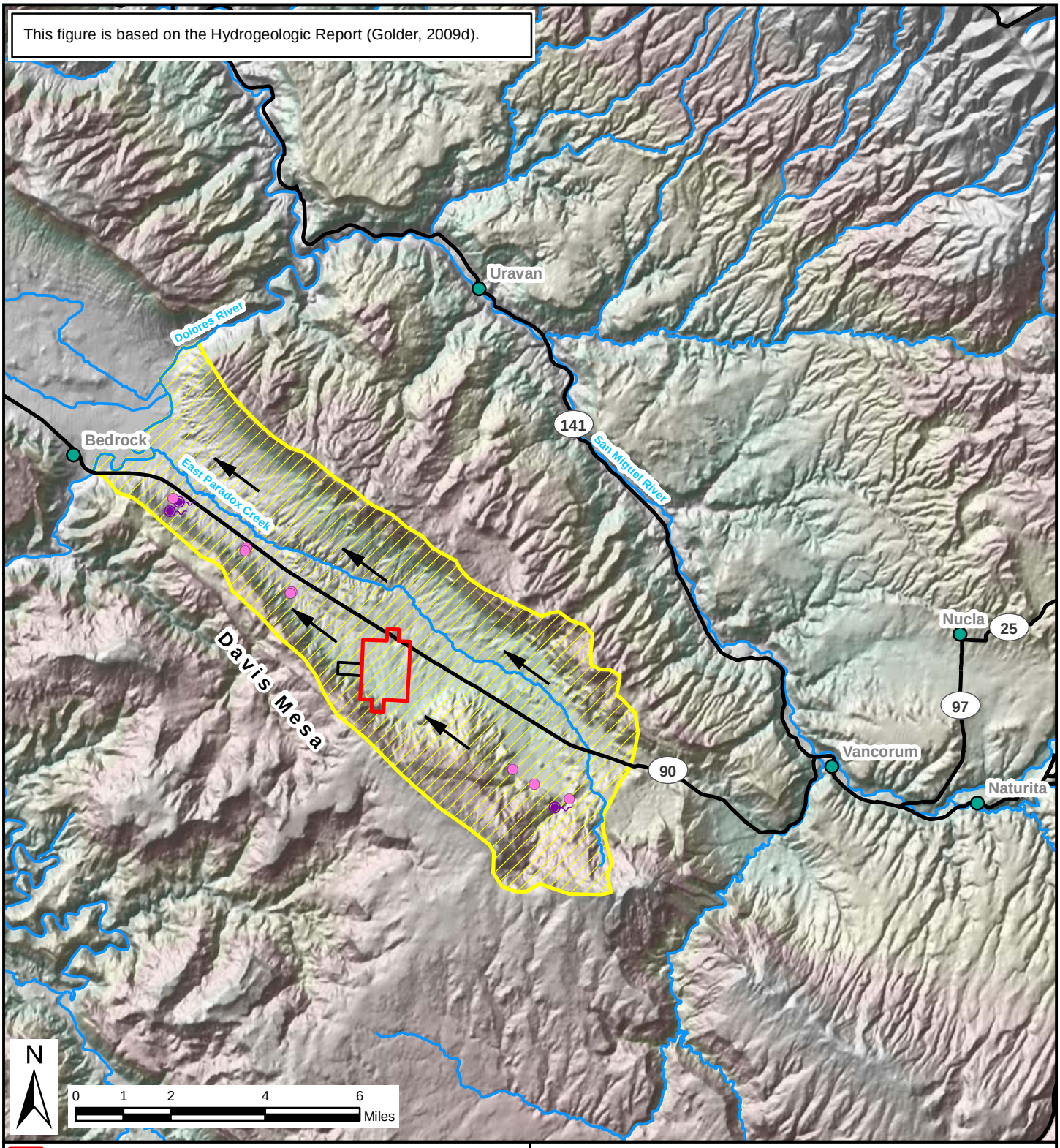
The nearest surface water is the Dolores River at Bedrock. The CDPHE-Water Quality Control Commission (WQCC) designated use classifications for the Lower Dolores River Basin, stream segment COGULD02, Mainstem of the Dolores River from the Little Gypsum Valley Bridge at the San Miguel/Montrose County line to the Colorado/Utah border, are Aquatic Life Warm 1, Recreation Class E, and Agriculture (CDPHE, 2007).

The CDPHE-WQCC defines the designated uses as follows (CDPHE, 2008a):

> Class 1 - Warm Water Aquatic Life 1. These are waters that (1) currently are capable of sustaining a wide variety of warm water biota, including sensitive species, or (2) could sustain such biota but for correctable water quality conditions. Waters shall be considered capable of sustaining such biota where physical habitat, water flows or levels, and water quality conditions result in no substantial impairment of the abundance and diversity of species.
>
> Recreation Class E. Existing Primary Contact Use. These surface waters are used for primary contact recreation or have been used for such activities since November 28, 1975.
>
> Agriculture. These surface waters are suitable or intended to become suitable for irrigation of crops usually grown in Colorado and which are not hazardous as drinking water for livestock.

The Clean Water Act requires states to compile a list of waterbodies, known as the 303(d) list, that do not meet water quality standards for their designated uses. The 303(d) list or 305(b) report that the CDPHE provides to the EPA lists the Dolores River as impaired due to iron concentrations and is considered a high priority section requiring a TMDL (total maximum daily load) analysis. The TMDL is an estimate of the greatest amount of a specific pollutant that a waterbody or stream segment can receive without violating water quality standards. This amount includes a margin of safety, waste load allocating (for point sources) and a load allocation (for non-point sources and natural background). The TMDL process is a method of analyzing pollution sources and allocating responsibility among these sources. At this time the CDPHE has not completed a TMDL for the Dolores River section near the Site (CDPHE, 2008b).

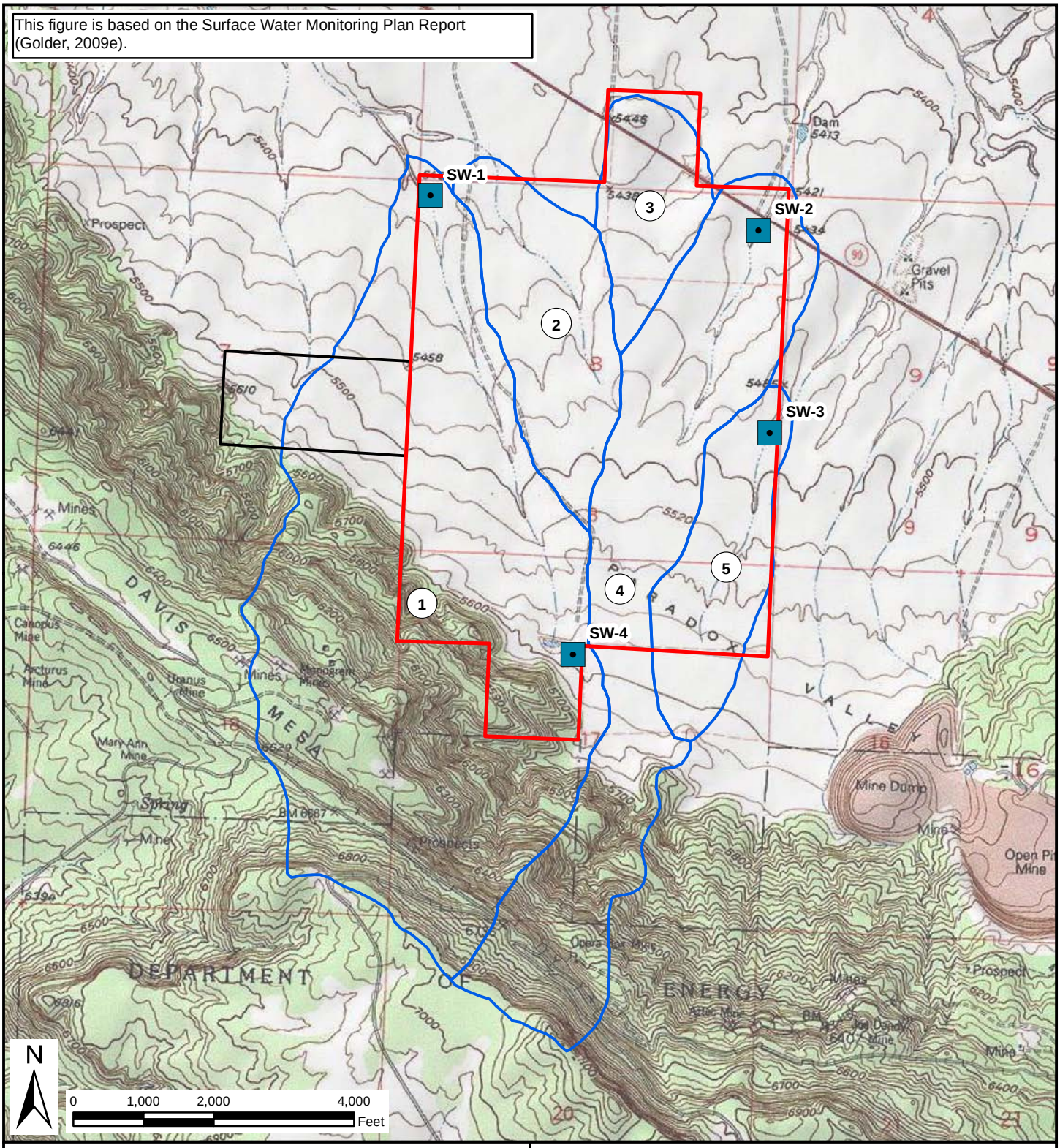
Surface water samples were collected from snow-melt and rain runoff events, from four stations within the Site. Locations of the box collectors are shown in Figure 3.4-2. Sampling events and analytical data are given in Table 3.4-1. The header of Table 3.4-1 shows the type of event as snow-melt (SM), or rain (P) with the precipitation recorded in the rain gauge at the particular station. Analyses included trace metals, dissolved and total, radionuclides, total dissolved solids (TDS), total suspended solids (TSS), nitrate + nitrite, and fluoride. Table 3.4-1a presents the quality control analyses (duplicate sample results) and water quality standards applicable to the reach of the Dolores River crossing Paradox Valley (the receiving stream).



Property Boundary
Well Field Boundary
Vicinity Wells (Chinle Formation)
Springs (Chinle Formation)
Surface Drainage Area

Figure 3.4-1

Site Location and Drainage Area



Sampler Location and ID

Property Boundary

Well Field Boundary

Drainage Basin and ID

Figure 3.4-2

Surface Water Sampler Locations

Table 3.4-1
Surface Water Data

Surface Water Sample ID		SW-1										SW-2		SW-3									SW-4
Date		2/12/08	9/29/08	10/6/08	1/27/09	5/3/09	5/27/09	6/22/09	6/30/09	7/13/09	7/28/09	2/12/08	1/27/09	2/12/08	9/29/08	10/6/08	1/27/09	5/27/09	6/22/09	6/30/09	7/13/09	7/28/09	7/28/09
Type of Event		SM	P - 0.6"	P - 0.7"	SM	SM	P - 1.4" X	P - 0.3"	P - 1.0"	P - 0.4'	P - 0.20"	SM	SM	SM	P - 0.5"	P - 0.8"	SM	P - 1.2"	P - 0.4"	P - 1.0"	P - 0.4"	P - 0.25"	P - 0.7"
Parameter	**Unit**																						
Field Parameters																							
Temperature	deg C	NM	16.1	4.7	2.1	21.2	23.1	24.1	19.6	23.8	15.8	NM	2.3	NM	15.2	2.3	1.1	21.5	26.2	21.5	26.1	20.2	21.1
pH	s.u.	NM	7.83	8.51	8.59	7.97	NM	7.52	7.24	7.75	8.18	NM	8.53	NM	7.72	8.48	8.37	NA	7.42	7.41	7.24	8.19	7.69
Specific Conductivity	µS/cm	NM	188	198	161	253	193	217	167	228	253	NM	120	NM	193	135	173	118	112	115	143	158	194
Dissolved Oxygen	mg/L	NM	6.24	7.62	S	NM	NM	NM	NM	3.07	0.14	NM	S	NM	6.09	4.41	S	NM	NM	NM	2.63	2.81	1.3
Oxidation-reduction Potential	mV	NM	148	191	143	148	149	NM	NM	116	79	NM	133	NM	188	165	168	153	NM	NM	103	94	123
General Water Quality																							
Nitrate+Nitrite as N	mg/L	0.7	9.16	1.91	<2	1.14	0.4	2.00	0.12	0.66	<0.1	0.4	<2	0.4	60.2	0.79	<2	0.5	0.65	0.10	0.20	<0.1	<0.1
Total Dissolved Solids (TDS)	mg/L	1240	4720	1170	910	270	1200	790	460	720	550	930	870	1580	1280	1320	630	2510	1050	1260	930	520	240
Total Suspended Solids (TSS)	mg/L	920	36000	3500	2700	3430	6400	2980	2960	2760	1270	1600	610	700	1940	1800	7600	3400	3810	3950	4690	2740	570
Fluoride	mg/L	0.1	<1	<1	<0.5	0.1	<4	0.2	0.2	0.2	<0.1	<0.1	<0.5	<0.1	0.1	<1	<0.5	<4	0.2	0.1	0.2	0.1	<0.1
Dissolved Metals																							
Aluminum	mg/L	0.08	<0.2	0.14	0.12	0.08	0.83	0.14	0.06	0.47	0.22	0.08	0.16	0.14	0.12	1.16	0.07	0.73	0.18	0.06	0.59	0.37	0.18
Antimony	mg/L	0.0005	<0.002	0.0012	0.0004	0.0008	0.0008	0.001	0.0015	0.0011	0.0011	<0.0004	0.0009	0.0005	0.0008	0.0016	0.0008	0.0008	0.0011	0.0014	<0.004	0.0013	0.0012
Arsenic	mg/L	0.0062	0.0067	0.0120	0.0034	0.0075	0.0156	0.0104	0.0078	0.0068	0.0098	0.0047	0.0058	0.0031	0.026	0.0231	0.0074	0.008	0.0056	0.0040	0.0062	0.0075	0.0051
Barium	mg/L	0.119	0.29	0.133	0.132	0.132	0.520	0.126	0.125	0.156	0.265	0.102	0.106	0.061	0.101	0.486	0.151	0.254	0.107	0.088	0.190	0.263	0.338
Beryllium	mg/L	<0.002	<0.01	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.004	<0.002	<0.002	<0.002	<0.002	<0.002
Cadmium	mg/L	<0.0001	<0.0005	0.0002	<0.0001	0.0001	0.0005	0.0002	<0.0001	0.0002	0.0002	<0.0001	<0.0001	0.0002	<0.0001	0.0004	<0.0001	0.0003	<0.0001	<0.0001	0.0002	0.0002	<0.0001
Copper	mg/L	<0.01	<0.05	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	0.01	0.09	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	<0.02	<0.01	<0.01	0.03	0.08	<0.01
Iron	mg/L	NA	0.14	0.09	0.07	1.20	0.22	0.07	0.18	0.20	0.28	NA	0.03	NA	1.69	0.10	0.05	2.04	0.09	0.04	0.24	0.30	0.26
Lead	mg/L	<0.0003	0.0009	0.0007	0.0002	0.0003	0.0017	0.0015	0.0001	0.0009	0.0085	0.0002	0.0002	0.0003	0.0002	0.0026	0.0002	0.0023	0.0003	<0.0001	0.002	0.0070	0.0015
Manganese	mg/L	NA	0.641	0.228	<0.005	0.226	0.553	0.206	0.074	0.426	0.601	NA	0.033	NA	0.025	0.645	0.046	0.21	0.015	0.024	0.427	0.417	0.216
Mercury	mg/L	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	mg/L	<0.01	<0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel	mg/L	NA	0.0041	0.0017	0.0017	0.0028	0.0145	0.0054	0.0022	0.0066	0.0082	NA	0.0017	NA	0.004	0.0034	0.0021	0.036	0.0034	0.0013	0.0028	0.0046	0.0019
Potassium	mg/L	17.5	17.0	15.0	17.1	16.5	19.5	20.3	17.1	24.1	29.4	9.1	6.5	8.4	13.0	9.8	13.4	10.3	8.1	8.6	9.7	10.7	14.4
Selenium	mg/L	<0.001	<0.0005	0.0003	0.0003	0.0004	0.0005	0.0008	0.0004	0.0007	0.0056	<0.001	0.0002	<0.001	0.0007	0.0002	0.0002	0.0004	0.0005	0.0003	0.001	0.0062	0.0004
Silver	mg/L	<0.01	<0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01	<0.01	<0.01	<0.01	<0.01
Thallium	mg/L	<0.0001	<0.0005	<0.0001	0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Uranium	mg/L	0.0032	0.0005	0.0001	0.0005	0.0010	0.0005	0.0004	0.0009	0.0005	0.0006	0.0020	0.0003	0.0004	0.0003	0.0002	0.0018	<0.0002	<0.0001	0.0001	0.0003	0.0003	0.0005
Vanadium	mg/L	0.023	<0.03	0.018	0.013	0.011	0.011	0.025	0.024	0.034	0.032	0.010	0.006	0.010	0.015	0.019	0.014	<0.01	0.016	0.007	0.030	0.026	0.021
Zinc	mg/L	NA	0.003	0.010	0.007	0.011	0.020	0.028	0.003	0.026	0.494	NA	0.003	NA	0.02	0.026	0.005	0.042	0.021	0.003	0.015	0.085	0.055
Total Metals																							
Antimony	mg/L	<0.004	NA	<0.002	NA	<0.002	NA	NA	NA	NA	NA	<0.004	NA	<0.004	NA	<0.002	NA	NA	NA	NA	NA	NA	<0.0008
Arsenic	mg/L	0.033	NA	0.050	NA	0.039	NA	NA	NA	NA	NA	0.020	NA	0.029	NA	0.048	NA	NA	NA	NA	NA	NA	0.008
Cadmium	mg/L	0.003	NA	0.0045	NA	0.0045	NA	NA	NA	NA	NA	0.003	NA	0.003	NA	0.0034	NA	NA	NA	NA	NA	NA	0.0005
Chromium	mg/L	0.12	0.6	0.08	0.07	0.14	0.15	0.09	0.08	<0.1	0.07	0.10	0.06	0.11	0.12	0.10	0.09	0.09	0.09	0.10	<0.1	0.07	<0.02
Lead	mg/L	0.041	NA	0.0891	NA	0.0689	NA	NA	NA	NA	NA	0.043	NA	0.052	NA	0.0925	NA	NA	NA	NA	NA	NA	0.0081
Mercury	mg/L	<0.0002	NA	<0.0002	NA	<0.0002	NA	NA	NA	NA	NA	<0.0002	NA	<0.0002	NA	<0.0002	NA	NA	NA	NA	NA	NA	<0.0002
Selenium	mg/L	0.0010	NA	0.0024	0.0020	0.0015	NA	NA	NA	NA	NA	<0.001	0.0019	<0.001	NA	0.0022	0.0033	NA	NA	NA	NA	NA	0.0009
Thallium	mg/L	0.003	NA	0.0033	NA	0.0026	NA	NA	NA	NA	NA	<0.001	NA	<0.001	NA	0.0024	NA	NA	NA	NA	NA	NA	<0.0002

Surface Water Sample ID		SW-1										SW-2		SW-3									SW-4
Date		2/12/08	9/29/08	10/6/08	1/27/09	5/3/09	5/27/09	6/22/09	6/30/09	7/13/09	7/28/09	2/12/08	1/27/09	2/12/08	9/29/08	10/6/08	1/27/09	5/27/09	6/22/09	6/30/09	7/13/09	7/28/09	7/28/09
Type of Event		SM	P - 0.6"	P - 0.7"	SM	SM	P - 1.4" X	P - 0.3"	P - 1.0"	P - 0.4'	P - 0.20"	SM	SM	SM	P - 0.5"	P - 0.8"	SM	P - 1.2"	P - 0.4"	P - 1.0"	P - 0.4"	P - 0.25"	P - 0.7"
Parameter	**Unit**																						
Radionuclides – Dissolved																							
Gross Alpha	pCi/L	73	2.3	0.26	1.6	1.6	2.6	2.7	2.8	3.3	3.6	56	1.6	75	150	0.0	4.9	0.05	0.5	2.1	2.7	1.1	3.8
Radium-226	pCi/L	NA	NA	0.23	0.16	0.68	0.33	0.77	0.68	0.58	1.2	NA	0.0	NA	NA	0.52	0.21	0.17	0.31	0.13	0.3	0.58	1.9
Radium-228	pCi/L	NA	NA	0.6	0.37	0.5	2.1	0.71	1.1	0.6	0.64	NA	0.99	NA	NA	2.3	1.1	0.66	1.6	0.51	1.2	1.1	0.6
Thorium-230	pCi/L	NA	NA	-0.12	-0.05	-0.02	-0.08	-0.07	-0.15	0.29	0.57	NA	0.03	NA	NA	-0.36	0.09	0.07	-0.01	0.09	-0.2	0.22	0.6
Thorium-232	pCi/L	NA	NA	0.04	-0.04	0.03	-0.02	0.0	-0.03	0.03	0.1	NA	0.07	NA	NA	-0.15	0.03	0.02	0.0	0.03	-0.05	0.1	0.03
Radionuclides – Total																							
Radium-226	pCi/L	20	21	NA	17	62	46	20	30	35	21	9.4	10	12	19	NA	3.7	15	22	28	27	29	13
Radium-228	pCi/L	7.8	2.5	NA	3.7	5.5	16	7.3	5.2	4.8	4.8	11	2.7	11	6	NA	3.9	12	18	4.6	10	5.1	3.8
Thorium-230	pCi/L	11	21	NA	0.01	28	83	17	23	34	30	5.2	0.05	11	13	NA	0.06	24	13	12	18	17	4.2
Thorium-232	pCi/L	1.98	3.83	NA	0.0	5.67	12.6	2.47	1.86	4.74	4.62	2.71	-0.05	2.99	4.93	NA	0.14	6.63	4.86	3.11	3.09	5.03	0.33

Notes:
NA - Not Analyzed
NM - Not Measured
P - 0.5" - Precipitation and Intensity (in total inches)
S-Saturated
SM – Snowmelt
X - SW-1 5/27/09 Measured at #1 Met station - cows broke gauge at site

Shading indicates a concentration or activity level above of a surface water standard applicable at segment 3a of the Dolores River.

Regulatory References:
CDPHE WQCD Regulation No. 31 - The Basic Standards and Methodologies for Surface Water (amended 1/14/08)
CDPHE WQCD Regulation No. 35 - Classifications and Numeric Standards for Gunnison and Lower Dolores River Basins (amended 2/12/07)
EPA CFR40 Part 440 Subpart C - Uranium, Radium and Vanadium Ores Subcategory

Table 3.4-1a
Surface Water Quality Control and Regulatory Standards

Surface Water Sample ID		Equipment Rinsate	DUP-1 (SW-3)	DUP-2 (SW-1)	DUP-3 (SW-3)	DUP-4 (SW-1)	DUP-5 (SW-3)	DUP-6 (SW-4)	CDPHE Agriculture	CDPHE Dolores Segment 3a	CDPHE Aquatic Class 2	CDPHE Recreational Class E	EPA 40 CFR Part 440
Date		2/12/08	9/29/08	9/26/08	5/27/09	6/22/09	7/13/09	7/28/09					
Type of Event		SM	P - 0.5"	P - 0.6"	P - 1.2"	P - 0.3"	P - 0.4"	P - 0.7"					
Parameter	**Unit**												
Field Parameters													
Temperature	deg C	NM	15.2	16.1	21.5	24.1	26.1	21.1					
pH	s.u.	NM	7.72	7.83	NA	7.52	7.24	7.69		6.5-9.0	6.5-9.0	6.5-9.0	6.0-9.0
Specific Conductivity	µS/cm	NM	193	188	118	217	143	194					
Dissolved Oxygen	mg/L	NM	6.09	6.24	NA	NA	2.63	1.3	<3.0	<5	<6	<3	
Oxidation-reduction Potential	mV	NM	188	148	153	NA	103	1.23					
General Water Quality													
Nitrate+Nitrite as N	mg/L	NA	NA	NA	NA	NA	NA	NA	100	100			
Total Dissolved Solids (TDS)	mg/L	NA	NA	NA	NA	NA	NA	NA					
Total Suspended Solids (TSS)	mg/L	NA	NA	NA	NA	NA	NA	NA					30(1);20(2)
Fluoride	mg/L	NA	NA	NA	NA	NA	NA	NA					
Dissolved Metals													
Aluminum	mg/L	NA	0.21	0.58	1.80	0.09	0.16	0.27					
Antimony	mg/L	NA	0.0006	0.0006	0.0008	0.0015	0.0013	<0.0004					
Arsenic	mg/L	NA	0.0117	0.0290	0.0099	0.0081	0.0078	0.0036			0.34(3);0.15(4)		1.0(max);0.5(1)
Barium	mg/L	NA	0.295	0.251	0.783	0.115	0.115	0.780					
Beryllium	mg/L	NA	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002					
Cadmium	mg/L	NA	0.0001	0.0004	0.0006	0.0001	<0.0001	0.0002					
Copper	mg/L	NA	0.02	<0.01	<0.01	0.02	0.01	0.01					
Iron	mg/L	NA	0.12	0.45	0.75	0.08	0.09	0.43					
Lead	mg/L	NA	0.0002	0.0024	0.0030	0.0004	0.0006	0.0029					
Manganese	mg/L	NA	0.080	0.848	0.297	0.042	0.209	0.228					
Mercury	mg/L	NA	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002			0.0014(3); 0.00001(4)		
Molybdenum	mg/L	NA	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01					
Nickel	mg/L	NA	0.0031	0.0050	0.0279	0.0055	0.0023	0.0032					
Potassium	mg/L	NA	17.0	17.6	11.7	21.5	13.3	14.3					
Selenium	mg/L	NA	0.0006	0.0005	0.0004	0.0009	0.0007	0.0023			0.0184(3); 0.0046(4)		
Silver	mg/L	NA	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01					
Thallium	mg/L	NA	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001					
Uranium	mg/L	NA	0.0003	0.0004	0.0002	0.0007	0.0006	0.0011					
Vanadium	mg/L	NA	0.021	0.014	0.005	0.029	0.020	0.023					
Zinc	mg/L	NA	0.007	0.024	0.149	0.006	0.004	0.120					1.0(1);0.5(2)
Total Metals													
Antimony	mg/L	<0.0004	NA	NA	NA	NA	NA	NA					
Arsenic	mg/L	<0.0005	NA	NA	NA	NA	NA	NA	0.1(2)	0.1			
Cadmium	mg/L	<0.0001	NA	NA	NA	NA	NA	NA	0.01(2)	0.01			
Chromium	mg/L	<0.01	NA	NA	NA	NA	NA	NA	0.1(2)	0.1			
Lead	mg/L	<0.0001	NA	NA	NA	NA	NA	NA	0.1(2)	0.1			

Surface Water Sample ID		Equipment Rinsate	DUP-1 (SW-3)	DUP-2 (SW-1)	DUP-3 (SW-3)	DUP-4 (SW-1)	DUP-5 (SW-3)	DUP-6 (SW-4)	CDPHE Agriculture	CDPHE Dolores Segment 3a	CDPHE Aquatic Class 2	CDPHE Recreational Class E	EPA 40 CFR Part 440
Date		2/12/08	9/29/08	9/26/08	5/27/09	6/22/09	7/13/09	7/28/09					
Type of Event		SM	P - 0.5"	P - 0.6"	P - 1.2"	P - 0.3"	P - 0.4"	P - 0.7"					
Parameter	**Unit**												
Mercury	mg/L	<0.0002	NA	NA	NA	NA	NA	NA					
Selenium	mg/L	<0.0001	NA	NA	NA	NA	NA	NA	0.02(2)	0.02			
Thallium	mg/L	<0.0001	NA	NA	NA	NA	NA	NA					
Radionuclides – Dissolved													
Gross Alpha	pCi/L	0.76	NA	NA	NA	NA	NA	NA					
Radium-226	pCi/L	NA	NA	NA	NA	NA	NA	NA					10(1);3.0(2)
Radium-228	pCi/L	NA	NA	NA	NA	NA	NA	NA					
Thorium-230	pCi/L	NA	NA	NA	NA	NA	NA	NA					
Thorium-232	pCi/L	NA	NA	NA	NA	NA	NA	NA					
Radionuclides – Total													
Radium-226	pCi/L	0.08	NA	NA	NA	NA	NA	NA	5	5	5	5	30(1);10(2)
Radium-228	pCi/L	2.5	NA	NA	NA	NA	NA	NA					
Thorium-230	pCi/L	-0.33	NA	NA	NA	NA	NA	NA	60	60	60	60	
Thorium-232	pCi/L	-0.04	NA	NA	NA	NA	NA	NA					

Notes:
Standards
(1) - Maximum value
(2) - 30-day average value
(3) – Acute
(4) - Chronic

Regulatory References:
CDPHE WQCD Regulation No. 31 - The Basic Standards and Methodologies for Surface Water (amended 1/14/08)
CDPHE WQCD Regulation No. 35 - Classifications and Numeric Standards for Gunnison and Lower Dolores River Basins (amended 2/12/07)
EPA CFR40 Part 440 Subpart C - Uranium, Radium and Vanadium Ores Subcategory

There is large variability in turbidity (TSS) and TDS between samples. These concentrations may be expected to be affected by many factors, such as the moisture and capillary cohesion of soil surface (crust), the rainfall rate and size of rain drops, presence of stock, and others. There is no significant correlation between TSS and TDS, gauge rainfall, or dissolved or total metals or radionuclide concentrations ("dissolved" concentrations are analyzed after filtration to 0.45 micron; "total" metal concentrations are analyzed after acid digestion of the water sample with its suspended solids). Total radionuclides and metals exceed dissolved concentrations. Total radionuclides and suspended solids exceed water quality criteria applicable to the Dolores River receiving reach; these are highlighted in the table.

3.4.2 Groundwater

3.4.2.1 Regional Hydrogeology

There have been many publications on regional hydrogeology of the Paradox Basin, but little specifically on Paradox Valley itself. Notable regional hydrologic studies include *Regional Hydrology of the Dolores River Basin, Eastern Paradox Basin* (Weir et al., 1983), *Regional Hydrology of the Blanding-Durango Area, Southern Paradox Basin* (Whitfield et al., 1983), and *Geohydrology of Mesozoic Rocks in the Upper Colorado River Basin in Arizona, Colorado, New Mexico, Utah, and Wyoming, Excluding the San Juan Basin* (Freethey and Cordy, 1991). Additional studies have focused on the geology in the region, including *Geologic Appraisal of Paradox Basin Salt Deposits for Waste Emplacement* (Hite and Lohman, 1973), *Geochemistry and Hydrodynamics of the Paradox Basin Region, Utah, Colorado, and New Mexico* (Hanshaw and Hill, 1969), and *Geology of the Pennsylvanian and Permian Cutler Group and Permian Kaibab Limestone in the Paradox Basin*, *Southeastern Utah and Southwestern Colorado* (Condon, 1997). These studies provide the following information regarding the regional hydrogeology.

- Three aquifer systems are recognized regionally in the studies above, namely alluvium, upper Paleozoic and Mesozoic strata, and lower Paleozoic strata. The Hermosa Formation is a regional aquitard between upper and lower bedrock aquifers.

- Alluvial groundwater along the San Miguel and Dolores rivers is in direct connection with surface water. River alluvium contains outwash sand and gravel from the San Juan Mountains. Alluvium in Paradox Valley is derived from weathering of the valley sides and consists of silt and sand, with some clay and gravel (Golder, 2009d), and is recharged by direct precipitation and runoff from the valley sides.

- The upper bedrock aquifer consists of all strata younger than (above) the Hermosa Formation. The Dolores, Chinle, and Moenkopi formations contain sandstones and shales, and are regionally considered to be aquitards (Topper et al., 2003), along with the Hermosa Formation. The upper aquifer has recharge and discharge patterns that are strongly linked to local topography and locally flows northwest to the Dolores River (Weir et al., 1983; Topper et al., 2003). Relatively short flowpaths and predominantly continental quartz sandstones give the upper aquifer generally low dissolved solids content.

- The Hermosa Formation isolates the upper and lower aquifer systems (Topper et al., 2003; Freethey and Cordy 1991; Weir et al., 1983; Whitfield et al., 1983). It contains thick, low permeability shales and salt deposits (particularly the Paradox Member) which raise dissolved solids concentrations in strata immediately above and below.

- The lower bedrock aquifer consists of limestone and marine sandstones; in the Paradox Basin the top of the lower aquifer consists of the Leadville Limestone, which has fracture and karst permeability, and carries brines, and oil and gas. Groundwater in the lower aquifer flows below the influence of local topography, toward the Colorado River (Freethey and Cordy, 1991).

Recharge derives from precipitation which ranges from 24 inches (60 cm) per year at high elevations (such as the La Sal and San Juan mountains), when it is predominantly from snowfall, to approximately 12 inches (about 30 cm) per year at lower elevations, when it is largely from fall thunderstorms. Meteorology is discussed fully in Section 3.6.

The Dolores River forms a groundwater divide for alluvial and upper bedrock aquifers regionally and in Paradox Valley in particular. This means that northwest and southeast ends of the valley are hydrologically separated by the Dolores, except in the deep, saline Leadville Limestone (regional lower aquifer).

3.4.2.2 Site Groundwater

The Site is within Paradox Valley, a collapsed anticline domed upward by a salt diapir (a buoyant, plastic salt flow) formed by the Paradox Member, and then sapped by dissolution of the salt core. Mesozoic and upper Paleozoic strata comprising the regional bedrock aquifer system outside the valley dip away from the valley, while within the valley, down-dropped remnants of the anticline flanks form a limited aquifer, referred to here as the valley margin Triassic aquifer. Recharge outside of the valley flows away from the anticline. The alluvial floor of the valley is largely underlain by the very low permeability, confining strata of the Hermosa Formation, including the core of the salt diapir derived from the Paradox Member. The location of the Site in the southeast end of Paradox Valley (Figure 3.4-1) isolates it from regional aquifers. Groundwater (and surface water) within the catchment boundary (shown as a yellow line in the figure) flows to the Dolores River, to which it discharges. Groundwater outside the boundary flows away from the valley, toward the San Miguel or Dolores rivers.

Although numerous reports have been published on regional hydrogeology, none has focused on the hydrogeology of the eastern Paradox Valley. The regional studies name the Mesozoic formations, including Navajo Sandstone, Wingate Sandstone, and the Entrada Sandstone as important components of the upper bedrock aquifer, but these are largely absent at the Site due to their removal by erosion of the collapsed anticline crest. Figure 3.4-3 shows a stratigraphic column similar to that in Section 3.3., Geology and Soils, but with groundwater bearing units at the Site noted to the right. Of the Mesozoic strata present outside the valley, only portions of Chinle and Moenkopi formations are present inside the valley. The Hermosa Formation is a shale aquitard between upper and lower aquifers, and also an aquitard where it has truncated Mesozoic strata. Not shown in the figure is the alluvial veneer. The degree of hydraulic connection between the Mesozoic strata outside the valley and the valley margin Triassic aquifer inside it is unknown. To the extent that the faulting disrupts the hydraulic connection by offsets and low permeability gouge, the valley margin Triassic aquifer may be partially isolated from regional bedrock aquifers.

This figure is based on the Hydrogeologic Report (Golder, 2009d).

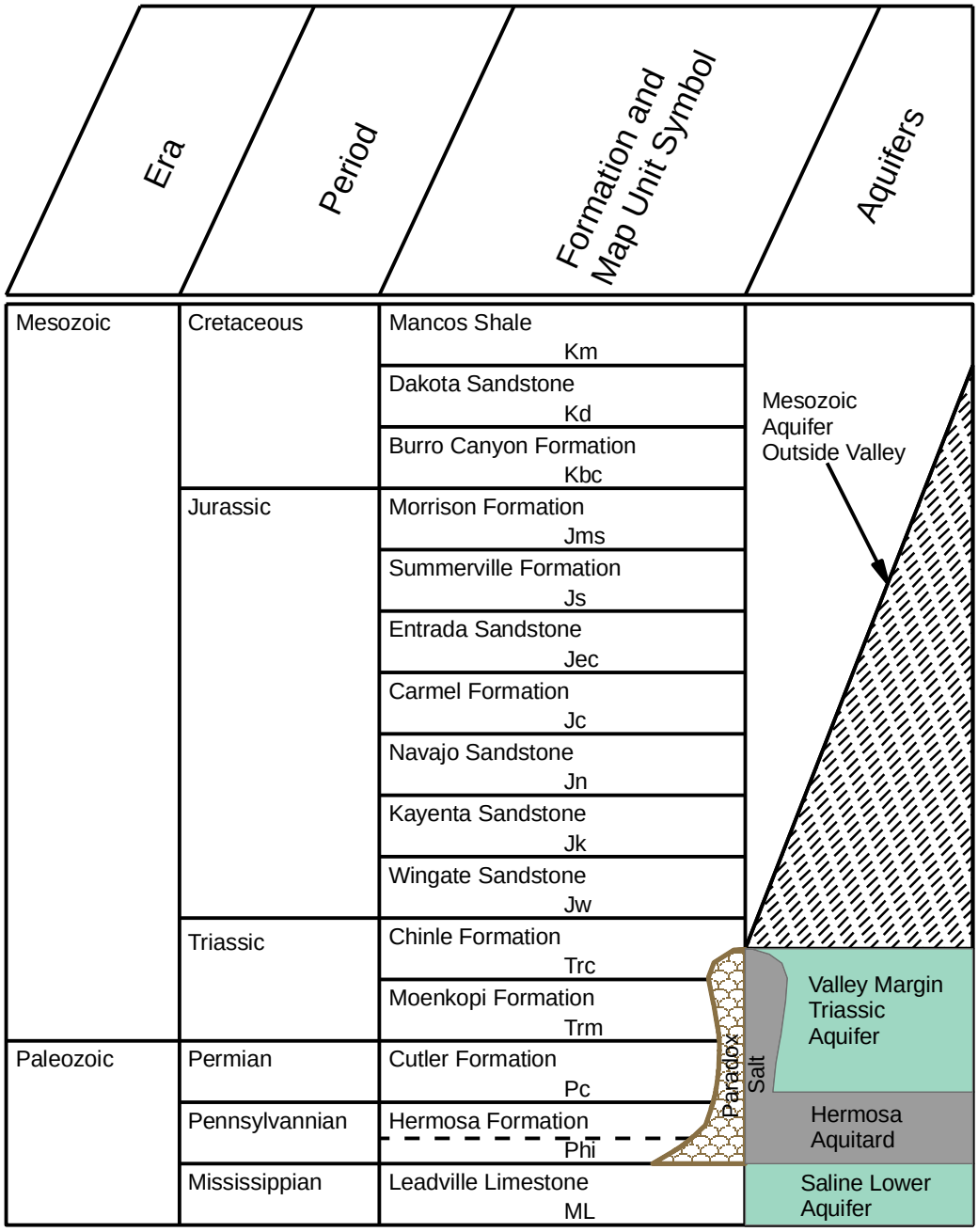


Figure 3.4-3

Schematic Stratigraphic Section Paradox Valley

Energy Fuels conducted a two-year site assessment of groundwater from fourth quarter 2007 through third quarter 2009 (Golder, 2009d). Of 35 borings, nine were completed as monitoring wells, three as pumping test – production wells, and six as observation piezometers for the pumping tests. Borehole and well locations are shown in Figure 3.4-4. Pumping tests were performed in 2008, and eight quarters of groundwater samples were analyzed. Aquifer hydraulic and water quality, pumping test analyses, and potential water supply yield are reported in the *Hydrogeologic Report* (Golder 2009d).

Borehole lithologies identified four formations with hydrologic significance at the Site:

1. Valley floor alluvium, shed by the valley sides, up to 150 feet (46 m) thick, and carrying some flow from direct infiltration and runoff from the valley sides north to the Dolores River.
2. Chinle Formation – occurring in faulted valley margin blocks at the Site and bearing some groundwater in its lower part.
3. Moenkopi Formation – underlies the Chinle Formation and also may contain groundwater in some locations.
4. Hermosa Formation – shale and salt of the Paradox Member, which truncates the Chinle and Moenkopi formations near the center of the valley, and underlies them under Davis Mesa.

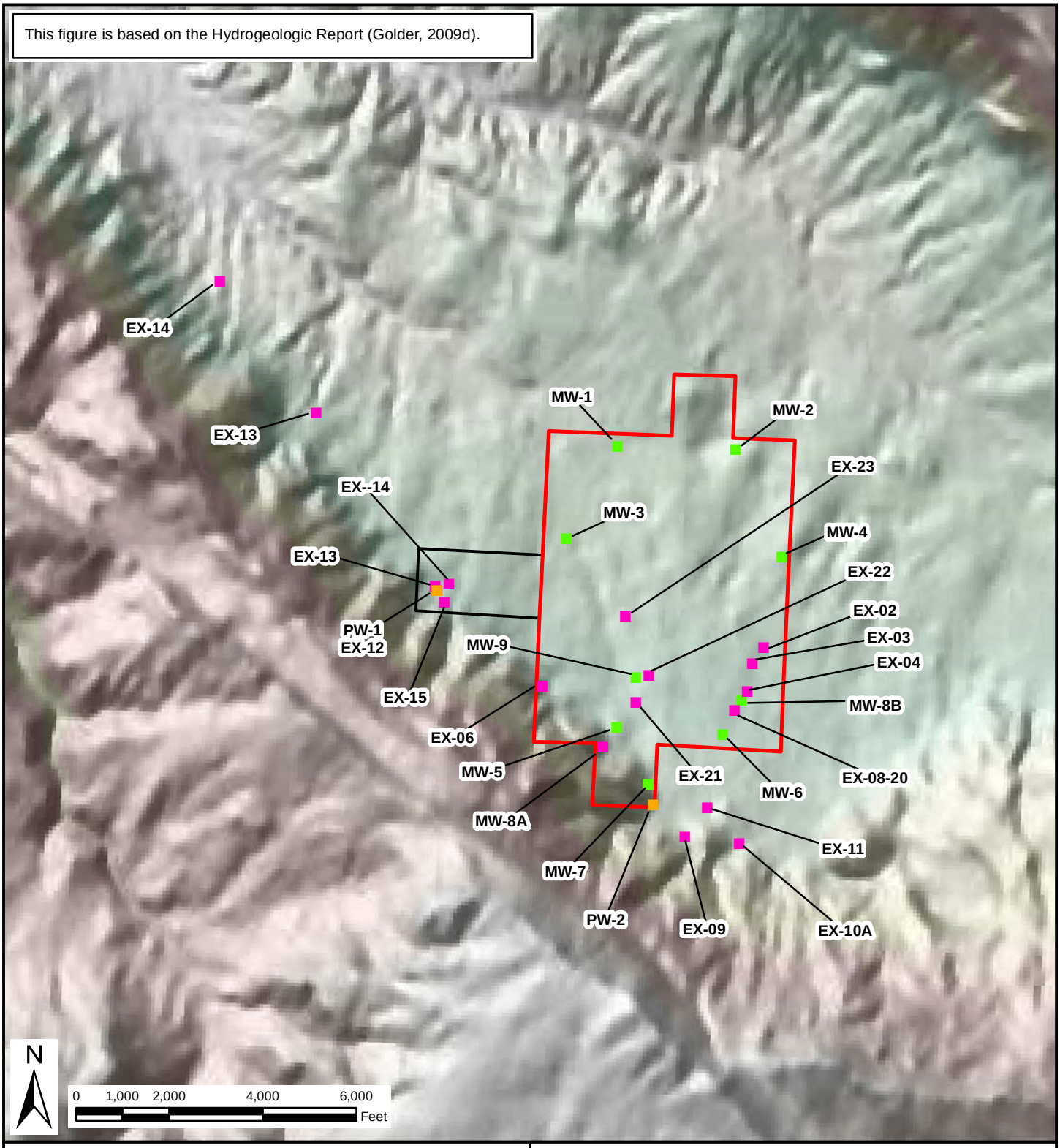
Alluvium was sampled by borings. It is up to 150 feet (46 meters) thick, but with almost no saturated thickness. According to the *Hydrogeologic Report* (Golder, 2009d) there is no water in the alluvium. Alluvial sediments encountered in borings are described as sand with basal gravels, which probably drain the small amount of direct infiltration to narrow channels incised in bedrock. One such gully in the bedrock surface is clearly evident beneath the Site in a contour map in Figure 3.3-9 (Section 3.3, Geology and Soils).

Partial sections of the Chinle and Moenkopi formations constitute the valley margin Triassic aquifer (with slivers of Wingate Sandstone). Site investigations show that this aquifer inside the valley, at the foot of Davis Mesa, is recharged by infiltration on the valley side, and the edge of the mesa is likely a groundwater divide. Groundwater south of this divide flows away from the Paradox Valley to discharge to the Dolores River, just as groundwater on the north side of the valley flows northeast to the San Miguel River.

Typical geologic cross sections through the Site are shown in Figure 3.3-4 (Section 3.3, Geology and Soils). These sections are located within the valley, as shown in Figure 3.4-3, running onto the lower valley slope at the southwest end. These have no vertical exaggeration. Sections show faulted blocks of purple and orange Triassic strata of limited extent, which constitute the only bedrock aquifer of the Site. The Chinle and Moenkopi formations extend from Davis Mesa to approximately the alignment of the fault labeled Fault #3 on Figure 3.4-3. While these two formations are not generally known as aquifers, the faulting and jointing of the valley margin appear to both connect them and give them secondary permeability.

The main characteristics of this valley bedrock Triassic aquifer are:

- Recharge on the valley sides, with flow toward the valley axis;
- Some hydraulic connection to the Mesozoic strata outside the valley, although the edge of Davis Mesa appears to be a groundwater divide;



Exploratory Borings
Monitoring Wells
Production Wells
Property Boundary
Well Field Boundary

Figure 3.4-4

Boreholes & Well Locations for Groundwater Characterization

- Northwest-trending faults contributing secondary permeability; and
- The Hermosa Formation forming a practically impermeable basement, truncating the valley margin Triassic aquifer on its northeast side, and also leaking salt into adjacent groundwater.

Groundwater in the valley margin Triassic aquifer flows away from the divide at the edge of the mesa to the northeast, toward the faulted contact with the Paradox salt. Flow turns northward at the contact, toward the Dolores River. Groundwater flow directions in the Site aquifer can be gauged from the potentiometric map of Figure 3.4-5. Flow is to the northeast into the valley, with contours suggesting recharge also from the slump block of the Morrison Formation to the southeast. Connection between the Morrison Formation slump block and the Moenkopi-Chinle block is not clear. Wells north of this aquifer (MW-1 to MW-4) are completed in the Hermosa Formation, and are dry.

In spring and summer 2008, hydraulic testing was conducted in the valley margin Triassic aquifer to both evaluate its water supply potential and to further characterize the Site groundwater regime. Testing and analyses are included in the *Hydrogeologic Report* (Golder (2009d). Testing consisted of:

- Nine short term (approximately 4-hour) pumping tests,
- Three long-term (48-hour) pumping tests, and
- Three rising-head/falling-head slug tests.

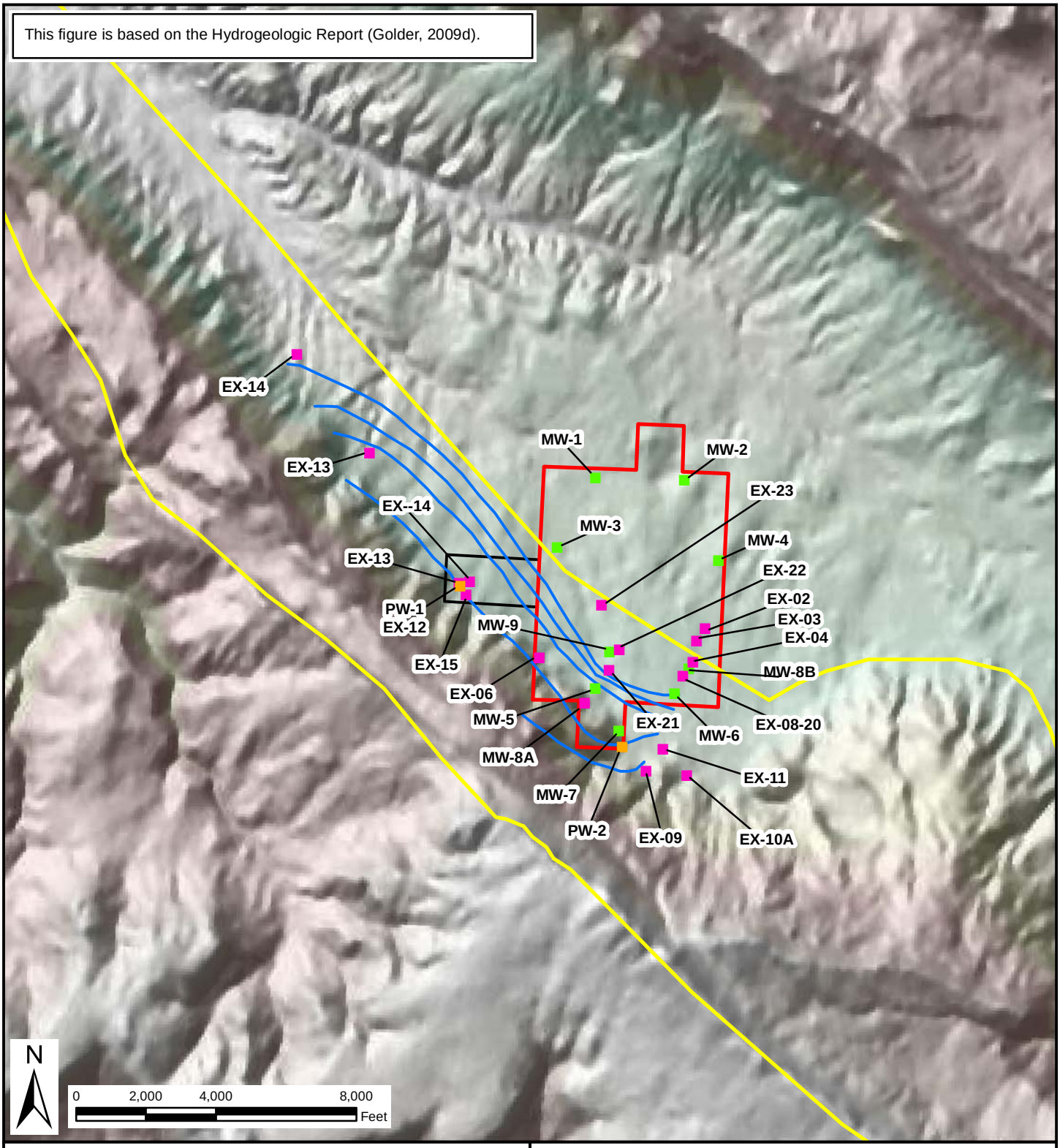
Discharge rates during the short-term pumping tests ranged from 4.7 to 39.8 gpm and in the long-term pumping tests from 10.3 to 67.5 gpm. The three long term tests were conducted simultaneously, with a cumulative yield of 130 gpm from PW-1, PW-2, and PW-3. Locations of the characterization boreholes and wells are shown in Figure 3.4-4. Results of analyses of the pumping tests are given in Table 3.4-2.

The average conductivity for the tested locations is 3×10^{-3} centimeters per second (cm/s), which is higher than expected for Chinle-Moenkopi. The range of hydraulic conductivity estimated from the testing is narrow, but the storativity is relatively low, which suggests extensive fracturing contributing secondary permeability. Lateral groundwater pore velocity estimated from Darcy's Law is approximately 7 feet per day - ft/d in the valley margin Triassic aquifer under the south end of the Site.

3.4.2.3 Existing Wells and Springs

Water wells and springs in the vicinity of the Site were located through Colorado Division of Water Resources (CDWR) database searches and field investigations. Field investigations were conducted to verify the existence, location, and condition of water wells located in close proximity. Owners of wells completed in the Chinle Formation and the BOR (operator of the Paradox Valley Unit) were also contacted to obtain additional well information such as withdrawal rates and use.

Water Wells. Table A-1 and Figure A-1 in the *Hydrogeologic Report (*Golder, 2009d) show the 46 water wells or permitted locations identified within the study area other than wells permitted and installed by Energy Fuels. Of these, 45 have been permitted with the state, and one older well identified by the BLM as the Prospector Well was not permitted. Some of the permits have not been exercised, and some others have been abandoned. Permitted well counts by formation, based on depth and location, are as follows:



Exploratory Borings
Monitoring Wells
Production Wells
Inferred GroundwaterContours
Approximate Limits of Valley Margin Triassic Aquifer
Property Boundary
Well Field Boundary

Figure 3.4-5

Potentiometric Surface Map

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Table 3.4-2
Summary of Aquifer Properties

Boring/ Well ID	Category of Boring/Well	Phase of Testing	Pumping Rate (gpm)[1]	Total Pumping Time (hours)	Maximum Observed Drawdown (ft)	Phase of Test for Analysis	Solution Type	Estimated Transmissivity (cm^2/s) [4]	Estimated Aquifer Thickness (ft)	Estimated Hydraulic Conductivity (cm/s) [4]	Estimated Storativity
EX-5	Exploration Hole	Phase 1	19.8	6	45.38	Pumping (step test)	Cooper-Jacob - Confined	0.5	55	3×10^{-4}	--
						recovery	Theis (Recovery)	0.3	55	2×10^{-4}	--
EX-6	Exploration Hole	Phase 1	27.8	6.7	29.14	Pumping (step test)	Cooper-Jacob - Confined	10	48	7×10^{-3}	--
						recovery	Theis (Recovery)	6	48	4×10^{-3}	--
EX-7	Exploration Hole	Phase 1	19.4	6.7	27.54	Pumping (step test)	Cooper-Jacob - Confined	11	60	6×10^{-3}	--
						recovery	Theis (Recovery)	10	60	5×10^{-3}	--
EX-8	Exploration Hole	Phase 2	26.2	4	19.2	pumping	Cooper-Jacob - Confined	11	60	6×10^{-3}	--
						recovery	Theis (Recovery)	10	60	5×10^{-3}	--
EX-10	Exploration Hole	Phase 2	14.9	5	16.7	pumping	Cooper-Jacob - Confined	0.8	60	4×10^{-4}	--
						recovery	Theis (Recovery)	6	60	3×10^{-3}	--
EX-11	Exploration Hole	Phase 2	8.8	4	47.9	pumping	Cooper-Jacob - Confined	0.2	60	9×10^{-5}	--
						recovery	Theis (Recovery)	0.5	60	3×10^{-4}	--
EX-12	Exploration Hole	Phase 2	39.8	6	3.57	pumping	Cooper-Jacob - Confined	10	60	6×10^{-3}	--
						recovery	Theis (Recovery)	32	60	2×10^{-2}	--
EX-15	Exploration Hole	Phase 2	14.4	6	53.78	pumping	Cooper-Jacob - Confined	0.8	91.1	3×10^{-4}	--
						recovery	Theis (Recovery)	3	91.1	9×10^{-4}	--
MW-6	Monitor Well	Phase 1	4.71	5	18.31	Pumping (step test)	Cooper-Jacob - Confined	0.5	30	6×10^{-4}	--
MW-7	Monitor Well	Phase 3	--	--	2.1	pumping	Theis - Confined	3	40	3×10^{-3}	3×10^{-4}
						recovery	Agarwal (CJ) - Confined	4	40	3×10^{-3}	3×10^{-4}
MW-8b	Monitor Well	Phase 2	slug test	--	--	falling head	Dagan - Unconfined	--	--	1×10^{-4}	--
						rising head	Dagan - Unconfined	--	--	2×10^{-4}	--
MW-9	Monitor Well	Phase 2	rising head test	--	--	rising head	Bouwer-Rice - Unconfined	--	--	2×10^{-8}	--
PW-1	Production Well	Phase 3	52.1 [2]	48.0	45.6 [2]	pumping	Theis - Distance-Drawdown	3	30	3×10^{-3}	3×10^{-5}
PW-1 OB-A	Observation Well	Phase 3	--	--	12.5	pumping	Theis - Confined	3	30	4×10^{-3}	2×10^{-5}
						recovery	Agarwal (CJ) - Confined	4	30	4×10^{-3}	1×10^{-5}
PW-1 OB-B	Observation Well	Phase 3	--	--	5.8	pumping	Theis - Confined	3	30	4×10^{-3}	3×10^{-5}
						recovery	Agarwal (CJ) - Confined	7	30	8×10^{-3}	4×10^{-5}
PW-2	Production Well	Phase 3	10.3	48.0	33.5	pumping	Theis - Distance-Drawdown	4	40	3×10^{-3}	5×10^{-4}
PW-2 OB-A	Observation Well	Phase 3	--	--	2.6	pumping	Theis - Confined	4	40	3×10^{-3}	7×10^{-4}
						recovery	Agarwal (CJ) - Confined	4	40	3×10^{-3}	1×10^{-3}
PW-2 OB-B	Observation Well	Phase 3	--	--	NR [3]		--	--	--	--	--
PW-3	Production Well	Phase 3	67.5	48.0	54.2	pumping	Theis - Distance-Drawdown	4	80	1×10^{-3}	1×10^{-2}
PW-3 OB-A	Observation Well	Phase 3	--	--	8.2	pumping	Cooper-Jacob - Unconfined	4	80	2×10^{-3}	1×10^{-2}
						recovery	Agarwal (CJ) - Unconfined	5	80	2×10^{-3}	1×10^{-2}
PW-3 OB-B	Observation Well	Phase 3	--	--	2.0	pumping	Cooper-Jacob - Unconfined	8	80	3×10^{-3}	9×10^{-3}
						recovery	slow recovery, could not be analyzed	--	--	--	--

Notes:
[1] gpm: gallons per minute
[2] Pumping rate and max drawdown listed for final pumping rate. At a pumping rate of 66 gpm during first 5 hours of test, a maximum drawdown of 53.6 feet was observed.
[3] NR: No response observed during pumping test
[4] cm/s: centimeters per second; cm^2/s: centimeters squared per second

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- Chinle/Moenkopi formations (11);
- Paradox Valley alluvium (10);
- Dolores River alluvium (16); and
- other (9).

A summary of the permitted wells for each aquifer is presented below. Additional details and informational references are provided in Table A-1 in the *Hydrogeologic Report* (Golder, 2009d).

Chinle/Moenkopi Formation Wells The wells permitted in the Chinle and Moenkopi formations are all located near the toe of Davis and Monogram mesas. These are:

- Four domestic wells currently in use (permit numbers 226684, 234136, 253522, and 269575): Supply for Hurdle, Herron, Boren, and Fehlmann/Davis residences, respectively);
- One domestic well not in use (permit number 91065): This supplied the Herron residence (previously owned by J. Russell) with domestic and livestock water until 2003, when it went dry and was replaced by well with permit number 234136;
- One stock well currently in use (permit number 258704): This is located on public land administered by the BLM, and used for watering cattle;
- Two intermittent or dry wells (permit numbers 86582 and 86583): Well with permit number 86582 produces water in wet years, and well with permit number 86583 is dry; and
- Three wells permitted but not installed (permit numbers 190027, 257495, and 279209): Owners indicated that well with permit numbers 190027 and 257495 were not installed, and well with permit number 279209 was drilled but was not completed.

Alluvial Wells Permitted alluvial wells are located near the central axis of the valley. Although some may have been intermittent producers, none are currently being used as follows:

- Inoperable wells (permit numbers 36544, 91066, and 102922): Well 36544, located immediately east of the Site, was installed by the landowner who has since passed away. An inspection in May 2008 found that the casing had collapsed. The windmill at well with permit number 91066 is broken and the well is not in use. Well with permit number 102922 was found to have an obstruction in the casing (possibly a stuck submersible pump) when inspected in June 2009;
- Wells abandoned or not installed (permit numbers 190026, 190028, 102923, 138759, 218930, and 226716): These wells do not appear to currently exist, based on interviews and field inspections; and
- “Prospector Well”: This well is located on the north side of the valley. It was sampled by the BLM in 1980, and water was of relatively poor quality with a specific conductivity of 3,350 micro Siemens per centimeter (*u*S/cm), and dissolved sulfate concentration of 2,300 mg/L. The current status of the well is unknown.

Dolores River Alluvial Wells These wells are located along the east bank of the Dolores River and are completed in river alluvium. Most are extraction wells for the BOR's desalinization plant as follows:

- Ten BOR extraction wells (permit numbers 26278, 26729, 26281, 23654, 23655, 23656, 23658, 23659, 23660, and 26280): These wells are currently pumping at a combined rate of about 230 gpm. The water is pumped to a desalinization plant, filtered water is discharged into the river below Paradox Valley and the extracted brine is disposed of in a deep injection well;
- Four abandoned BOR wells (permit numbers 23662, 23663, 23667, and 1997009); and
- Two domestic and stock wells (permit numbers 234100 and 268908): Well with permit number 234100 is 43-foot deep, and located at a residence just north of SH 90 on the right bank. This well may be upstream of the Paradox salt contacts and relatively fresh. Well with permit number 268908 is located in the center of the valley near the BOR wells, and was probably not completed because of high salinity.

Other Aquifers Nine wells apparently do not fit the previous classes. Many are indicated to be on the valley side or on the mesas. Some appear to be incorrectly located, or to be monitoring wells for mining activity as follows:

- Two active monitoring wells (permit numbers 48086 and 48088): Wells are completed in the Entrada Sandstone at an underground mine immediately south of the Site and are dry;
- Three abandoned wells (permit numbers 8547, 25277, and 32483): Well with permit number 8547 is an abandoned monitoring well for an underground mine. Well with permit number 25277 may have been installed to supply water to the change room for the open pit mine east of the Site. The mine operator, Cotter Corporation, could not locate this well and it is presumed abandoned. Well with permit number 32483 ("Dalton well") belongs to the reclaimed Nill Mine. This mine was wet. Water was pumped from the mine for livestock use until the mine was reclaimed and sealed; and
- Four incorrectly located wells (permit numbers 21384, 29990, 29991 and 115739): The given coordinates for these four wells place them on BLM-administered land, but the BLM has no record of them. Wells with permit numbers 29990 and 29991 were filed by the DOE. The DOE indicated that they were probably monitoring wells installed in Section 35 near the Durita Site, which is located in Township 46 North, Range 16 West, rather than Township 46 North, Range 17 West as listed in the CDWR database. Similar errors may apply to the other two wells.

Springs. Three springs identified within the study area are shown in Table A-2 and Figure A-1 in the *Hydrogeologic Report* (Golder, 2009d), named Stone Spring, Merrill Spring, and Oublier Spring. A field assessment in June 2009 found Merrill Spring and Stone Spring, approximately 5 miles northwest of the Site, issue from the Chinle Formation on the southwest side of the valley. Merrill Spring was not flowing at the time of the visit. Stone Spring provides water to two households on the Boren property through a PVC pipe. Flow from Stone Spring was estimated to be approximately 10 gpm. Oublier Spring, located approximately 4 miles southeast of the Site, was determined to flow from near the base of the Salt Wash Member of the Morrison Formation.

3.4.2.4 Groundwater Quality

Groundwater quality in the vicinity of the Site has been assessed by groundwater samples collected from 20 locations over the eight-quarter period from October 2007 to August 2009 (Golder, 2009d). The sampling locations included:

- monitoring wells MW-5, MW-6, MW-7, MW-8b, MW-9;
- production wells PW-1, PW-2, PW-3;
- exploratory holes EX-5, EX-6, EX-7, EX-10, EX-12, EX-15, EX-23; and
- four domestic wells and one spring used for domestic purposes.

Groundwater at, and in the immediate vicinity of, the Site is magnesium-calcium, sulfate-bicarbonate type, as is shown in a Piper or trilinear diagram in Figure 3.4-6. The ratios of major cations are shown in the left triangle, and anions in the right, while the quadrilateral combines the two. Each point represents a ratio of average concentrations for a well. All groundwater has near-neutral pH (7-8). The single sample collected from Monitoring well MW-9 is not shown on the Piper diagram, as the well was completed in a low permeable formation and could not be developed properly for collecting representative water samples.

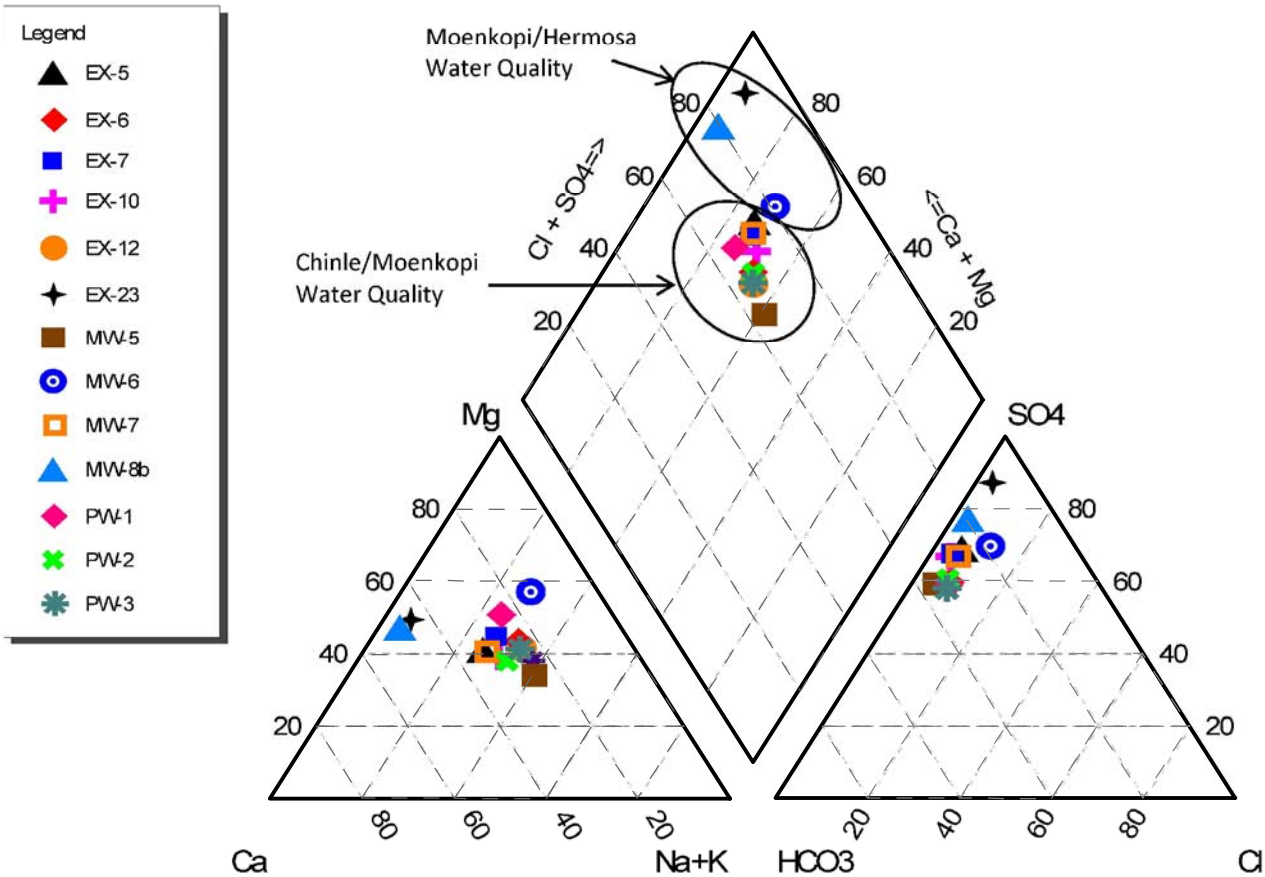
TDS concentrations are higher at the base of the Chinle Formation and in the Moenkopi Formation than in the upper Chinle, due to longer residence time in the aquifer for deeper, older water, and on the north edge of the aquifer, due to proximity to the Hermosa Formation. Shallower As illustrated in Figure 3.4-7, Chinle groundwater (Wells MW-5, MW-7, MW-9, PW-1, PW-2, and PW-3) has TDS between 600 and 1,100 mg/L, while deeper water (Wells MW-6 and MW-8b) has TDS 1,100 to 3,040 mg/L. Deeper water also shows negative oxidation-reduction potential (ORP) values, and detectable concentrations of sulfide and ammonia. That is, the water solutes are reduced with respect to reduction-oxidation state. Co-existence of sulfate and sulfide indicates active microbial sulfate reduction, presumably fueled by organic compounds diffusing out of the Hermosa shales (Dexter Dyer, 2003).

The concentrations of several parameters in the groundwater are consistently above the CDPHE Domestic Water Supply and Agricultural standards (CDPHE, 2008c). These constituents are highlighted in Table 3.4-3, and discussed below. Most of these exceedances of standards in the baseline water samples are due to the native conditions of diffusion of salts from the Paradox Member and uranium from the Morrison Formation. Elevated selenium, arsenic, and uranium concentrations are typical in groundwater in the Salt Wash Member of the Morrison Formation.

Arsenic: Arsenic concentrations are above the domestic supply standard of 0.01 mg/L in samples from PW-1, PW-3, EX-6, EX-7, and EX-12. The highest concentration was measured in the sample from PW-1 (0.0177 mg/L)..

Sulfate: Sulfate concentrations are above the domestic water supply standard of 250 mg/L in all the wells sampled at the Site. Dissolution of natural salts present in the Moenkopi, Chinle and Hermosa formations, particularly anhydrite and gypsum, is responsible for sulfate concentrations above the standard. The concentrations are highest at wells MW-6 and MW-8b, and borehole EX-23 (which was drilled into the top of the Hermosa Foromation). The highest reported concentration of sulfate in a sample from a monitoring or production well was 1,810 mg/L for a sample from monitoring well MW-8b collected in July 2008. The highest reported sulfate concentration in the Moenkopi/Chinle screened wells was 480 mg/L in MW-7.

This figure is based on the Hydrogeologic Report (Golder, 2009d).



Notes:
- Data are shown for one representative sample at each location.
- PW: Production Well
- MW: Monitoring Well
- EX: Exploratory Hole

Figure 3.4-6

Piper Water Quality Diagram

This figure is based on the Hydrogeologic Report (Golder, 2009d).

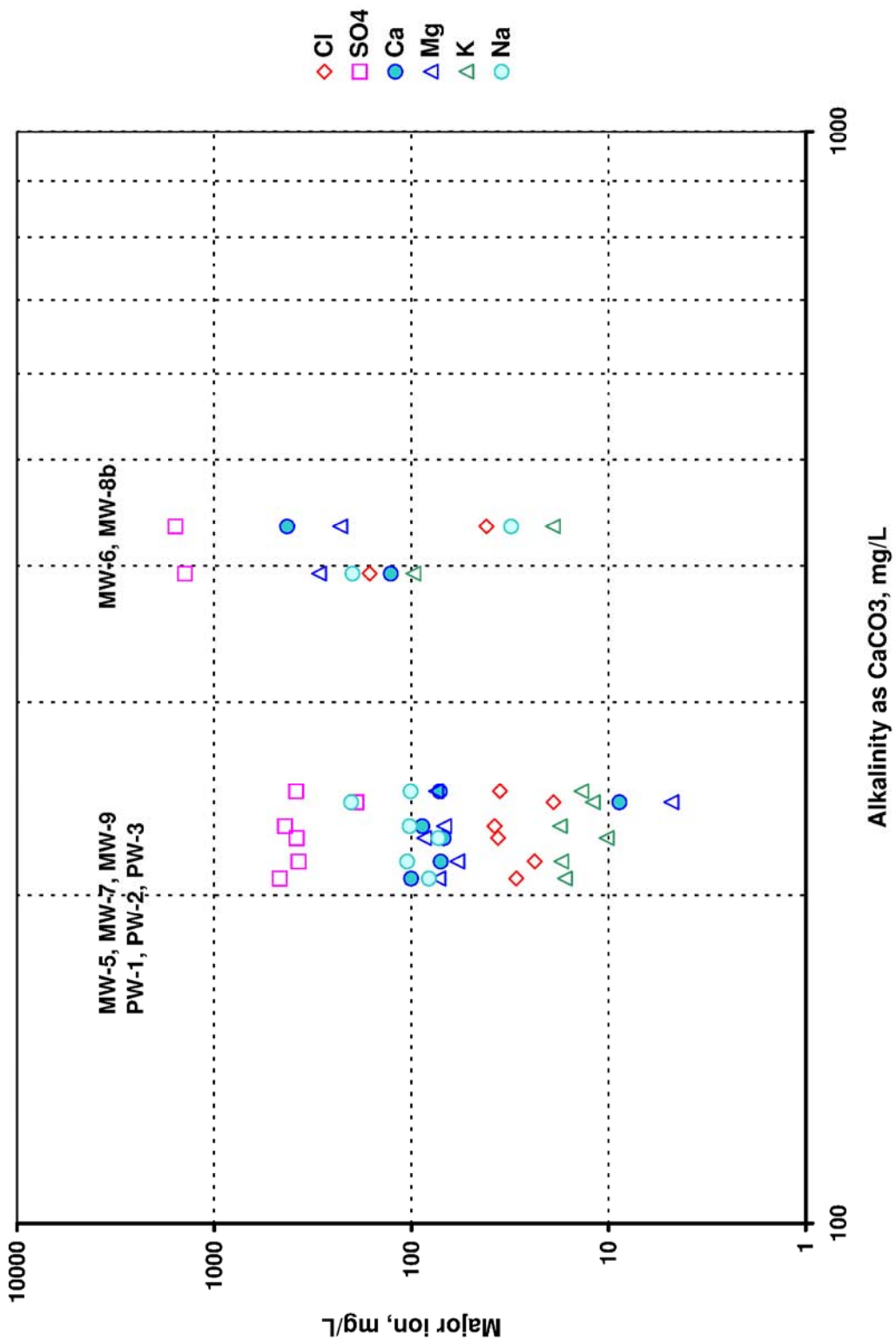


Figure 3.4-7

Major Ions

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Table 3.4-3
Analytical Data for Monitoring Well Samples

Analyte	CDPHE Domestic Water Supply Standards[1]	CDPHE Agricultural Standards[1]	MW-5							MW-6								MW-7						MW-8B					MW-9[2]
			1/31/08[2]	4/30/08	8/7/08	11/14/08	2/19/09	4/30/09	7/31/09	10/16/07	1/29/08	4/29/08	8/7/08	11/14/08	2/18/09	4/28/09	7/28/09	6/7/08	9/9/08	11/13/08	2/18/09	4/29/09	7/31/09	7/21/08	11/13/08	2/18/09	4/29/09	7/29/09	9/10/08[2]
Dissolved Metals																													
Aluminum (mg/L)	None	5	0.23	<0.03	0.04	0.04	0.32	0.05	0.05	<0.1	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	0.05	<0.03	<0.03	<0.03	<0.03	<0.03	<0.06	<0.06	0.09	<0.03	<0.06	0.07
Arsenic (mg/L)	0.01	0.1	0.0015	0.0021	0.0025	0.0028	0.0027	0.0032	0.0017	<0.001	<0.001	0.0006	0.001	<0.01	0.002	<0.03	0.006	0.0073	0.0046	0.0059	0.0062	<0.03	0.0054	0.002	<0.01	0.003	0.007	0.007	0.0111
Barium (mg/L)	2.0	None	0.034	0.021	NA	NA	NA	NA	NA	<0.1	NA	0.024	NA	NA	NA	NA	NA	0.016	NA	NA	NA	NA	NA	0.038	NA	NA	NA	NA	0.044
Boron (mg/L)	None	0.75	0.59	0.53	0.47	0.46	0.45	0.42	0.41	2.20	2.30	2.27	2.5	2.36	2.39	2.36	2.35	0.21	0.31	0.31	0.36	0.34	0.33	0.36	0.48	0.52	0.47	0.46	2.63
Cadmium (mg/L)	0.005	0.01	0.0002	<0.0001	NA	NA	NA	NA	NA	<0.005	NA	0.0001	NA	NA	NA	NA	NA	<0.0001	NA	NA	NA	NA	NA	<0.0002	NA	NA	NA	NA	<0.0001
Calcium (mg/L)	None	None	69.8	76.6	69.1	69.5	70.2	72.0	69.5	109	123	121	133	132	137	131	131	92.6	101.0	100	103	104	101	495	368	385	500	384	8.8
Cesium (mg/L)	None	None	<0.0002	<0.0002	NA	NA	NA	NA	NA	<0.1	NA	<0.0002	NA	NA	NA	NA	NA	<0.0002	NA	NA	NA	NA	NA	<0.0004	NA	NA	NA	NA	<0.0002
Chromium (mg/L)	0.1	0.1	<0.01	<0.01	NA	NA	NA	NA	NA	<0.005	NA	<0.01	NA	NA	NA	NA	NA	0.03	NA	NA	NA	NA	NA	<0.02	NA	NA	NA	NA	<0.01
Copper (mg/L)	1	0.2	< 0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	<0.02	<0.02	<0.01	0.02	<0.01
Iron (mg/L)	0.3	5	0.19	<0.02	<0.02	0.04	0.22	<0.02	0.06	1.46	<0.04	<0.04	<0.04	<0.04	0.12	<0.04	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.12	0.91	<0.04	1.48	1.43	0.03
Lead (mg/L)	0.05	0.1	0.0020	<0.0001	<0.0001	<0.0001	0.0006	<0.0001	0.0001	<0.001	<0.0004	<.0001	<0.0002	<0.002	<0.0002	<0.0002	<0.0002	0.00010	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0002	<0.002	<0.0002	<0.0002	<0.0002	<0.0001
Magnesium (mg/L)	None	None	54.5	61.2	60	57.4	58.7	59.3	58.4	261	284	288	309	295	304	299	312	61.0	75.0	72.9	77.0	76.0	76.0	230	217	228	254	218	4.8
Manganese (mg/L)	0.05	0.2	0.042	0.012	0.028	0.025	0.053	0.015	0.021	0.060	0.010	0.01	<0.01	0.020	<0.01	<0.01	0.015	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.33	1.43	0.81	0.937	1.15	0.019
Mercury (mg/L)	0.002	0.01	<0.0002	<0.0002	NA	NA	NA	NA	NA	<0.001	NA	<0.0002	NA	NA	NA	NA	NA	<0.0002	NA	NA	NA	NA	NA	<0.0002	NA	NA	NA	NA	<0.0002
Molybdenum (mg/L)	0.035	None	0.03	0.03	0.02	0.01	<0.01	0.02	<0.01	<0.1	<0.02	0.030	<0.02	<0.02	<0.02	<0.02	<0.02	0.03	0.01	0.01	<0.01	0.02	<0.01	0.04	<0.02	<0.02	<0.01	<0.02	0.06
Nickel (mg/L)	0.1	0.2	<0.01	<0.01	NA	NA	NA	NA	NA	0.05	NA	<0.01	NA	NA	NA	NA	NA	<0.01	NA	NA	NA	NA	NA	<0.02	NA	NA	NA	NA	<0.01
Potassium (mg/L)	None	None	17.6	18.1	19.0	16.9	16.9	16.3	16.8	91.0	98.4	95.4	105	99.7	97.2	93.0	102	18.1	16.8	16.9	16.4	15.5	16.2	16.7	20.8	19.7	20.3	18.2	12.0
Selenium (mg/L)	0.05	0.02	0.0170	0.0358	0.0200	0.0231	0.0206	0.0231	0.0207	0.003	0.027	0.1660	0.0321	0.236	0.0478	0.0413	0.217	0.0273	0.0279	0.0309	0.0280	0.0270	0.0236	0.079	0.010	0.0007	0.0002	0.0004	0.0017
Sodium (mg/L)	None	None	136	127	109	95.0	89.9	88.2	88.8	172	205	190	219	208	206	190	200	79.2	82.7	82.2	83.1	80.2	81.3	34.1	29.7	29.4	32.8	29.8	202
Uranium (mg/L)	0.03	None	0.0760	0.0896	0.106	0.1100	0.1030	0.1070	0.0911	<0.0003	<0.0002	<0.0001	<0.003	<0.002	0.0003	<0.0002	<0.0002	0.0775	0.1030	0.1080	0.0986	0.0952	0.0970	0.0578	0.033	0.0861	0.0164	0.0143	0.0245
Vanadium (mg/L)	None	0.1	0.007	0.006	0.012	0.009	0.013	0.008	0.007	<0.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.018	0.014	0.016	0.010	0.015	0.014	<0.01	<0.01	<0.01	<0.005	<0.01	0.025
Zinc (mg/L)	5	2	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01	<0.02	<0.02	<0.02	<0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	<0.02	<0.02	<0.01	0.02	<0.01
General Water Quality																													
Alkalinity as $CaCO_3$ (mg/L)	None	None	240	234	203	207	205	203	211	392	394	386	387	397	399	388	406	154	198	218	223	222	228	426	436	389	449	474	243
Carbonate as $CaCO_3$ (mg/L)	None	None	<2	<2	5	<2	13	<2	<2	<1	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	4	4	<2	<2	<2	<2	<2	<2	11
Bicarbonate as $CaCO_3$ (mg/L)	None	None	240	234	203	207	192	203	211	478	394	386	387	397	399	388	406	154	198	218	218	218	228	426	436	389	449	474	232
Chloride (mg/L)	250	None	21	22	33	24	24	21	21	142	170	160	170	160	170	160	170	25	28	30	32	31	30	48	37	40	42	41	19
Fluoride (mg/L)	4.0	2	0.4	0.5	0.6	0.6	0.5	0.7	0.5	0.3	0.3	0.4	0.4	0.4	0.3	0.4	0.3	0.7	0.6	0.6	0.5	0.5	0.5	0.7	0.6	0.5	0.6	0.5	1.0
Ammonia as N (mg/L)	None	None	0.08	0.23	0.06	0.10	<0.05	<0.05	<0.05	1.01	0.8	0.95	1.05	1.06	0.91	1.01	0.98	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.06	0.12	<0.05	0.09	0.05	<0.5
Nitrate/Nitrite as N(mg/L)	10.0	100	1.09	1.20	2.51	2.17	1.96	2.26	2.31	<0.1	<0.02	<0.02	0.06	<0.02	0.03	0.02	0.05	0.61	0.85	0.72	0.77	0.75	0.69	0.04	<0.02	0.03	0.04	<0.02	10.2
Silica (mg/L)	None	None	17.7	17.4	17.5	14.4	16.1	14.2	15.4	10.3	10.7	10.7	11.4	9.8	10.0	9.5	10.7	15.8	19.7	17.5	19.3	17.4	18.3	11.7	17.3	18.5	20.2	16.9	11.8

Analyte	CDPHE Domestic Water Supply Standards[1]	CDPHE Agricultural Standards[1]	MW-5							MW-6								MW-7						MW-8B					MW-9[2]
			1/31/08[2]	4/30/08	8/7/08	11/14/08	2/19/09	4/30/09	7/31/09	10/16/07	1/29/08	4/29/08	8/7/08	11/14/08	2/18/09	4/28/09	7/28/09	6/7/08	9/9/08	11/13/08	2/18/09	4/29/09	7/31/09	7/21/08	11/13/08	2/18/09	4/29/09	7/29/09	9/10/08[2]
Sulfate (mg/L)	250	None	390	370	390	370	370	360	360	1330	1400	1070	1490	1460	1490	1460	1560	460	460	460	480	470	460	1810	1370	1450	1680	1540	190
Sulfide as S (mg/L)	None	None	0.04	<0.02	<0.02	<0.02	<0.08	<3	<0.2	NA	13.4	10.3	11.9	11.5	12.4	13.2	11.6	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	1.9	0.61	0.19	0.05	0.44	0.10
Total Organic Carbon (mg/L)	None	None	12	8	NA	NA	NA	NA	NA	<1	NA	12	NA	NA	NA	NA	NA	9	NA	NA	NA	NA	NA	29	NA	NA	NA	NA	18
Total Dissolved Solids (mg/L)	None	None	840	820	820	770	790	770	770	2400	2740	1140	2670	2750	2760	2800	2770	850	930	970	940	930	970	3040	2520	2560	2980	2850	610
Total Suspended Solids (mg/L)	None	None	120	780	NA	78	350	337	237	13.3	<5	<5	NA	13	<5	<5	<5	<5	5	9	<5	<5	<5	833	18	<5	<5	<5	168
Dissolved Radionuclides																													
Gross Alpha (pCi/L)[3]	15[3]	None	50	65	49	49	41	44	56	11.1	17.0	12	9.7	<7.6	12	<6.8	11	36	56	42	45	51	70	42	23	7	11	15	26
Gross Beta (pCi/L)	4 mrem/yr	None	32	41	32	30	27	24	31	92.8	140.0	91	110	99	96	81	93	34	33	40	29	33	36	23.0	24.0	23	20	22	20
Radium-226 (pCi/L)	5 (Ra 226 and 228)	5 (Ra 226 and 228)	0.53	0.33	0.42	<0.35	0.3	0.37	0.34	1.6	2.2	1.9	3.3	1.9	2.1	2	1.6	<0.35	<0.25	<0.4	<0.28	<0.17	0.17	12.0	0.54	0.49	0.89	0.33	<0.45
Radium-228 (pCi/L)			NA	NA	NA	NA	NA	NA	1.9	NA	NA	NA	NA	NA	NA	NA	4.4	NA	NA	NA	NA	NA	0.29	NA	NA	NA	NA	1.5	NA
Calculated Values																													
Charge Balance (%)	None	None	2.9	6.4	1.5	0.8	0.8	2.4	0.8	-3.5	-1.2	7.8	0.7	-0.6	-0.7	-1.2	-2.2	0.4	3.0	0.3	0.3	0.7	0.7	-2.5	-0.5	0.5	2.7	-4.9	3.1
Field Parameters																													
Temperature (°C)	None	None	12.4	17.7	16.3	15.8	14.5	18.8	16.9	17.9	18.0	18.8	19.0	18.8	17.9	18.7	19.6	18.7	15.8	15.6	14.6	15.7	19.9	18.4	15.3	14.6	16.0	17.4	17.6
pH (std. units)	6.5-8.5	6.5-8.5	10.3	7.5	7.5	7.9	8.0	7.8	7.8	7.7	5.3	7.0	6.9	7.0	7.1	6.9	7.1	8.0	7.8	7.6	7.6	7.4	7.6	6.4	6.8	6.8	6.7	6.8	8.2
Specific Conductivity (mS/cm)	None	None	2.34	1.19	1.23	1.10	1.04	1.09	1.16	3.17	5.32	3.14	3.43	3.29	3.51	3.29	3.27	1.06	1.28	1.25	1.34	1.29	1.29	3.06	3.00	2.81	2.94	3.02	0.99
Dissolved Oxygen (mg/L)	None	None	6.0	2.1	5.9	5.8	6.8	12.2	7.4	2.6	1.5	0.0	0.1	0.1	0.1	0.2	0.1	2.2	4.0	3.8	4.8	5.6	3.4	6.1	0.3	0.3	0.7	0.1	2.1
ORP (mV)[4]	None	None	--	--	203	150	86	72	106	--	-310	-373	-361	-331	-330	-355	-354	29	161	138	88	62	169	-123	-154	-199	-203	-189	154

NOTES:

(1) CDPHE, Water Quality Control Commission, 5 CCR 1002-41, Regulation 41, *The Basic Standards for Ground Water*, Effective May 31, 2008

(2) Results for MW-9 qualified by Kleinfelder due to slow recharge of MW-9; groundwater sample may contain drill water

(3) The gross alpha standard does not include gross alpha from radon and uranium. However, the laboratory results include the alpha contribution from radon and uranium.

(4) ORP: Oxidation Reduction Potential

- Concentrations detected below the practical quantitation limit are shown as the detected value. Undetected concentrations are shown as less than the method detection limit.

- NA: Not Analyzed. Cesium, cadmium, barium, nickel, chromium, mercury and total organic carbon were generally analyzed in the initial sampling event only.

Selenium: Selenium concentrations have been measured above the Colorado agricultural standard of 0.02 mg/L in several samples from exploration holes, the domestic well, monitoring wells, and production well PW-3. Selenium concentrations in EX-15, EX-23, MW-6, and MW-8b are above the domestic water supply standard of 0.05 mg/L. Selenium may be derived from gypsum and anhydrite in the Hermosa Formation, and also from sulfides in the reduced uranium-bearing strata of the Salt Wash Member of the Morrison Formation because it readily substitutes for sulfur in sulfates and sulfides. The highest selenium concentration from a monitoring or production well was 0.24 mg/L from a sample collected at MW-6 in November 2008.

Boron: Boron is above the agricultural standard of 0.75 mg/L in samples from MW-6, MW-9, EX-15, and EX-23. The highest boron concentration reported in a Site water sample was 2.6 mg/L from MW-9 in September 2008. Boron minerals are known in the Hermosa Formation evaporites, and the potential for commercial extraction of boron has been considered (Mayhew, 1965). Mayhew reports brines up to 0.1 percent boron in the Hermosa Formation.

Iron: Iron concentrations are above the domestic water supply standard of 0.3 mg/L in samples from PW-1, PW-2, MW-6 and MW-8b. At PW-1 and PW-2, elevated iron concentrations may be derived from the steel casing used for well construction. At PW-1 and PW-2, iron concentrations from the fourth quarter 2008 through the third quarter 2009 range from 2.88 mg/L (PW-1, fourth quarter 2008) to 21.2 mg/L (PW-2, first quarter 2009). These higher concentrations are indicative of ferrous iron, Fe^{++}, because ferric iron, Fe^{3+}, is relatively insoluble. The ferrous iron is compatible with observed reducing conditions in deeper wells. Samples collected in August 2008 during the pumping tests showed iron at substantially lower concentrations than in follow-up samples months later (0.02 mg/L at PW-1 and 0.12 mg/L at PW-2), suggesting iron dissolving in a redox reaction from casing, probably microbially mediated. Elevated iron concentrations were initially reported in MW-6 and MW-8b, but concentrations decreased in more recent sampling events.

Manganese: Manganese concentrations are above the domestic water supply standard of 0.05 mg/L in samples from MW-5, MW-6, MW-8b, PW-1, PW-2, and EX-23. The highest manganese concentration from a monitoring or production well was 1.4 mg/L from a sample collected at MW-8b in November 2008. The elevated manganese concentrations in PW-1 and PW-2 are also likely derived from steel casings installed in these wells.

Uranium and gross alpha: Uranium concentrations and gross alpha activity levels are above the domestic water supply standards of 0.03 mg/L (uranium) and 15 picocuries per Liter (pCi/L) (gross alpha) in most wells. However, the gross alpha analyses included uranium and radon, so these results cannot be directly compared to the water quality standard, which specifically excludes the alpha contributions from these two elements. It is likely that the majority of the gross alpha in the groundwater is attributable to uranium, which is an ore in the Morrison Formation.

Chromium, molybdenum, and nitrate/nitrite have also been detected at the Site at concentrations above CDPHE standards; however, these detections are not consistently above standards. Shallow nitrates are likely due to livestock. Trace metals may also be derived from the steel casing. Where present in the bedrock aquifer, chromium must be in the trivalent form because the deep water is reduced.

3.4.3 Water Usage

No surface water resources exist within the southern Paradox Valley. Some shallow washes have been bermed in the past to retain surface water, but these have been washed out and have not been maintained. The Dolores River is approximately 7 miles northwest of the Site, and not considered a water resource for the Site.

Eight permitted wells are known in the south valley, all of which are completed in the Chinle Formation. Five of these are operational, and three are known to be dry or inoperable. Table 3.4-4 summarizes known information about these wells, and the two springs to the northwest of the Site, which also emanate from the Chinle Formation. Their locations and available water quality information are provided in the *Hydrogeologic Report* (Golder, 2009d).

3.5 ECOLOGICAL RESOURCES

3.5.1 Vegetation

3.5.1.1 Baseline Data

Ecological studies including baseline flora and fauna data were collected to fulfill the objectives specified in NRC NUREG-1748, *Environmental Review Guidance for Licensing Actions Associated with NMSS Programs* (NRC, 2003a), as well as guidance provided in NRC Regulatory Guide 3.8, *Preparation of Environmental Reports for Uranium Mills* (NRC, 1982a) Surveys for vegetation were conducted by Kleinfelder during four seasons starting in Summer 2007 and continuing through Spring 2008 (Kleinfelder, 2009g). Concurrently, wildlife, wildlife habitat, and point bird surveys were conducted (Kleinfelder, 2009h). In August 2009, WestWater Engineering surveyed an added 80-acre parcel (well field) for vegetation and wildlife resources (WestWater, 2009). Additionally, WestWater Engineering conducted a survey for Colorado hookless cactus within appropriate habitat.

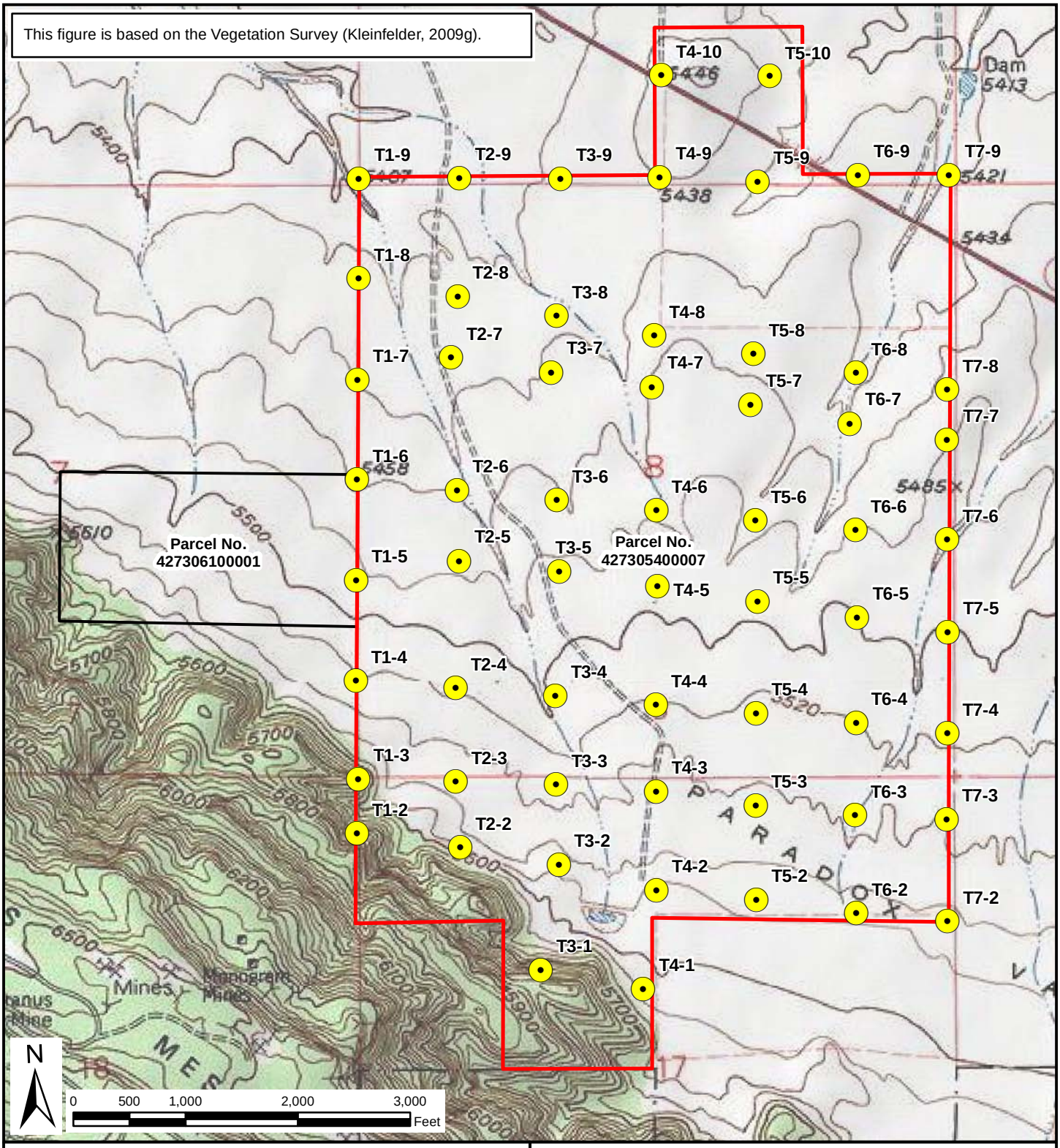
3.5.1.2 On-Site Survey Methodology

Vegetation surveys were conducted on 880 acres on multiple dates during four seasons by Kleinfelder from 2007 through 2008 to establish the vegetation baseline for the Site (Kleinfelder, 2009g). Line-transect sampling, modified from Buckland et al. (2007), was used to collect site-specific vegetation data. Seven transects were systematically established north to south approximately 300 yards apart from east to west. Sample points were positioned every 300 yards on each transect using dead reckoning techniques with a compass and rangefinder; 60 sample points were established on a sampling grid (Figure 3.5-1). Summer 2007 vegetation surveys were completed on odd-numbered sample points for each of the seven transects from August 20 through August 24, 2007. Fall 2007 vegetation surveys were completed on even-numbered sample points on September 18 and 19, 2007. Winter 2007/2008 vegetation surveys were conducted on odd-numbered sample points on January 16 and 17, 2008. Spring 2008 vegetation surveys were conducted on all sample points to evaluate seasonal changes (May 19 and 20, 2008). Vegetation measurements sampled included: canopy height, diameter at breast height (DBH) of the closest three trees, percent ground cover (living vegetation), percent debris cover (non-living vegetation), and the vegetative cover associated with the five most dominant plant species in descending order. In addition to sampling vegetation as described above, a wetland and vegetation assessment of 10 ephemeral streams and a non-jurisdictional retention

Table 3.4-4
Off-Site Water Wells and Springs in the Chinle Formation

Permit #	Proposed for Monitoring (Yes/No)	Owner/Name	Well Depth (ft)	Well Yield (gpm)	Depth to Water (ft)	Construction Date	Distance from Site Boundary (miles)	Status	Permitted Use
Wells									
258704	Yes	BLM	280	15	168	2/28/2004	2.6	Operational	Stock
269575	Yes	Fehlmann, Lin D. & Davis, Robert M.	302	8	158	1/21/2007	3.2	Operational	Domestic & Stock
226684	Yes	Hurdle, Sylvia S.	320	14	134	7/30/2000	4.0	Operational	Domestic
253522	Yes	Boren, Verl	100	20	28(1)	--	5.0	Operational	Domestic
234136	Yes	Herron, William & Katherine Gray	255	10	157	10/26/2001	4.0	Operational	Domestic
91065	No	Russell, John D.	143	10	103	1st use: 5/16/1978	4.0	No longer in use	Domestic & Stock
86582	No	Blackburn Ranches	160(2)	15	Varies(2)	--	3.2	Intermittent use only	Stock
86583	No	Blackburn Ranchettes	160(2)	0	Dry(2)	--	3.2	Dry(2)	Stock
Springs									
NA	Yes	Stone Spring (used by Verl Boren)	NA	~10(3)	NA	NA	4.8	Flowing	--
NA	No	Merrill Spring	NA	--	NA	NA	4.7	Dry in June 2009	--

Notes:
Well information provided from the CDWR, Well Permit Database, accessed September 30, 2008 and June 19, 2009.
NA: Not Applicable
(1) Depth to water provided from personal communication between Verl Boren and Energy Fuels Resources Corporation, June 17, 2009. Depth to water from state permit database is 40 ft.
(2) Information provided from personal communication between Dan Cooper and Dick White of Energy Fuels Resources Corporation, October 1, 2008.
(3) Information obtained from site visit to Boren property on June 17, 2009.



Sample Points
Property Boundary
Well Field Boundary

Figure 3.5-1

Habitat Assessment Sample Points

pond was conducted within the Site during Fall 2007 and Spring 2008 (Kleinfelder, 2008c). Vegetation types were recorded and compared against Colorado State and U.S. Fish and Wildlife Service (USFWS) Federal Threatened and Endangered Species Lists. Representative samples for plants that were not identified in the field, due to time constraints and identification keys, were placed in an 8 ½ inch by 11 inch plant press. Samples were dried in the press for at least 5 days. Identification was completed using a regional dichotomous key in conjunction with a dissecting stereo microscope (Kleinfelder, 2008c and 2009g).

Subsequent to the vegetation sampling conducted in 2007 and 2008, Energy Fuels included an additional 80-acre parcel west of the Site. Vegetation types within the additional parcel were determined through aerial photography, field identification of plants, and on-the-ground assessments of plant abundance surveyed on August 24, 2009 (WestWater, 2009). Identification of plant species was aided by using pertinent published field guides (Anthony et al., 2007; Kershaw et al., 1998; Weber and Wittman, 2001; and Whitson et al., 2004).

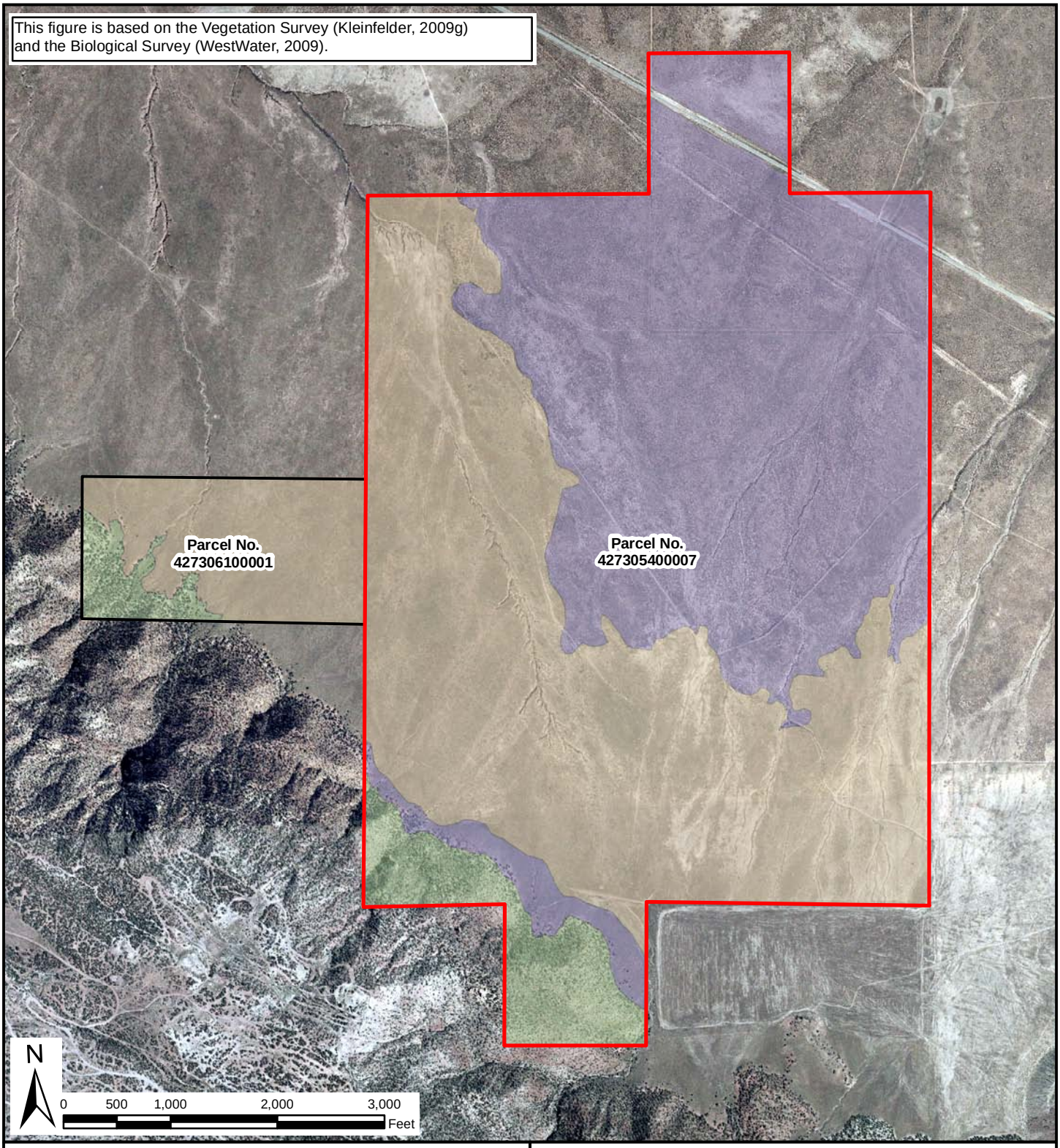
3.5.1.3 Vegetation Cover Types

Three dominant vegetation communities are located within the Site and include 1) pinyon-juniper vegetation along the bluffs in the southwest portion of the Site, 2) big sagebrush habitat located in a narrow strip adjacent to the pinyon-juniper habitat and on the northeast half of the Site, and 3) a mixed grassland habitat located in the central portion of the Site between both big sagebrush habitats. According to the former landowner, existing grasslands was sagebrush-dominated in the past, but sagebrush was removed by mechanical means and the area has since taken on a more native grassland appearance. The woodlands are dominated by Utah juniper (*Juniperus osteosperma*) and pinyon pine (*Pinus edulus*) mixed with Colorado (singleleaf) ash (*Fraxinus anomala*), forbs, and grasses. The shrublands within the Site are characterized by big sagebrush (*Artemisia tridentata*), prickly pear (*Opuntia* spp.), and various grasses. Invasive downy brome (*Bromus tectorum*), also known as cheatgrass, is prevalent on the Site, especially in the mixed grassland and in the understory of the shrubland community.

The dominant vegetation communities were mapped by Kleinfelder (2009g) and WestWater (2009) using GIS, aerial photography, and ground reconnaissance (see Figure 3.5-2). Table 3.5-1 provides the acreage and percent of total area of the three dominant vegetation communities within the Site. Plants identified within the Site during survey efforts are provided in Table 3.5-2.

Table 3.5-1
Acreage and Percent of Total Area of the Three Dominant Vegetation Communities within the Site

Dominant Vegetation Community	Acres	Percent of Total Area
Pinyon-Juniper Woodland	50.72	5.8
Big Sagebrush	427.20	48.5
Mixed Grasslands	402.08	45.7
Total	**880.00**	**100.0**



Property Boundary
Well Field Boundary

Dominant Vegetation Communities

Pinyon-Juniper Woodland
Big Sagebrush
Mixed Grasslands

Figure 3.5-2

Dominant Vegetation Communities

Table 3.5-2
Plants Documented within the Site During Vegetation Surveys[1]

Common Name [2]	Scientific Name	Dominant Vegetation Types Located
Trees		
Colorado (singleleaf) ash	*Fraxinus anomala*	PJ
Utah juniper	*Juniperus osteosperma*	PJ, BS
Pinyon pine	*Pinus edulus*	PJ
Shrubs		
Utah serviceberry	*Amelanchier utahensis var. utahensis*	PJ
Big sagebrush	*Artemisia tridentate*	BS, MG
Four-wing saltbrush	*Atriplex canescens*	BS, MG
Mountain Mahogany	*Cercocarpus montanus*	PJ
Mormon tea	*Ephedra virdis var. virdis*	PJ
Rubber rabbitbrush	*Ericameria nauseosa*	MG
Cliff fendlerbush	*Fendlera rupicola*	PJ
Yucca	*Yucca baccata*	PJ, BS
Forbs		
Curveseed butterwort	*Ceratocephala testiculata*	MG
Nipple cactus	*Coryphantha zizipara*	PJ, BS
Herb sophia*	*Descurainia Sophia*	MG
Hedgehog cactus	*Echinocereus triglochidiatus*	PJ, BS
Redstem filaree*	*Erodium cicutarium*	MG
Broom snakeweed*	*Gutierrezia sarothrae*	PJ, BS, MG
Four o'clock	*Mirabilis multiflora*	PJ
Prickly pear	*Opuntia spp.*	BS, MG
Plantain	*Plantago major*	BS, MG
Russian thistle*	*Salsola iberica*	BS, MG
Mustard	*Family Brassicaceae*	BS, MG
Grasses		
Indian ricegrass	*Acnatherum hymenoides*	PJ, BS
Bentgrass	*Agrostis palustris*	PJ, BS, MG
Three-awn grass	*Aristida spp.*	PJ, BS, MG
Blue grama	*Bouteloua gracilis*	BS, MG
Downy brome*	*Bromus tectorum*	PJ, BS, MG
Needle-and-thread grass	*Hesperostipa comata*	PJ, BS, MG
Galleta grass	*Hilaria jamesii*	BS, MG
Fox-tailed barley	*Hordeum jubatum*	BS
Witchgrass	*Panicum capillare*	PJ, BS, MG
Sand dropseed	*Sporobolus cryptandrus*	BS, MG
Sixweeks fescue	*Vulpia octoflora*	BS, MG

[1] Sources: WestWater Engineering, 2009 and Kleinfelder, 2009g.
[2] An asterisk (*) indicates non-native, invasive weeds.
[3] Dominant Vegetation Types: PJ = pinyon-juniper woodlands, BS = big sagebrush, and MG = mixed grasslands.

None of the species that are dominant in the big sagebrush type or the mixed grassland type are particularly palatable to livestock. In the big sagebrush type, big sagebrush predominates, but is not particularly palatable to cattle because volatile oils can cause rumen stasis (Stubbendieck et al., 1992). Broom snakeweed (*Gutierrezia sarothrae*) is a predominant subshrub in both vegetation types but is an indicator of livestock overgrazing, an accumulator of selenium, and poisonous to sheep and cattle (Stubbendieck et al., 1992; Whitson et al., 2004). Another shrub, gray or rubber rabbitbrush (*Chrysothamnus* (*Ericameria nauseosa*) *nauseosus*) was also present but is worthless forage for livestock and, like snakeweed, is often associated with overgrazing (Whitson et al., 2004). Fourwing saltbush (*Atriplex canescens*) is a shrub and also present in big sagebrush and mixed grasslands within the Site and may provide some forage value for cattle (McKean, 1976).

The only native forbs identified within the Site were prickly pear, a native but a problem in overgrazed pastures, and unidentified species of mustard (*Brassicaceae*) which were possibly tansymustard (*Descurainia pinnata*) and/or desert princesplume (*Stanleya pinnata*). If present, both are worthless forage for livestock. Kleinfelder (2009g) also reported Russian thistle (*Salsola iberica*), a noxious weed, and only has forage value early in the growing season. All vegetation types are infested with cheatgrass, a noxious weed and indicator of heavy grazing (Stubbendieck et al., 1992), but which has some forage value early in the growing season before the inflorescence emerges (Whitson et al., 2004). Another non-native invasive species, redtop bent or creeping bentgrass (*Agrostis stolonifera* var. *palustris*) is common in the mixed grasslands and is good forage for cattle. Other grasses occur within the Site and include non-native redstem filaree (*Erodium cicutarium*), native blue grama (*Bouteloua gracilis*), and galleta (*Hilaria jamesii*), all of which provide good forage while green. However, none of them would be considered dominant (Kleinfelder, 2009f). Native sixweeks fescue (*Vulpia octoflora*) is also present on the Site but provides little forage value (Stubbendieck et al., 1992).

Also, a non-jurisdictional wetland feature (retention pond) and ten linear stream features (nine discontinuous ephemeral streams and one stream connected to East Paradox Creek) are located within the Site. Vegetation types located at these wetland and waterbody features were dominated by the adjacent upland vegetation types, although some plants associated with wetlands were documented.

<u>Pinyon-Juniper Woodlands</u> Pinyon-juniper woodlands are common in western Montrose County and are found from 4,500 to 9,000 feet, although most commonly between 5,000 and 7,000 feet. At higher elevations they occur on south and west facing slopes (Lyon and Sovell, 2000; Schrupp et al., 2000). In Colorado, there are approximately 5 million acres of pinyon-juniper habitat (Brown, 1994), of which 70 percent occurs within the Colorado Plateau Ecoregion (Colorado Partners in Flight, 2008).

Pinyon and juniper trees within western Colorado are typically short and widely spaced as a result of coarse, sandy, and shallow soils with low fertility. Understory can range from almost barren to a diverse mixture of shrubs, forbs, and grasses. However, in sites with more moisture, the canopy becomes denser and the understory vegetation decreases. Several different species of pinyon and juniper trees occur within the western United States but in western Colorado, the species found include pinyon pine and Utah juniper, with Rocky Mountain juniper (*Juniperus scopulorum*) occurring mostly in mesic sites (Lyon and Sovell, 2000). Generally in western Colorado pinyon pine and juniper are co-dominant, although pinyon is more tolerant of cold and juniper more tolerant of drought (Mutel and Emerick, 1992 in Lyon and Sovell, 2000). As a result, juniper occurs at lower elevations and is often mixed with sagebrush and desert shrubs, while pinyon pine is found at higher elevations (Lyon and Sovell, 2000; Peet 1988 in Schrupp et al., 2000). Tree height and density generally increases with elevation (Schrupp et al., 2000).

The pinyon-juniper woodland community comprises 50.72 acres of the 880-acre Site (5.8 percent). Three habitat sample points were surveyed within this community. Total vegetation cover is 20.6 percent, where debris cover and bare soil is 15.0 percent and 64.4 percent, respectively. Total ground cover is 35.6 percent (Table 3.5-3). The dominant overstory species is pinyon pine and Utah juniper, with the following species represented within the understory (Table 3.5-2): Colorado (singleleaf) ash, Utah serviceberry, mountain mahogany, Mormon tea (*Ephedra virdis var. virdis*), cliff fendlerbush (*Fendlera rupicola*), and various forbs and grasses (Kleinfelder, 2009g and WestWater, 2009). A list of the five dominant species documented in descending order during each sampling site visit are provided in Appendices A and B in the *Vegetation Survey* (Kleinfelder 2009g).

Big sagebrush is the most common understory of the pinyon-juniper woodlands in the region surrounding the Site, but other shrub species may include: rabbitbrush (*Chrysothamnus* spp.,), shadscale (*Atriplex confertifolia*), four-wing saltbush, tamarisk (*Tamarix ramosissima*), greasewood (*Sarcobatus vermiculatus*), snakeweed (*Gutierrezia sarothrae*), and winterfat (*Krascheninnikovia lanata*) at lower elevations; and mountain mahogany (*Cercocarpus montanus*), Gambel's oak (*Quercus gambelii*), serviceberry, mountain snowberry (*Symphoricarpos oreophilus*), mountain lover (*Pachystima myrsinites*), Oregon grape (*Mahonia aquifolium*), and elk sedge (*Carex garberi*) at higher elevations. The herbaceous understory is often sparse and includes needle-and-thread (*Hesperostipa comate*), Indian ricegrass (*Acnatherum hymenoides*), blue grama, galleta, Sandburg bluegrass (*Poa secunda*), and bottlebrush squirreltail (*Elymus elymoides*). Common forbs include hairy golden aster (*Heterotheca villosa*), twin bladderpod (*Physaria acutifolia*), roughseed cat's-eye (*Cryptantha flavoculata*), and scarlet globemallow (*Sphaeralcea coccinea*) (Lyon and Sovell, 2000 and Schrupp et al., 2000). Most of these understory species were not observed within the Site (see Table 3.5-2). Downy brome is the most frequent non-native invasive species (Lyon and Sovell, 2000) and was observed during vegetation surveys.

Succession after disturbance (i.e., fire) within pinyon-juniper woodlands will progress from annual grasses to perennial grasses, shrubs, and then finally pinyon-juniper, although this process may take up to 300 years creating a mosaic of different successional stages on the landscape (Lyon and Sovell, 2000).

Table 3.5-3 provides the canopy heights, canopy cover, DBH, percent ground cover of living vegetative material, percent debris cover (dead vegetative material), and percent bare ground for the three habitat sample points within the pinyon-juniper woodland community recorded by Kleinfelder (2009g) in the *Vegetation Survey*.

Table 3.5-3
General Vegetation Characteristics for the
Pinyon-Juniper Woodland Community within the Piñon Ridge Mill Site[1]

Vegetation Community	Average Canopy Height (Feet)	Average Canopy Cover (percent)	Maximum DBH (inches)	Average DBH (inches)	Average Ground Cover (percent)	Average Debris Cover (percent)	Average Bare Ground (percent)
Pinyon-Juniper Woodland	14.8	11.7	5.4	4.1	20.6	15.0	64.4

[1] Source: Kleinfelder, 2009g.

Sagebrush Shrublands Sagebrush shrublands occur within a variety of climatic conditions, including low-elevation, semi-desert habitats and moist, cool, mountainous areas. Within the Colorado Plateau, sagebrush is found at elevations of approximately 4,000 feet to 10,000 feet (Colorado Partners in Flight, 2008). It is often a major component of pinyon-juniper communities (Lyon and Sovell, 2000).

In Montrose County, four species of sagebrush are common and have a wide ecological range resulting in overlap between their ranges: black sage (*Artemesia nova*), big sagebrush, mountain big sage (*Artemisia tridentata sp. vaseyana*), and silver sage (*Artemisia cana*). Black sage tends to be compact/cushion-like and grows in very dry areas, on alkaline soils, and in shallow sandy soils or on windswept ridges in pinyon-juniper woodland, whereas big sagebrush occupies deep soils in the valleys and is the tallest of the species. Mountain big sage is the most abundant species, occupying higher, cooler sites on shallower and drier soils, and is the most common species in pinyon-juniper woodlands. Silver sage is at higher elevations with ponderosa pine and aspen (Lyon and Sovell, 2000; Schrupp et al., 2000).

The big sagebrush community comprises 427.20 acres of the 880-acre Site (48.5 percent). Twenty-eight habitat sample points were surveyed for this community. Total vegetation cover is 51.5 percent, and debris cover and bare soil is 16.6 percent and 31.9 percent, respectively. Total ground cover is 68.1 percent (see Table 3.5-4). The dominant overstory species is big sagebrush, with the following species represented as secondary species or within the understory (Table 3.5-2): Utah juniper, four-wing saltbush, yucca (*Yucca baccata*), and various forbs and grasses including, but not limited to broom snakeweed, prickly pear, bentgrass, blue grama, galetta grass, and fox-tailed barley (*Hordeum jubatum*). Cheatgrass was prevalent within the big sagebrush community (Kleinfelder, 2009g and WestWater, 2009). A list of the five dominant species documented in descending order during each sampling site visit are provided in Appendices A and B in the Vegetation Survey (Kleinfelder, 2009g).

Table 3.5-4 provides the average percent ground cover of living vegetative material, percent debris cover (dead vegetative material), and percent bare ground recorded for 28 habitat sample points within the big sagebrush community by Kleinfelder (2009g).

Table 3.5-4
General Vegetation Characteristics for the Big Sagebrush Community within the Site[1]

Vegetation Community	Average Ground Cover (percent)	Average Debris Cover (percent)	Average Bare Ground (percent)
Big Sagebrush	51.5	16.6	31.9

[1] Source: Kleinfelder, 2009g.

Other shrubs found in association with sagebrush communities in western Colorado in the region surrounding the Site include bitterbrush (*Purshia* spp.) and mountain snowberry. Grasses, especially bunchgrasses, are common components of sagebrush habitats. Some grass species not identified during survey efforts within the project area but are known to occur within the region surrounding the Site include wheatgrass species (*Pseudoroegneria* spp.), muttongrass (*Poa fendleriana*), Indian paintbrush (*Castilleja* spp.), hairy golden aster, rough-seed cat's-eye, scarlet globemallow, sand aster (*Corethrogyne filaginifolia*), junegrass (*Koeleria macrantha*), Arizona fescue (*Festuca arizonica*), Idaho fescue (*F. idahoensis*), and several milkvetches (*Astragalus* spp.) (Lyon and Sovell, 2000; Colorado Partners in Flight, 2008; Schrupp et al., 2000). As with pinyon-juniper woodlands, the most common non-native species is cheatgrass (Lyon and Sovell, 2000) as was observed within the Site.

Sagebrush will not sprout from roots after a disturbance (i.e., fire), but must come back from seed. Reestablishing sagebrush from seed is a slow process that can take 15 to 30 years. Wildfires probably sculpted a landscape mosaic of sagebrush stands of varying age interspersed with grassy open areas on the scale of tens to thousands of hectares (Colorado Partners in Flight, 2008).

The primary use of sagebrush habitats by humans has been for livestock grazing. However, heavy grazing tends to increase sagebrush cover and decrease perennial bunch grasses, allowing other shrubs such as rabbitbrush and snakeweed to increase, or other non-native species to invade (USDA, 1972 in Lyon and Sovell, 2000). In some cases land managers remove the shrub cover through plowing, burning, chaining, or herbicide treatment to increase forage for grazing of domestic livestock or wildlife (Colorado Partners in Flight, 2008; Lyon and Sovell, 2000). Other factors compromising the ecological integrity of sagebrush shrublands include invasion by exotic (e.g., cheatgrass) or native (e.g., pinyon-juniper) plant species, conversion to agricultural, residential, and other developed land types, and changes in natural fire regimes (Colorado Partners in Flight, 2008).

Mixed Grasslands Mixed grasslands in western Colorado are generally dominated by relatively deep-rooted grasses, such as needle-and-thread, that use soil moisture below 0.5 meters (1.6 feet) during the typically dry summers (NatureServe, 2009; Lyon and Sovell, 2000). The mixed grasslands can be found at elevations from 4,100 to 8,800 feet at a variety of sites including stream terraces, plains, valleys, canyon floors, gentle hillslopes, knolls, and bluffs. Soils associated with the mixed grasslands are variable and may include sand, cobbles, sandy, silt, and clay loams, and silty clay (NatureServe, 2009). These coarse soils allow for rapid infiltration and storage of winter and summer precipitation (Kleiner, 1968; Daubenmire, 1970; Kleiner and Harper, 1977; Thilenius et al., 1995 in NatureServe, 2009). Trees and large shrubs are generally absent, often as a result of seasonal drought, occasional fires, and grazing by domestic animals and wildlife. A few trees such as cottonwoods (*Populus deltoides*), oaks (*Quercus* spp.), and willows (*Salix* spp.) grow near rivers and streams, and hundreds of species of flowers grow among the grasses (Colorado Partners in Flight, 2008 and NatureServe, 2009).

The mixed grassland community within the Site was sagebrush-dominated in the past, according to the landowner, but sagebrush was removed by mechanical means and the area has since taken on a more native grassland appearance. The mixed grassland community comprises 402.08 acres of the 880-acre Site (45.7 percent). Twenty-nine habitat sample points were surveyed for this community. Total vegetation cover is 55.7 percent, and average debris cover and bare soil were 20.2 percent and 24.1 percent, respectively. Total ground cover is 75.9 percent (Table 3.5-5). The dominant grass species is bentgrass, sixweeks fescue, and the invasive, non-native cheatgrass. Also interspersed throughout the mixed grassland community is big sagebrush, four-wing saltbush, fox-tailed barley, galleta grass, prickly pear, blue grama, and herb sophia (*Descurainia sophia*) (Kleinfelder, 2009g and WestWater, 2009). Table 3.5-2 provides a complete list of species documented within the mixed grassland community during vegetation surveys. A list of the five dominant species documented in descending order during each sampling site visit are provided in appendices A and B in the *Vegetation Survey* (Kleinfelder 2009g).

Table 3.5-5 provides the average percent ground cover, percent debris cover, and percent bareground recorded for 29 habitat sample points within the mixed grassland community by Kleinfelder (2009g).

Table 3.5-5
General Vegetation Characteristics for the Big Sagebrush Community within the Site[1]

Vegetation Community	Average Ground Cover (percent)	Average Debris Cover (percent)	Average Bareground (percent)
Mixed Grasslands	55.7	20.2	24.1

[1] Source: Kleinfelder, 2009g.

Within the region surrounding the Site, vegetation cover within the mixed grassland community is relatively sparse to moderate (10 to 40 percent) and is generally dominated by needle-and-thread (Lyon and Sovell, 2000; NatureServe, 2009). Other typical grass species represented at lower cover and not identified within the Site include Letterman's needlegrass (*Achnatherum lettermanii*), Purple threeawn (*Aristida purpurea*), bottlebrush squirreltail, junegrass, saline wildrye (*Leymus salinus*), muttongrass, Sandburg bluegrass, and alkali sacaton (*Sporobolus airoides*) (Lyon and Sovell, 2000; NatureServe, 2009). Forbs associated with mixed grasslands have cover that ranges from sparse to moderate and may also include: field sagewort (*Artemisia campestris*), tarragon (*Artemisia dracunculus*), white sagebrush (*Artemisia ludoviciana*), arrowleaf balsamroot (*Balsamorhiza sagittata*), Arizona thistle (*Cirsium arizonicum*), thicksepal cryptantha (*Cryptantha crassisepala*), fineleaf hymenopappus (*Hymenopappus filifolius*), hoary tansyaster (*Machaeranthera canescens*), scarlet globemallow, American vetch (*Vicia Americana*), and species of pussytoes (*Antennaria* spp.), milkvetch, buckwheat (*Eriogonum* spp.), and stickseeds (*Lappula* spp.). Scattered shrubs with less than 5 percent total cover are associated with mixed grasslands and have been observed within the region surrounding the project area including basin big sagebrush (*Artemisia tridentata* sp. *tridentata*), mountain big sagebrush, winterfat, antelope bitterbrush (*Purshia tridentata*), wax currant (*Ribes cereum*), and mountain snowberry (NatureServe, 2009; Lyon and Sovell, 2000). Cheatgrass is often widespread within this vegetation community as was observed within the Site, and contributes substantially to cover in disturbed areas. Other non-native species that may be present within the mixed grasslands include burning bush [*Bassia scoparia (Kochia scoparia)*], Kentucky bluegrass (*Poa pratensis*), tumblemustard (*Sisymbrium altissimum*), and yellow salsify (*Tragopogon dubius*) (NatureServe, 2009).

Overgrazing by livestock and plowing are the two greatest threats to mixed grasslands in western Colorado (Colorado Partners in Flight, 2008). Grazing has encouraged the increased growth of sod grasses on areas with deep soil and heavy to moderate rainfall. In areas with low precipitation, the bunchgrasses have been replaced by annual grasses, woody plants (i.e., sagebrush), and cacti (Paysen et al., 2000; Colorado Partners in Flight, 2008). Lack of fire and fragmentation are also threats. Fire plays a big role in this biome, preserving biodiversity and keeping trees from overtaking the grasses. These fires help certain plants by germinating seeds, clearing ground cover to allow rare plants a chance, and by nourishing the soil with freshly burnt vegetation (Colorado Partners in Flight, 2008).

3.5.1.4 Wetlands

On-Site Survey Methodology. Wetland delineation surveys were conducted by Kleinfelder on April 7 and April 8, 2008 (Kleinfelder, 2008c). The wetland delineation was conducted in accordance with the USACE Wetland delineation Manual (1987) and the Arid West Supplement (January 2006). The wetland delineation effort consisted of the Routine, Small Area Determination Method, as described in the Manual (1987), and by the evaluation of sample plots for wetland or non-wetland status. Visual observations were used to identify vegetation,

soil, and hydrological characteristics within the vicinity of the sample plots. Survey methodology is described in detail in the *Preliminary Delineation of Jurisdictional Water of the United States* (Kleinfelder, 2008c).

Wetland Features. No USACE jurisdictional wetlands were observed within the Site (Kleinfelder, 2008c). Only one non-jurisdictional wetland feature, a retention pond located on the Site historically used to water cattle, exhibited hydrologic criteria necessary for classification as a wetland. However, vegetation present at the retention pond sample plots did not meet the standards to be considered wetland vegetation (more than 50 percent of the dominant species must be hydrophytic). Most vegetation documented at the retention pond surveyed was upland vegetation similar to the surrounding dominant vegetation type (mixed grasslands and big sagebrush), although sunflowers (*Helianthus annuus*) and common cockleburs (*Xanthium strumarium*) – two species that can be associated with wetlands – were observed (Kleinfelder, 2008c).

No specific hydrophytic vegetation was associated with the ten ephemeral streams (nine discontinuous and one stream connected to East Paradox Creek) located on the Site. Kleinfelder (2008c) identified that one ephemeral stream with apparent connection to East Paradox Creek has potential to be a Waters of the United States (WoUS) and subject to USACE jurisdiction. Vegetation at each linear drainage consisted of vegetation within the dominant vegetation community it was located. Vegetation growth at the drainages was generally much greater as a result of increased available moisture, often three times the size of surrounding vegetation. These features were dominated by upland species such as four-winged saltbrush, big sagebrush, and Russian thistle (Kleinfelder, 2008c and 2009g). Vegetation associated with the wetland features were included in the totals for those dominant vegetation communities and discussed above.

In a letter dated June 5, 2008 from Kleinfelder to the USACE, Kleinfelder (on behalf of Energy Fuels) requested a review of their conclusions and verification of their findings that no USACE jurisdictional wetland resources or WoUS were observed within the Site. The USACE responded to Kleinfelder's request (September 15, 2008) stating that the Site is comprised entirely of uplands and accordingly, the proposed work would not require Department of Army Corps of Engineers authorization (USACE, 2008). The letter contains an approved jurisdictional determination for the subject site and the verification is valid for 5 years from the date of the letter unless new information warrants revision of the determination before the expiration date (USACE Identification Number: SPK-2008-1010).

3.5.1.5 Invasive, Non-Native Species

Noxious weeds are plants that are aggressive competitors non-native to an area, and are an increasingly serious problem in western Colorado. Most have come from Europe or Asia, either accidentally or as ornamentals that have escaped. Noxious weeds take advantage of any disturbance of the soil and are dispersed by wind, water, animals, people, and vehicles. Once established in a new environment they tend to spread quickly because insects, diseases, and animals that normally control them are absent.

Major weeds that are common in western Colorado are (Lyon and Sovell, 2000): Canada thistle (*Cirsium arvense*), Russian knapweed (*Acroptilon repens*), white top (*Cardaria* spp.), purple loosestrife (*Lythrum salicaria*), oxeye daisy (*Leucanthemum vulgare*), yellow toadflax (*Linaria vulgare*), tamarisk, Russian olive (*Eleagnus angustifolia*), houndstongue (*Cynoglossum officinale*), downy brome (cheatgrass), burdock (Family Asteraceae), cocklebur (*Xanthium strumarium*), Jim Hill mustard (*Sisymbrium altissimum*), Russian thistle, perennial pepperweed

(*Lepidium* spp.), cranesbill (*Erodium cicutarium*), and musk thistle (*Carduus nutans*). Canada thistle invades almost anywhere that contains disturbed soils and sufficient moisture. Russian knapweed is abundant in disturbed areas, along roads, and in Disappointment Valley in the greasewood flats. It was found in many locations, including along the Dolores River between Slick Rock and Bedrock, in Broad Canyon, Mailbox Park, Tuttle Draw, Dry Creek Basin, and Slick Rock. White top was also found in disturbed areas, such as hayfields and roadsides, and was noted near Mesa Creek, Maverick Draw, Atkinson Creek, and in the Redvale and Norwood areas. Purple loosestrife has been found in wet areas and can be a serious threat to wetlands and riparian areas. Oxeye daisy is a problem in mountain areas from the San Miguel River to Lizard Head Pass, is found along the South Fork, and in the Mountain Village area. Yellow toadflax is common along the San Miguel, on the mesas, and in the mountains. Tamarisk is found in riparian areas along the Dolores and San Miguel Rivers. Russian olive also occupies these same habitats. Houndstongue is widespread and abundant at higher elevations. Downy brome (cheatgrass) is found wherever there has been disturbance and is widespread. Once it has been established, cheatgrass is difficult to eliminate. Musk thistle tends to be found in moist areas in the middle elevations. Burdock is found throughout western Colorado in moist, disturbed sites. Cockleburs are abundant in drying stock ponds in the pinyon-juniper zone. Kentucky bluegrass is commonly planted for pasture or for erosion control and is abundant in moist areas, often replacing native grasses. The most common invader in the sagebrush shrublands, as well as in the pinyon-juniper woodlands is cheatgrass (Lyon and Sovell, 2000).

There are several lists of noxious weeds that have been identified under the Colorado Noxious Weed Act (Title 35, Article 5.5) that have been identified for various degrees of management within the state. The “A” list includes species that are not known to occur in Colorado or that have very limited distribution and that the Department of Agriculture Commissioner designates must be eradicated (18 species); “B” listed species include weeds with populations of varying distributions and densities and are designated by the Commissioner (in consultation with the state noxious weed advisory committee, local governments, and other interested parties) for inclusion in state noxious weed management plans designed to stop the continued spread of these species (40 species); “C” listed species are widespread and common in Colorado and can pose a threat to agricultural lands and may be required to be controlled (14 species) (Colorado Department of Agriculture, 2009a). The Montrose County Noxious Weed Management Plan (Colorado Department of Agriculture, 2009b) has designated 17 species (of the 72 species that occur on the Colorado State noxious weed lists) as noxious weeds that must be managed within the county. Table 3.5-6 provides a list of 21 noxious weeds that occur on the Colorado State noxious weed list and either occur on the Montrose County weed list and/or have been documented within the Site (Kleinfelder, 2009g and WestWater, 2009) or within the vicinity of the Site (Lyon and Sovell, 2000).

Noxious weeds are present throughout the Site due to disturbed habitat from present and historic agricultural activities, including cattle grazing. The observed noxious weeds are successional plants associated with the current land management practices. Observed noxious weeds at the Site include (Table 3.5-6): downy brome, Russian thistle, broom snakeweed, redstem filaree, and herb sophia (Kleinfelder, 2009g and WestWater, 2009), of which two occur on the Colorado State noxious weed list and require management (Table 3.5-2).

Table 3.5-6
Potential Occurrence and Observed Noxious Weed Locations in the Project Area [1]

Common Name Scientific Name	Montrose County Noxious Weed List	Location in Relation to Site
Colorado State A List		
Yellow Starthistle *Centaurea solstitalis*	X	Unknown
Purple Loosestrife *Lythrum salicaria*	X	In Vicinity
Colorado State B List		
Russian Knapweed *Acroptilon repens*	X	In Vicinity
Hoary cress *Cardaria draba*	X	Unknown
Plumeless Thistle *Carduus acanthoides*	X	Unknown
Musk thistle *Carduus nutans*	X	In Vicinity
Diffuse knapweed *Centaurea diffusa*	X	Unknown
Spotted knapweed *Centaurea maculosa*	X	Unknown
Oxeye Daisy *Chrysanthemum leucantheum*	X	In Vicinity
Canada Thistle *Cirsium arvense*	X	In Vicinity
Bull Thistle *Cirsium vulgare*	X	Unknown
Houndstongue *Cynoglossum officinale*	X	In Vicinity
Russian Olive *Elaeagnus angustifolia*		In Vicinity
Redstem filaree *Erodium cicutarium*		Within Site
Leafy Spurge *Euphorbia esula*	X	Unknown
Perennial pepperweed *Lepidium latifolium*		In Vicinity
Yellow Toadflax *Linaria vulgaris*	X	In Vicinity
Scotch Thistle *Onopordum acanthium, O. tauricum*	X	Unknown
Colorado State C List		
Jointed Goatgrass *Aegilops cylindrical*	X	Unknown
Common burdock *Arctium minus*	X	In Vicinity
Downy brome (cheatgrass) *Bromus tectorum*		Within Site

[1] Sources: Kleinfelder, 2009g; WestWater, 2009; Colorado Department of Agriculture, 2009a and 2009b; Lyon and Sovell, 2000.

3.5.2 Species of Special Status

The USFWS (2009a) has identified several fish and wildlife species and two plant species that are listed under the Endangered Species Act (ESA) that occur or could occur within Montrose County. As such, those species have been classified as “important” by the NRC in Regulatory Guide 3.8, Section 2.9 (NRC, 1982a). Each of these listed species is described below and is summarized in Table 3.5-7, which also includes two candidate species.

Table 3.5-7
Threatened, Endangered, and Candidate Species Potentially Occurring in Montrose County and in the Vicinity of the Site[1]

Listed Species	ESA Status[2]	Habitat[3]	Potential Occurrence within the Site
Mammals			
Canada Lynx *Lynx Canadensis*	Threatened with Critical Habitat	Coniferous forests interspersed with thickets of trees and shrubs, rocky outcrops, large woody debris; closely associated with snowshoe hares	Few occurrences of dispersed introduced lynx in Montrose County (Uncompahgre National Forest)
Black-footed Ferret *Mustela nigripes*	Endangered	Historically occupied areas ranging from short-grass and mid-grass prairie to semi-desert shrublands	Historic distribution in Colorado includes Montrose County, coincidental with Gunnison's prairie dog
Gunnison's Prairie Dog *Cynomys gunnisoni*	Candidate (in part of range)	Inhabit grasslands and semidesert1 to montane shrublands, elevations from 6,000-12,000 feet	Known to occur in Montrose County
Birds			
Mexican Spotted Owl *Strix occidentalis lucida*	Threatened with Critical Habitat	Steep rocky canyons with exposed cliffs and dense old growth conifer forest or canyons in pinyon-juniper with scattered patches of old Douglas-fir	Known to occur in Montrose County
Yellow-billed Cuckoo *Coccyzus americanus*	Candidate	Uncommon during summer in lowland riparian forested habitats and in urban areas with tall trees	Known to occur in Montrose County
Gunnison Sage-Grouse *Centrocercus minimus*	Former Candidate	Expansive sagebrush with grasses, forbs and healthy riparian ecosystems	Known to occur in Montrose County
Fish			
Bonytail *Gila elegans*	Endangered with Critical Habitat	Eddies, pools, and backwaters near swift current in large rivers of the Colorado River system	Main branches of the Colorado River including the Black Rocks area of the Colorado River downstream of Grand Junction
Humpback Chub *Gila cypha*	Endangered with Critical Habitat	Adults, in habitats ranging from deep turbid rapids often associated with large boulders and steep cliffs to flooded lowlands; young, in slow-moving backwaters	Main branches of the Yampa, Gunnison, Green, and Colorado rivers including the Black Rocks area of the Colorado River downstream of Grand Junction
Colorado Pikeminnow *Ptychocheilus lucius*	Endangered with Critical Habitat	Fast, deep, white-water rivers with backwater areas and eddy habitats 2 to 3 feet deep that support aquatic insects, small fish as prey species	Main branches of the Yampa, Gunnison, Green, and Colorado rivers including the Black Rocks area of the Colorado River downstream of Grand Junction
Razorback Sucker *Xyrauchen texanus*	Endangered with Critical Habitat	Slow backwater habitats or large rivers and impoundments, not small tributaries or headwaters, with mud, sand or gravel substrate	Main branches of the Yampa, Gunnison, Green, and Colorado rivers
Plants			
Colorado Hookless Cactus *Sclerocactus glaucus*	Threatened	Rocky hills, alluvial benches, and lower mesa slopes in desert shrub communities from 4,500 to 6,000 feet	Known to occur in northern Montrose County and/or Delta County
Clay-loving Wild Buckwheat *Eriogonum pelinophilum*	Endangered with Critical Habitat	Whitish, alkaline clay soils on Mancos shale, with sparse salt desert shrub community; elevations from 5,200 to 6,400 feet	Known to occur in eastern Montrose County in the vicinities of Montrose and Olathe

[1] Source: USFWS, 2009a.
[2] ESA Status = Endangered Species Act Status.
[3] Source: CDOW, 2009b; CNHP, 2009a and 2009b.

Candidate species are those for which the USFWS "has on file sufficient information on biological vulnerability and threats to support a proposal to list as endangered or threatened, but for which preparation and publication of a proposal is precluded by higher-priority listing actions" (USFWS, 2007a). Although candidate species have no legal protection under the ESA, candidate species may be proposed for listing in the future which could require consultation if construction of the Mill Facility would likely jeopardize the continued existence of such species (USFWS and National Marine Fisheries Service - NMFS, 1998). Consequently, the Services (USFWS and NMFS) encourage conservation of candidate species and their consideration in environmental planning (USFWS and NMFS, 1998). In this regard, candidate species may also be considered as "important" under the criterion, above, but also under an additional criterion that the species 1) affects the well-being of some ESA-listed species (Gunnison's prairie dog), and 2) the species is critical to the structure and function of the ecological system (Gunnison Sage-grouse) as described in Section 2.9 (NRC, 1982a).

Section 7 of the ESA, as amended, requires federal agencies to consult with the USFWS to ensure that any action the agency authorizes, funds, or implements is not likely to jeopardize the continued existence of a listed species, threaten a species, or result in the destruction or adverse modification of designated critical habitat (16 United States Code [USC] section 1536(a)(2)(1988)). If a listed species is found on private property, section 9 of the ESA requires the landowner to manage the species and habitat so that there will be no "take" of the species. Take includes "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect; or to attempt to engage in any such conduct". If use of the private property would potentially lead to a take, then the landowner could seek an incidental take permit under section 10 of the ESA. Incidental take (take that could occur while conducting otherwise lawful economic activities) would require the landowner to develop a habitat conservation plan (HCP) that would analyze likely impacts, identify measures to mitigate impacts, provide means of funding the measures, describe protocols for dealing with unexpected situations, and present alternatives to the activity that would minimize take with reasons why they would not be implemented. The USFWS could then issue an incidental take permit, possibly conditioned with other actions that would have to be implemented (Shogren, 1998).

Similar constraints apply to plants listed under the ESA for activities and projects under federal jurisdiction. On non-federal lands, the ESA prohibits the removal, cutting, digging up, or damaging or destroying of any ESA-listed plant species on any other area in knowing violation of any state law or regulation, or in the course of any violation of a state criminal trespass law. Colorado's Title 33, Article 2, Non-game and Endangered Species Conservation statute (CRS § 33-2-101 – 108) includes protections to nongame, endangered or threatened species of wildlife identified by the state but does not include protections to threatened or endangered plants.

Species Surveys. Surveys for wildlife, wildlife habitat, and migratory birds were conducted concurrently with surveys for vegetation during 2007 and 2008 (Kleinfelder, 2009h and 2009g). Similar to the vegetation survey, diurnal pedestrian surveys were conducted along transects and the presence of wildlife and/or their sign was documented. Night-time observation points were located at each corner of the Site and one in the middle of the Site. Nocturnal surveys were conducted during the Fall, Winter, and Spring seasons. A handheld spotlight with the capability to illuminate up to 1,000,000 foot candles was utilized. A spotter completed a 360-degree sweep with the handheld spotlight, while a second field worker documented the results behind the spotter, saving the documenters' night vision. A bird survey was conducted each season using point count survey techniques and a survey specifically to detect western burrowing owls was implemented during the Summer (2007) and Spring (2008) surveys (Kleinfelder, 2009). The

species' calls were broadcast from a portable player using a recommended protocol (CDOW, 2007).

The adjacent 80-acre parcel (well field) was examined by WestWater Engineering on August 24, 2009 (WestWater, 2009). Vegetation types were determined through field identification of plants, aerial photography, and on-the-ground assessments of plant abundance. Identification of plant species was aided by using pertinent published field guides (Anthony et al., 2007; Kershaw et al., 1998; Weber and Wittmann, 2001; and Whitson et al., 2004). Casual wildlife reconnaissance was also conducted at that time (WestWater, 2009).

In addition to on-site surveys, much of the following information about species and their potential occurrence on-site was obtained from databases that have been developed by CDOW, Natural Diversity Information Source (CDOW, 2009b) and the Colorado Natural Heritage Program - CNHP (2009a and 2009b), including spatial data provided in geographic information system (GIS) formats. In addition, relevant agency reports and published literature were reviewed, analyzed, and synthesized to develop the species' profiles provided in these sections to supplement results of on-site surveys with the goal of conducting appropriate and comprehensive impact analyses.

3.5.2.1 Federally Listed Threatened and Endangered Species

The Canada lynx is currently listed as threatened, although habitat in Colorado was not deemed as essential to the conservation of the species (USFWS, 2009a). Though unlikely, lynx could occur in Montrose County. Montrose County was within the historical range of endangered black-footed ferrets and their presence in the county has been judged as likely by CDOW (2009b). Mexican spotted owls, listed as threatened, are known to occur in Montrose County (CDOW, 2009b). Likewise, the Colorado hookless cactus and the clay loving buckwheat occur in Montrose County (CNHP, 2009a and 2009b). In addition, the western yellow-billed cuckoo is a candidate species under the ESA and may occur in Montrose County. The Gunnison's prairie dog is a candidate species under the ESA within part of its range, while Gunnison Sage-grouse is a former candidate species whose status is being reconsidered; both are known to occur in Montrose County (USFWS, 2009a; CDOW, 2009b).

Four species of Colorado River Basin fish (the bonytail chub, Colorado pikeminnow, humpback chub, and razorback sucker) are listed as endangered and critical habitat has been designated, although none has been designated in Montrose County for any of the four species.

To the extent that knowledge exists and data are available for the "important" species (defined in NRC Regulatory Guide 3.8, Section 2.9 (NRC, 1982a)) included in Table 3.5-7 the following sections provide discussions of the species' seasons of occurrence, estimates of abundance, local flight patterns, and critical habitats as well as spatial and temporal distributions, life histories, critical life stages, biologically significant activities, seasonal habitat requirements and population fluctuations, food chain, and other interspecific relationships as recommended in guidance provided by the NRC in Section 6.3.5 of NUREG-1748 (NRC, 2003a).

Canada Lynx. Canada lynx within the contiguous United States were listed as threatened on March 24, 2000 (USFWS, 2000a). The listing includes lynx within Colorado; 218 lynx captured in Alaska and Canada were introduced to Colorado between 1999 and 2007. Lynx are also listed by Colorado as endangered under the State's Non-game and Endangered Species Conservation statute (CRS § 33-2-101- 108).

In 2000, the USFWS (2000a) identified significant threats to the lynx including threats by destruction, modification, or curtailment of the species' habitat or range within the Northern Rockies/Cascades and Southern Rockies. Lynx habitats have been adversely affected by timber harvest, mostly within western boreal forests (subalpine fir/spruce forest). However, timber harvest levels on federal lands in the West have declined since the 1990's and reduction of early successional habitats with concomitant reductions of snowshoe hare habitats may have affected lynx in some areas (USFWS, 2000a). USFWS (2000a) concluded that lynx populations in the contiguous United States occur at naturally low densities, generally maintained by limited abundance of primary prey (snowshoe hare), which in turn results from patchy distribution of transitional boreal forest habitat. While lynx have been trapped, legally or otherwise, USFWS (2000a) recognized that overharvest (overutilization) of the species is not a factor that threatens lynx, especially since the 1980's when legal trapping became considerably restricted or eliminated by states.

Lynx inhabit coniferous forests interspersed with thickets of trees and shrubs, rocky outcrops, and large woody debris that are often used for den sites. Canada lynx are specialized predators that are highly dependent on snowshoe hare, although they may also prey opportunistically on squirrels, mice, beaver, muskrat, birds, young ungulates, and some carrion when hare populations decline. Breeding populations are not possible without an adequate snowshoe hare population (USFWS, 2003). They are highly mobile, and often explore outside their home ranges (USFWS, 2003). Historically, lynx occurred in the mountains of Colorado, probably the southern limit of the species' distribution. Records indicated they were present in the Park, Gore, San Juan, and La Plata mountains, as well as the White River Plateau (Fitzgerald et al., 1994).

The 218 Canada lynx that were introduced to the San Juan Mountains in southwestern Colorado (Shenk, 2005) are not designated as experimental under section 10(j) of the ESA. USFWS (2006a) recognized the reintroduction as important though not essential for recovery of lynx; the reintroduction program has been included in the recovery plan, but not the critical habitat designation (USFWS, 2006a). Lynx have dispersed from the San Juan Mountains into the Uncompahgre National Forest in central Montrose County. A few lynx have been located in San Miguel County, south of the Site and in San Juan County, Utah to the west of the Site (Shenk, 2005).

Recent compilations of lynx locations between 1999 and 2008, following reintroduction to southern Colorado, indicated they mostly used Engelmann spruce/subalpine fir forest cover types throughout the year, including mixtures of conifers with aspen (CDOW, 2009c). Lynx also utilized riparian cover types, primarily from July through December. Lynx were mostly located on gentle slopes, more so on slopes facing north, and were found at elevations averaging above 10,000 feet (CDOW, 2009c). Den sites also tended to be within Engelmann spruce/subalpine fir forests but on steeper north facing slopes at elevations averaging above 11,000 feet with considerable vegetative understory cover and coarse woody debris. Generally, reproducing female lynx have smaller home ranges (average of 29 square miles) than attending males (average of 39 square miles); non-reproductive females have the largest home ranges, averaging over 270 square miles (CDOW, 2009c). Diets of lynx released in Colorado appear similar to those of lynx elsewhere; snowshoe hares were the most common prey, followed by red squirrel (CDOW, 2009c). Snowshoe hares do occur within Montrose County but their elevational distribution ranges from 8,000 to 11,500 feet (CDOW, 2009b). The lowest elevation record is 6,500 feet from Gunnison County and the westernmost specimen of snowshoe hare is from Anvil Points, near Rifle, Garfield County (CDOW, 2009b). Consequently, the Site is not suitable habitat for lynx and a resident population of lynx in the project vicinity is highly unlikely.

Of the 218 lynx that were introduced to Colorado from 1999 through 2007, 115 have died from various causes including 16 that were known to be shot (five others were probably shot) and 14 more that were struck by vehicles (CDOW, 2009b). Others have died from starvation, disease, predation, or from unknown causes.

Critical habitat was initially designated for Canada lynx in 2006 (USFWS, 2006a) and areas of designated critical habitat were revised in 2009 (USFWS, 2009b). However, no critical habitat has been designated in Colorado. Although resident Canada lynx are highly unlikely to occur at the Site, transient lynx may occur as they disperse from population centers where they have become established following reintroductions.

Black-Footed Ferret. The black-footed ferret was included on the 1967 list of native fish and wildlife threatened with extinction under the Endangered Species Preservation Action of 1966 (USFWS, 1967) and included in Appendix D, the "United States List of Endangered Native Fish and Wildlife" (USFWS, 1970) prior to enactment of the ESA of 1973.

Black-footed ferrets are closely associated with prairie dogs, particularly black-tailed prairie dogs (*Cynomys ludovicianus*) and to a lesser extent, white-tailed prairie dogs (*C. leucurus*) and Gunnison's prairie dogs. Black-footed ferrets declined as prairie dog habitat declined because: 1) steady conversion of native prairie to cropland, which was unsuitable habitat for prairie dogs, 2) active control of prairie dogs through poisoning to reduce competition with livestock, and 3) introduction of exotic diseases, especially sylvatic plague, to which prairie dogs and ferrets are highly susceptible, and canine distemper (Lockhart et al., 2006). Similar threats to prairie dogs and ferrets are ongoing.

As of 2004, the black-footed ferret captive breeding program propagated more than 4,800 ferrets and reintroduced approximately 1,800 ferrets to nine sites in multiple states. However, only 600 ferrets were believed extant in the wild and only three reintroduction sites were judged as viable (Lockhart et al., 2006).

Black-footed ferrets' original distribution in North America closely corresponded to distributions of prairie dogs (Hall and Kelson, 1959; Fagerstone, 1987) and until 1985, a free-living population inhabited white-tailed prairie dog colonies located west of Meeteetse, Wyoming. This population was reduced by canine distemper in 1985 (Clark, 1985) and surviving ferrets were captured for captive breeding and eventual reintroduction to the wild. Black-footed ferrets depend on prairie dogs for food and prairie dog burrows for shelter (Hillman and Clark, 1980 and Fagerstone, 1987). They are mostly nocturnal and spend much of their time underground so their presence in an area is difficult to confirm. Black-footed ferrets breed from mid-March through early April (Clark and Stromberg, 1987) and young are born in prairie dog burrows. Young ferrets venture above ground during July but remain near the nest burrow (Fagerstone, 1987).

Black-footed ferrets were reintroduced to Rio Blanco and Moffat counties in northwest Colorado in 1999 at one site (Coyote Basin) on the Colorado-Utah border west of Rangely and in 2001 at a second site (Wolf Creek) south of Dinosaur National Monument. From 1999 to the present, a total of 255 ferrets have been released in Utah and 189 ferrets have been released in Colorado, both releases have been within white-tailed prairie dog colonies. Reproduction was confirmed in Coyote Basin in the fall of 2000 and in 2005 at the Wolf Creek site (BLM, 2009b). The Coyote Basin site is approximately 128 miles north and the Wolf Creek site is 135 miles north of the Site.

No critical habitat has been designated for black-footed ferrets. Black-footed ferrets are highly unlikely to occur in the Site and vicinity.

Mexican Spotted Owl. The Mexican spotted owl was listed as a threatened species in 1993 (USFWS, 1993). At the time they were listed, there were only 20 historic records (13 records accepted) of spotted owls in Colorado, mostly from the San Juan Mountains in southwestern Colorado.

At the time they were listed, the USFWS (1993) reported that significant portions of habitat had been lost or modified, primarily due to pressures from local and regional human population growth as well as natural causes, primarily fire. Timber harvest on NFS lands in the southwest, in particular, was held responsible for much loss of suitable spotted owl habitats. Timber harvest reduced the extent of uneven aged, multilayered timber stands and reduced the structural diversity that is characteristic of suitable habitats. Fragmentation of owl habitats has occurred during conversion of large contiguous tracts of forest to smaller areas, isolating stands from one another. Fragmentation has affected quality of owls' home ranges, reduced prey availability, and altered microclimatic conditions that are important to suitability of nest and roost sites (USFWS, 1993). Fragmentation was responsible for enhanced predation of spotted owls by avian predators, such as great horned owls and red-tailed hawks (USFWS, 1993). In addition, the USFWS identified less severe threats including land exchange, oil and gas leasing, mineral development, and grazing while noting that individual actions may generate low impact to the species but in combination, they may generate high cumulative impact because of synergistic interactions (USFWS, 1995).

To facilitate species' recovery, Mexican spotted owls' range within the United States was divided into six recovery units; the Site is within the Southern Rocky Mountains-Colorado Recovery Unit. Few spotted owls have been detected within the Southern Rocky Mountains-Colorado Recovery Unit; only 20 records of owls were reported prior to 1990 and 14 more were reported between 1990 and 1993, the fewest records for any of the Recovery Units within the United States (USFWS, 1995). In Colorado, Mexican spotted owls inhabit two types of habitats: 1) large canyons with steep, exposed cliffs and old-growth forests composed of Douglas-fir, white fir, and ponderosa pine, and 2) canyons in pinyon-juniper vegetation with small patches of late seral Douglas-fir (Andrews and Righter, 1992; USFWS, 1995). During summer, spotted owls roost in cool microclimatic sites in association with closed canopies and/or north-facing slopes (Andrews and Righter, 1992).

Roost and nest trees were found to be the oldest and largest within stands, whether stands were mixed-conifer dominated by Douglas-fir, ponderosa pine-Gambel oak, or riparian forests with diverse tree species (USFWS, 2004). Mexican spotted owl nests are either in trees with broken tops that provide platforms, trees with mistletoe brooms, trees with trunk cavities, on cliff ledges, or cliffs with potholes (Gutiérrez et al., 1995). One to four eggs hatch after 28 to 32 days. Eggs are incubated by the female, but both parents care for the young, which fledge 34 to 36 days after hatching. Pair formation begins in February to early March followed by nest construction through April. Only one clutch of eggs is generally laid per nesting season (Gutiérrez et al., 1995).

Prior to 1990 there were only 20 historical records of Mexican spotted owls in Colorado. Most historical records were along the Colorado Front Range, as far north as Fort Collins. Since 1990 there have be 14 additional records on NFS lands and BLM-administered lands (Ward et al., 1995). Records of spotted owls within the CNHP element database (2009b) are limited to San Miguel and Montezuma counties in southwestern Colorado. Owls observed in southwestern

Colorado were in canyon bottoms containing mixed-conifer or ponderosa pine-Gambel oak forests incised into mesas covered with pinyon-juniper vegetation (Ward et al., 1995). No suitable habitat for Mexican spotted owls is present within the Site or vicinity.

The USFWS (2004) designated over 8.6 million acres of critical habitat for the Mexican spotted owl over four western states, including Utah and Colorado. The closest designated critical habitat unit (CP-15) is on BLM-administered land within Carbon and Emery counties, Utah (USFWS, 2004) and is approximately 30 miles east of Price, Utah. It includes the West Tavaputs Plateau, primarily along the Desolation Canyon area of the Green River. There is no critical habitat near the Site. Mexican spotted owls are highly unlikely to occur at the Site and vicinity.

Bonytail Chub. The bonytail chub is an exceedingly rare minnow originally native to the Colorado River system of the western United States and northern Mexico (USFWS, 2002a). The bonytail was listed as endangered by the USFWS in 1980 because it had been nearly extirpated from its historical range. Recovery goals for the bonytail chub were released by the USFWS in 2002 as an amendment and supplement to the 1990 recovery plan. There are two recovery units; the upper Colorado River Basin, including the Green River and upper Colorado River subbasins; and the lower basin, including the mainstream and its tributaries from Lake Mead downstream to the southerly International Boundary with Mexico (USFWS, 2002a). The primary threats to bonytail are streamflow regulation, habitat modification, predation by non-native fish species, hybridization, and pesticides and pollutants (USFWS, 2002a).

The bonytail is endemic to the Colorado River Basin. The species experienced a significant decline in abundance, starting around 1950, although the decline was poorly documented. At the time it was listed, threats to the species included physical alterations (impoundments and diversions) and chemical changes to habitats and introductions of non-native fish (USFWS, 1980). There have been adverse effects to bonytails and other fish native to the Colorado River Basin by changes in river flow regimes, migratory barriers, changes in water temperature, competition and predation by exotic fish species, parasites, and altered food base (USFWS, 1987; USFWS, 2002a).

Bonytails that inhabit riverine habitats have not been observed to spawn. However, spawning appears to occur during late June and early July at water temperatures of about 18°C (Vanicek and Kramer, 1969). Apparently, spawning occurs over gravel bars in moderately deep water; eggs were deposited randomly, and no effort to safeguard the eggs was observed (Vanicek and Kramer, 1969).

Females produce between 1,000 and 17,000 eggs. Eggs begin hatching about 9 hours after fertilization and alevins remain in the gravel for 48 to120 hours before emerging. Survival rate of juveniles is 17 to 38 percent (USFWS, 2002a). Water temperatures between 68°F and 70°F appear to be optimal for reproduction, incubation, and survival of eggs and newly hatched fry (USFWS, 2002a). Water temperatures have decreased due to impoundments within the Colorado River Basin since colder water from the bottom of impoundments is released downstream (USFWS, 2002a).

The fish are considered big or mainstream river species, preferring pools and eddies of warm, often heavily silted, swift moving rivers; however, they do occur in reservoir habitats, as well (USFWS, 2008a). Viable populations are extremely rare within the Green River drainage in Utah and are not known within the State of Colorado (USFWS, 2002a; CDOW, 2009b). Apparently, there are no self-sustaining populations of bonytails in the Colorado River Basin. During the

1960s through the early 1980s, adult bonytail were captured in the Upper Colorado River Basin including the Yampa River, Green River, and Colorado River mainstream (USFWS, 2002a). Most recently, wild bonytails were captured in Lake Mohave, Nevada (in 2002) and Lake Havasu, Arizona (in 1990).

The USFWS has designated critical habitat for the bonytail chub in river channels and flooded, ponded, or inundated riverine habitats that would be suitable for adults and young. Critical habitat within Colorado has been designated on the Colorado River in Mesa County from Black Rocks (River Mile 137), downstream to Fish Ford River on the Utah-Colorado border (USFWS, 1994).

Recent information suggests that floodplain habitats may be more important to survival and recovery of the bonytail than originally thought; the last reported concentrations of the species in the upper Colorado River Basin occurred in or upstream of alluvial river reaches with substantial floodplain habitat (USFWS, 2002a). The USFWS has suggested that flooded bottomland habitats that are relatively free of predators may contribute to successful reproduction and recruitment, and support species' recovery (USFWS, 2002a); however, no critical habitat for the bonytail has been designated anywhere in the Dolores River.

Humpback Chub. The humpback chub was included on the 1967 list of native fish and wildlife threatened with extinction under the Endangered Species Preservation Act of 1966 (USFWS, 1967) and included in Appendix D, the "United States List of Endangered Native Fish and Wildlife" (USFWS, 1970) prior to enactment of the ESA of 1973. Humpback chubs are endangered under the ESA (USFWS, 2009a). The second revised Humpback Chub Recovery Plan was released in 1990. The goal of the plan is the protection or restoration of five viable, self-sustaining populations in the Colorado River Basin, as well as the protection of their habitat (USFWS, 1990a).

Similar to other endangered species such as the bonytail, humpback chubs have been adversely affected by stream alteration (dams, irrigation, dewatering, and channelization); competition with and predation by introduced, non-native fish species; and hybridization with other species of the genus Gila (USFWS, 1990a). Reduced water flows have also affected humpback chubs (Woodling, 1985; USFWS, 1990a; USFWS, 1994).

The humpback chub prefers waters that are deep, fast-moving, and turbid (Woodling, 1985), and they are often associated with large boulders and steep cliffs (CDOW, 2009b); however, they have been found in relatively quiet waters as well and may use diverse habitats (USFWS, 1990a). Evidence suggests that humpback chubs may spawn from April to June with water temperatures between 61°F to 68°F (USFWS, 1990a). Optimal temperature for egg hatch is in warmer (68°F) water. Similar to other species of Gila, humpback chubs feed on benthic invertebrates but will also feed on insects floating on the surface (USFWS, 1990a).

The known historic distribution includes portions of the mainstream Colorado River and four of its tributaries: the Green, Yampa, White, and Little Colorado (USFWS, 2002b). The distribution of humpback chub in 1990 included the Colorado River mainstream reaches in the vicinity of Westwater Canyon, Utah and Black Rocks, Colorado (USFWS, 1990a). In the Black Rocks and Westwater Canyon reaches, young humpback chubs appear to utilize shallow waters with depths averaging 2.1 feet but not exceeding 5.1 feet (Valdez et al., 1990). Alternatively, adults in the same areas were found in water averaging 50 feet (maximum depth of 92 feet) and were associated with in-stream large boulders where there were steep cliffs along the riverbanks

(Valdez et al., 1982; Wick et al., 1981). From its confluence with the San Miguel River, the Dolores River enters the Colorado River more than 65 miles downstream.

The USFWS has designated the same critical habitat for the humpback chub as for the bonytail chub on the Colorado River in Mesa County extending from Black Rocks near the Utah border to Fish Ford in Utah (USFWS, 1994). Designation of critical habitats for all listed fish in the Colorado River Basin, including the humpback chub, was based on presence of primary constituent elements – physical and biological features – needed for species' continued survival and identified above for the bonytail (USFWS, 1994). There is no critical habitat near the Site.

Colorado Pikeminnow. Historically, the Colorado pikeminnow occurred in great numbers throughout the Colorado River system from Green River, Wyoming to the Gulf of California in Mexico. The species was included on the 1967 list of native fish and wildlife threatened with extinction under the Endangered Species Preservation Act of 1966 (USFWS, 1967) and included in Appendix D, the "United States List of Endangered Native Fish and Wildlife" (USFWS, 1970) prior to enactment of the ESA of 1973. Colorado pikeminnows are endangered under the ESA (USFWS, 2009a).

In 1973, modification of habitat by construction of large reservoirs was cited as the primary threat to the species. Adverse conditions associated with cold temperatures in tailwaters below dams, reduced flows, and introduced fish species affected pikeminnow reproduction and survival (USFWS, 2002c). Additional threats identified in the species' Recovery Plan (USFWS, 1991a) were summarized as a combination of factors including direct loss of habitat, changes in flow and temperature, blockage of migration routes, and interaction (competition and predation) with introduced fish species. Pesticides and pollution also adversely affect the species (USFWS, 2002c).

Adult Colorado pikeminnows can be found in big, deep water (i.e., eddies, pools, and other areas adjacent to the main current flows), whereas young pikeminnow inhabit shallow, quiet backwaters (Woodling, 1985). Spawning occurs after high spring runoff flows with water temperatures ranging from 64°F to 73°F (USFWS, 2002c). After hatching, pikeminnow larvae drift downstream from spawning substrates and typically inhabit in-channel backwater sites, characterized by warm, deep, and turbid water that historically formed after spring peak runoff (USFWS, 2002c), generally during June, July, and August (USFWS, 1994).

Currently, wild populations are found only in the upper Colorado River Basin. In Colorado, they are found in the Green, Yampa, Little Snake, White, Colorado, Gunnison, San Juan, and Dolores rivers (Woodling, 1985; USFWS, 2002c). The Gunnison River is considered occupied habitat for 33.5 miles from the confluence with the Colorado River, and the Colorado River mainstream is occupied habitat from Palisade, Colorado downstream to Lake Powell (USFWS, 2002c). Spawning occurs in the upper Colorado and Gunnison rivers (USFWS, 2002c). The Dolores River is occupied by Colorado pikeminnow but only 2 km (1.2 miles) upstream from the confluence with the Colorado River (USFWS, 2002c). The Dolores River enters the Colorado River more than 65 miles downstream from its confluence with the San Miguel River in Montrose County.

The USFWS (1994) designated critical habitat in the Colorado River and its 100-year floodplain from the Colorado River Bridge at exit 90 north of Interstate-70 near Rifle in Garfield County, downstream to Lake Powell. The Gunnison River from the Uncompahgre River confluence downstream to the Colorado River is also designated as critical habitat (USFWS, 1994). Designation of critical habitats for all listed fish in the Colorado River Basin, including the

Colorado pikeminnow, was based on presence of primary constituent elements – physical and biological features – needed for species' continued survival and identified above for the bonytail (USFWS, 1994). There is no critical habitat near the Site.

Razorback Sucker. The razorback sucker was listed as endangered by the USFWS in 1991 because of limited numbers found throughout the Colorado River Basin and minimal evidence of natural recruitment (USFWS, 1991a). When razorback suckers were listed, the USFWS (1991a) noted there was not much indication of recruitment to populations and decreasing population trends for adult fish. Habitat alterations, including diversion and depletion of water, introduction of non-native fishes, and construction and operation of dams were cited as contributing to the observed downward trends. In addition, water development projects have depleted flows, altered flow regimes, changed water quality, and fragmented habitats. These effects combined with changes in fish communities due to introductions of many non-native fish species, predation by non-native fishes, loss of habitat, and pesticides and pollutions, have been cited as the causes for the species' endangered status (USFWS, 2002d).

The razorback is most often found in quiet, muddy backwaters along the river (USFWS, 1994; CDOW, 2009b). Spawning extends from April through June, and occurs in river bars with cobble, gravel, and sand substrates during high flows from spring runoff, when water temperatures are greater than 57°F (USFWS, 2002d). Juvenile rearing habitats are in quiet, warm, shallow water associated with various river and floodplain features (USFWS, 2002d). Reproduction has been adversely affected by lower water temperatures due to impoundments within the Colorado River Basin since colder water from the bottom is released downstream (USFWS, 2002d). Similar to habitats utilized by bonytail, young razorback suckers utilize warm shallow waters at tributary mouths and backwaters and inundated floodplains as nursery environments (USFWS, 2002d).

This species was once abundant through the Colorado River Basin, primarily in the mainstream and major tributaries and now is known within the Upper Colorado River Basin including the lower Yampa and Green rivers, mainstream Colorado River, and lower San Juan River (USFWS, 2002d). Within the Upper Colorado River Basin, naturally reproducing populations are only found in the middle Green River in Utah and in an off-channel pond in the Colorado River near Grand Junction (USFWS, 2002d). Razorback suckers have been reintroduced to the lower 34 miles of the Gunnison River from which wild populations had been previously extirpated (USFWS, 2002d).

The USFWS has designated 1,724 miles of critical habitat - 49 percent of historical habitat for the species – and includes the Gunnison River and its 100-year floodplain in Mesa County from the Redlands Diversion Dam to the confluence with the Colorado River (USFWS, 1994). There is no critical habitat near the Site.

Colorado Hookless Cactus. Colorado hookless cactus is a federally-listed threatened plant (USFWS, 1979) that occurs on river benches, valley slopes, and rolling hills in Delta, Garfield, Mesa, and Montrose counties, Colorado (USFWS, 1990b). In 1979, the species was listed as *Sclerocactus glaucus*, with the common name as Uinta Basin hookless cactus. Recently, USFWS (2007b) identified three separate species that were formerly included within the *Sclerocactus glaucus*-complex to include *Sclerocactus brevispinus* (*Pariette cactus*), *S. glaucus* (renamed the Colorado hookless cactus), and *S. wetlandicus* (currently with no common name but suggested to be named as the Uinta Basin hookless cactus due to its distribution in Utah). USFWS (2009c) revised the taxonomy of the 1990 listed *S. glaucus*, previously considered a complex (USFWS, 1990b), to recognize three distinct species: Pariette cactus (*S. brevispinus*),

Colorado hookless cactus (*S. glaucus*), and redefined Uinta Basin hookless cactus (*S. wetlandicus*). All three species remain listed as threatened until the USFWS can conduct a five-factor analysis for each species to reevaluate status and evaluate the necessary elements for critical habitat (USFWS, 2009c). This rule becomes effective on October 15, 2009.

S. glaucus is a perennial herb that produces pink flowers from April to late May. It is found in xeric, fine-textured soils overlain with cobbles and pebbles, growing in salt desert shrub and pinyon-juniper communities, at elevations ranging from 4,400 to 6,200 feet (CNHP, 2009a). Anthropogenic threats to this species include collecting, mineral and energy developments, off-road vehicle and recreation effects, road construction, water developments, and pesticide use (USFWS, 1990b).

Reproduction is predominantly sexual, although individuals may sprout multiple stems. Flowering occurs April to May and fruiting occurs May to June. Bees, flies, beetles, and ants have been observed visiting flowers. Many species of bees (bees in the family Halictadea are pollinators of other species of *Sclerocactus*) and long-tongued moths have been identified as pollinators, although reproduction (seed production) may be limited because of underpollination (Tepedino, 1999). Once seeds are released they are dispersed by gravity, water flow, or possibly insects and/or birds (USFWS, 1990b). Ants have been observed grazing on flowers and immature fruits, but significance to species survival is unknown (USFWS, 1990b).

There are two population centers of *S. glaucus* in Colorado (USFWS, 1990b): 1) on alluvial river terraces of the Gunnison River from near Delta, Colorado to southern Mesa County, Colorado (approximately 8,000 plants) and 2) on alluvial river terraces of the Colorado River and in the Plateau of Roan Creek drainages in the vicinity of DeBeque, Colorado (approximately 4,000 plants). An intensive survey of potential Colorado hookless cactus habitat present at the Site (pinyon-juniper woodland) was performed on August 24, 2009 but no hookless cactus were found (WestWater, 2009). Likewise, previous botanical surveys were conducted at the Site on multiple occasions from August 2007 through May 2008 but no *S. glaucus* plants were observed even though the surveys conducted in May 2009 coincided with the species' flowering period (Kleinfelder, 2009g). Colorado hookless cactus has not been found in the Paradox Valley area in previous survey efforts (USFWS, 1990b; Lyon and Sovell, 2000; Ferguson, 2009).

No critical habitat has been designated for the species. The Colorado hookless cactus is highly unlikely to occur at the Site and vicinity.

Clay-Loving Buckwheat. Clay-loving buckwheat was proposed for listing as an endangered species on June 22, 1983. The species was designated endangered on July 13, 1984, and the known range of the species at that time (119.8 acres) was designated as critical habitat USFWS, 1984). There is a current petition to revise critical habitat for this species and if the petition is found to be substantial, a 12-month finding will be submitted by September 21, 2009 (USFWS, 2009d).

At the time of listing, horse grazing was a major threat to the species and its habitat. There was also off-road vehicle use occurring in conjunction with management of the horses and pasture (USFWS, 1984). Rural residential housing tracts also pose a problem (USFWS, 1988), and this type of development is reported to have extirpated or degraded known occurrences (USFWS, 2009d). It is known to occur in the Mancos Shale hills within Delta and Montrose counties, Colorado. Much of the former habitat in the vicinity of Montrose, Colorado has been destroyed since the species was listed in 1984 (Flora of North America, 2008). Habitat associated with the clay-loving buckwheat in Delta County was largely destroyed in 2001 by off-road vehicle

activities in the designated critical habitat. A small population of clay-loving buckwheat is preserved at the Fairview Natural Area east of the City of Montrose (Flora of North America, 2008).

Clay loving buckwheat is a low-growing, rounded, densely branched subshrub in the buckwheat family. It is estimated to live between 20 and 50 years, with flowering usually occurring from late May to early September and individual flowers lasting fewer than 3 days. Reproduction requires a pollinator. This species is found in plant communities with low species diversity, low productivity, and minimal canopy cover (USFWS, 2009d).

The clay loving buckwheat is endemic to the adobe hills and flats immediately adjacent to the communities of Delta and Montrose, Colorado (USFWS, 2009d). The plants' northern range occurs near Lasear in Delta County and the southern range is the southeastern edge of the City of Montrose at elevations from 5,180 to 6,350 feet. The area in which the species occurs is dry, receiving an average of 8 to 9 inches of precipitation a year in the whitish, alkaline clay soils of the Mancos shale Formation. These soils are part of the Billings Series, with a fine texture and weak, unstable structure. Plants are generally found in swales or drainages where there is more moisture, and are located in low-lying areas with rolling topography and steeper, more barren slopes above them. Plants near Delta are located at lower elevations in small areas where snow lingers (USFWS, 2009d). Surveys were conducted at the Site on multiple occasions from August 2007 through May 2008, but no clay loving buckwheat plants were observed, even though the surveys conducted in August and September 2007 corresponded with the species' flowering period (Kleinfelder, 2009g). Clay loving buckwheat has not been found in the vicinity of the Site during previous survey efforts (Lyon and Sovell, 2000).

Critical habitat was designated on 120 acres of private land in Delta County, Colorado in 1984, which was the entire known area at the time (USFWS, 1984). The designated critical habitat is approximately 60 miles northeast of the Site. Soils within the Site are atypical of the critical habitat soils known to provide habitat for this species (Kleinfelder, 2009g). The clay-loving buckwheat is highly unlikely to occur at the Site and vicinity.

3.5.2.2 Candidate Species

Western Yellow-billed Cuckoo. The yellow-billed cuckoo is a federal candidate species that is being considered for listing due to loss of riparian habitat from agricultural use, water use, road development, and urban development (USFWS, 2007c). This species was petitioned for listing as threatened or endangered in 1998. Following a status review, the USFWS (2001) found that listing the western Distinct Population Segment (DPS) of yellow-billed cuckoos (including those in Colorado) as threatened was warranted but precluded and the species is currently a candidate species for listing (USFWS, 2009a).

Western yellow-billed cuckoos are considered a riparian obligate species and are usually found in large tracts of cottonwood/willow habitats with dense sub-canopies where they are known to breed. Yellow-billed cuckoos may also occur along narrow and patchy riparian corridors, which provide relatively suitable moist deciduous woodlands within otherwise unsuitable arid vegetation (USFWS, 2007c). The birds inhabit lowland riparian forests and urban areas with tall trees.

Yellow-billed cuckoos are brood parasites by which they occasionally lay eggs in nests of other yellow-billed cuckoos or nests of other bird species (USFWS, 2007c). Clutch size is usually two or three eggs, and development of the young is very rapid, with a breeding cycle of 17 days

from egg-laying to fledging of young. Rapid development of chicks allows them to out-compete other species' young in the parasitized nest.

The western DPS of yellow-billed cuckoos extends from the Continental Divide west including all states west of the Rocky Mountains and extends into southern British Columbia at the northern extent and into the northwestern states of Mexico at the southern limit (USFWS, 2007c). Currently, the range of the cuckoo is limited to disjunct fragments of riparian habitats from northern Utah, western Colorado, southwestern Wyoming, and southeastern Idaho southward into northwestern Mexico and westward into southern Nevada and California (USFWS, 2007c). North American populations of this species have been declining (Andrews and Righter, 1992).

Only one nesting observation was confirmed along the Yampa River near Hayden from 1987 to 1994. Other confirmed nesting attempts during the mid-1980s were associated with outbreaks of caterpillar infestations in box elders in the Four Corners Region/Durango area (USFWS, 2007c).

The bird is an uncommon local summer resident in western valleys, primarily from Mesa County southward. Numbers of this species fluctuate widely from year to year (CDOW, 2009b; Andrews and Righter, 1992). No known population of this species exist within the BLM Grand Junction Field Office or Uncompahgre Field Office areas although there have been a few sightings along the Colorado River corridor in the vicinity of Grand Junction (USFWS, 2007c) and in 1998, 242 miles of lowland river habitat were surveyed in west-central Colorado but only one cuckoo, believed to be one of a nesting pair, was found (USFWS, 2007c). CNHP (2009b) records indicate one occurrence of yellow-billed cuckoo in the state, within La Plata County. There is no suitable habitat for this species within the Site or vicinity, because there are no riparian forests dominated by cottonwoods.

Gunnison's Prairie Dog. Gunnison's prairie dog is a candidate species but only within a portion of their range. In 2004, the USFWS was petitioned to list Gunnison's prairie dog as threatened or endangered under the ESA and to designate critical habitat. The USFWS decided that there was insufficient information to warrant further review but was challenged in court and eventually conducted an additional review of the species' status. In 2008, the USFWS published their finding (USFWS, 2008b) that Gunnison's prairie dogs inhabiting central and south-central Colorado and north-central New Mexico were warranted for listing under ESA. The geographic area included in the finding does not coincide with the Site and Montrose County. Only Gunnison's prairie dogs inhabiting montane habitats - higher elevation, cooler, and moister plateaus, benches, and intermountain valleys - found in the northeastern portion of the species' range in central and southcentral Colorado and north-central New Mexico were included in the finding. However, while the USFWS determined that listing these populations under the ESA was warranted, they noted that listing was precluded by pending actions with higher priorities (USFWS, 2008b).

Gunnison's prairie dogs have inhabited the Site in the past; abandoned burrows (not occupied during the current year) were found within and adjacent to the 80-acre parcel in Section 7 (Township 46 North, Range 17 West). Gunnison's prairie dogs inhabit the Paradox Valley and were observed at two locations near the Site during surveys conducted in August, 2009. One active colony was observed approximately 1 mile east and another larger colony was found approximately 1.5 miles west of the Site (WestWater, 2009).

These populations of Gunnison's prairie dogs are not included in the USFWS' recent finding and would not be considered as candidate species because Gunnison's prairie dog was not found to be threatened or endangered throughout its entire range. Within approximately 60 percent of its range, including Gunnison's prairie dogs in the Paradox Valley, the available habitat and threats (primarily plague) were judged to currently not be sufficient to put the species in danger of extinction (endangered) or make it likely to become endangered within the foreseeable future (threatened) (USFWS, 2008b).

Gunnison's prairie dogs are colonial, similar to other species of prairie dogs and occur in small patchy colonies of fewer than 50 animals (Pizzimenti and Hoffmann, 1973). They have been described as a keystone species of the sagebrush ecosystem by creating habitat, providing food, and their burrowing helps to aerate the soil, add organic matter, and contributes to increased water penetration. Abandoned burrows are used by burrowing owls, weasels, snakes, badgers, and even foxes, and prairie dogs are important prey species for a variety of avian and mammalian predators (USFWS, 2009d).

Indiscriminate poisoning has reduced the species' numbers and range, and they are extremely susceptible to sylvatic plague. Plague has the potential to eradicate a colony within months. However, populations can recover from sylvatic plague epizootics rapidly, depending on females' reproductive and survival rates (Cully, 1997). Another threat to this species is habitat conversion to agriculture and urban developments (CDOW, 2009d). Recreational shooting of prairie dogs is less likely to be a major factor in controlling Gunnison's prairie dogs than black-tailed prairie dogs (*Cynomys ludovicianus*), which occur at much higher densities than Gunnison's prairie dog (Reeve and Vosburgh, 2006). CDOW (2009d) has developed a draft conservation plan to address managing principal threats to Gunnison's prairie dog which include plague, range condition, chemical control, shooting, and oil/gas developments.

Gunnison Sage-Grouse. Gunnison Sage-grouse has been a candidate species for listing under the ESA. In 2000, USFWS (2000b) designated the Gunnison Sage-grouse as a candidate species but in 2006, the USFWS removed the species as a candidate stating that listing was not warranted (USFWS, 2006b). Following the removal, a complaint was filed in District Court in 2006 declaring that the USFWS had violated the ESA in its finding on the Gunnison Sage-grouse. In August 2009, a settlement was reached in which the USFWS agreed to reconsider its 2006 finding and publish a new finding on or before June 30, 2010. Consequently, Gunnison Sage-grouse is discussed here as a former candidate (and potentially, a future candidate species); it has remained a species of special concern in Colorado where it has declined because of habitat loss due to housing and human development, livestock grazing, water diversion projects and increased deer and elk populations; the Colorado Wildlife Commission eliminated hunting in areas occupied by Gunnison Sage-grouse in 2000 (CDOW, 2009e).

Historically, Gunnison Sage-grouse ranged across 15 counties in western Colorado but are now restricted to one large, contiguous population in southern and central Gunnison and northeastern Saguache counties, as well as several much smaller populations sporadically located across Mesa, Montrose, Ouray, San Miguel, and Dolores counties (Braun et al*.,* 1994; Braun, 1995). Threats include habitat loss, fragmentation, and degradation of sagebrush habitats by development, agriculture, and grazing. Populations have declined in some areas due to treatments of sagebrush with herbicides and fire (Braun et al*.,* 1977). Indeed, some areas of sagebrush within the Site have been subject to similar eradication efforts in the past using mechanical control (brush-hogging).

There are seven separate populations of Gunnison Sage-grouse in Colorado and Utah. The Site coincides with San Miguel Basin population for which a conservation plan was finalized in 1998 (San Miguel Basin Sage Grouse Working Group, 1998). The sage grouse area closest to the Site is the Dry Creek Basin/Miramonte area. Results of studies conducted in the area indicate that wintering habitats used from November through March, nesting habitats utilized from April through June, early brood-rearing habitats used by hens with chicks during May and June, and escape cover adjacent to lek sites (used from March through May) were most important to birds in the Dry Creek Basin/Miramonte area (San Miguel Basin Sage Grouse Working Group, 1998). Wintering habitats used from November through March are not limiting in Dry Creek Basin. Leks sites in the area are associated with alkali flats and low sagebrush cover with taller sagebrush (>12 inches) escape cover within 200 yards. Nest sites are generally in taller, dense sagebrush 16 or more inches tall with more than 25 percent canopy cover, while early brood-rearing habitats tend to be in areas dominated by forbs and grasses with less sagebrush cover, associated with conditions often found in drainage channels (San Miguel Basin Sage Grouse Working Group, 1998).

CDOW (2009b) has mapped overall range utilized by the Dry Creek Basin/Miramonte population of Gunnison Sage-grouse. Overall range encompasses all mapped seasonal activity areas within the observed range of the population (CDOW, 2009b). Overall range is approximately 1.5 miles south of the Site. The closest lek, however, is farther than 11 miles south and wintering habitat is 12 miles south of the Site. According to CDOW (2008), the strip of pinyon-juniper vegetation associated with higher elevations south of the Site separates the occupied habitat in the Dry Creek Basin from potentially suitable habitat in the East Paradox Valley. Wintering Gunnison Sage-grouse were observed at the Site as recently as 2002 (CDOW, 2008). However, no sage-grouse or sign (feces, feathers, skeletal material) were observed at the Site during recent surveys conducted in August 2009 (WestWater, 2009) or during four seasonal on-site surveys from August 2007 through May 2008 (Kleinfelder, 2009h).

3.5.2.3 BLM Sensitive Species and State of Colorado Species of Special Concern

In addition to candidate species and species listed as threatened or endangered under the ESA, the BLM and the State of Colorado have identified sensitive animal species and BLM has identified certain plant species as sensitive. Species lists developed by BLM (2000) and Colorado (CNHP, 2009a) were used to determine both the BLM and State's sensitive species for animals and plants that may occur in Montrose or San Miguel counties and BLM's Uncompahgre Field Office (Montrose) and/or Grand Junction Field Office. Species' status, habitat descriptions and species' known distributions within Colorado that have been compiled by CDOW, Natural Diversity Information Source (CDOW, 2009b), and the CNHP (2009a and 2009b) were used to judge whether species' potentially occur at or near the Site, which is included in Table 3.5-8 and ultimately whether they could be potentially affected by construction of the Mill.

Table 3.5-8
Colorado and BLM Sensitive Wildlife Species Not Listed Under the ESA that Could Potentially Occur in the Vicinity of the Site in Montrose County

Common Name Scientific Name	Habitat [1]	Potential Occurrence [2]	Federal Sensitive[3]	State Status[4]	State Rank[5]
Mammals					
Townsend's Big-eared Bat *Corynorhinus townsendii pallescens*	Montane forests, pinyon-juniper woodlands, semi-desert shrublands	Possible	BLM GJ, UN	SC	S2
Spotted Bat *Euderma maculatum*	Ponderosa pine in montane forest, pinyon-juniper woodlands, aspen, semi-desert shrublands	Possible	BLM GJ, UN	S2	S2
Allen's (Mexican) Big-eared Bat *Idionycteris phyllotis*	Mountainous wooded areas; riparian woodland; near rocks	None	BLM UN		S2
Fringed Myotis *Myotis thysanodes*	Ponderosa pine, greasewood, oakbrush, saltbush shrublands	Possible	BLM GJ, UN	-	S3
Yuma Myotis *Myotis yumanensis*	Pinyon-juniper, riparian woodlands near water; roosts in caves, crevices, structures	Possible	BLM GJ, UN		none
Big Free-tailed Bat *Nyctinornops macrotis*	Rocky slopes, canyon lands, roosts in crevices	Unlikely	BLM GJ		S1
Wolverine *Gulo gulo*	Historical and recent sitings at higher elevations with heavy timber	None		SE	S1
Kit Fox *Vulpes macrotis*	Semidesert shrubland and margins of pinyon-juniper woodlands; saltbush, sagebrush, greasewood	Unlikely		SE	S1
Botta's Pocket Gopher *Thomomys bottae*	Agricultural land, grasslands, roadsides, open parklands, pinyon-juniper woodlands, open montane forest, montane shrublands, and semidesert shrublands	Possible		SC	S1
Northern Pocket Gopher *Thomomys talpoides*	Agricultural and pasture lands, semidesert shrublands, and grasslands at lower elevations upwards into alpine tundra	Unlikely		SC	S1
Northern River Otter *Lutra Canadensis*	Riparian habitats that traverse ecosystems ranging from semidesert shrublands to montane and subalpine forests	None		ST	
Birds					
Northern Goshawk *Accipter gentiles*	Forests of aspen, ponderosa pine, lodgepole pine	None	BLM GJ, UN		S3B,S2N
Barrow's Goldeneye *Bucephala islandica*	Winter – reservoirs, rivers Summer – mountain reservoirs, ponds in forests	None	BLM GJ	SC	S2B, SZN
Ferruginous Hawk *Buteo regalis*	Grassland, semidesert shrublands, rare in pinyon-juniper. Nest on isolated structures	Unlikely	BLM GJ, UN	SC	S3B,S4N
Gunnison Sage-Grouse *Centrocercus minimus*	Sagebrush grasslands and areas with herbaceous vegetation	Possible	BLM GJ, UN	SC	S1

Common Name Scientific Name	Habitat [1]	Potential Occurrence [2]	Federal Sensitive[3]	State Status[4]	State Rank[5]
Western Snowy Plover *Charadrius alexandrinus nivosus*	Beaches, dry mud or salt flats, sandy shores of rivers, lakes, and ponds	None	BLM GJ	SC	S1B,SZN
Black Tern *Chlidonias niger*	Reservoirs, lakes, breeding in cattail marshes by open water	None	BLM GJ		S3S4B,SZN
Long-billed Curlew *Numenius americanus*	Short-grass grasslands, wheatfields, dryland agriculture near water	None	BLM GJ, UN	SC	S2B,SZN
White-faced Ibis *Plegadis chihi*	Marsh edges, wet meadows, reservoir shorelines	None	BLM GJ, UN		S2B, SZN
American White Pelican *Pelecanus erythrorhynchos*	Larger reservoirs, breeding on islands in eastern Colorado	None	BLM GJ	SC	S1B,SZN
Columbian Sharp-tailed Grouse *Tympanuchus phasianellus columbianus*	Gambel oak, serviceberry shrublands, sagebrush shrublands, irrigated fields	None		SC	S2
Greater Sandhill Crane *Grus canadensis tabida*	Migrants – mudflats around reservoirs, agriculture, moist meadows, Breeding – parks with grassy hummocks, beaver ponds, natural ponds with willows or aspens	None		SC	S2B,S4N
Bald Eagle *Haliaeetus leucocephalus*	Reservoirs, rivers, wintering in semidesert and grasslands	Present		ST	S1B,S3N
American Peregrine Falcon *Falco peregrinus anatum*	Open conifer forests, riparian forests, and cliffs migrant in western Colorado	Possible		SC	S2B
Western Burrowing Owl *Athene cunicularia*	Grasslands in or near prairie dog towns	Present		ST	S4B
Reptiles					
Longnose Leopard Lizard *Gambelia wislizenii*	Flat or gently sloping, open ground shrublands	Unlikely	BLM GJ, UN	SC	S1
Milk Snake *Lampropeltis triangulum taylori*	Grasslands, sandhills, canyons, open woodlands ponderosa, pinyon-juniper	Unlikely	BLM GJ	SC	S2
Midget Faded Rattlesnake *Crotalus oreganus concolor*	Most terrestrial habitats in west-central Colorado	Possible	BLM GJ	SC	S3
Amphibians					
Boreal Toad *Bufo boreas* pop. 1	Pond margins, wet meadows, riparian areas in subalpine zones	None		SE	S1
Great Basin Spadefoot *Spea intermontana*	Pinyon-juniper woodlands, sagebrush, semidesert shrublands, stream floodplains, canyon bottoms	None	BLM GJ	SC	S3
Northern Cricket Frog *Acris crepitans*	Muddy, marshy edges of ponds, streams, other permanent water	None	BLM GJ	SC	SH
Canyon Treefrog *Hyla arenicolor*	Intermittent streams in deep rocky canyons with pinyon-juniper vegetation	Possible	BLM GJ, UN	SC	S2
Northern Leopard Frog	Margins, banks of marshes, ponds, streams,	Unlikely	BLM	SC	S3

Common Name Scientific Name	Habitat [1]	Potential Occurrence [2]	Federal Sensitive[3]	State Status[4]	State Rank[5]
Rana pipiens	other permanent water		GJ, UN		
Fish					
Colorado River Cutthroat Trout *Oncorhynchus clarkii pleuriticus*	Colorado River drainage, clear mountain streams	None	BLM GJ, UN	SC	S3
Roundtail Chub *Gila robusta*	Colorado River drainage, mostly large rivers, also streams and lakes	None	BLM GJ, UN	SC	S2
Bluehead Sucker *Catostomus discobolus*	Headwater streams to large rivers with moderate velocity, not in standing water	None	BLM GJ, UN	SC	S4
Flannelmouth Sucker *Catostomas latipinnis*	Larger streams and rivers with riffles, eddies, backwaters	None	BLM GJ, UN	SC	S3S4
Invertebrates					
Great Basin Silverspot (Nokomis Fritillary) Butterfly *Speyeria nokomis Nokomis*	Spring-fed meadows, seeps, marshes, boggy streamside meadows with flowing water; bog violets are larval food plants	Possible	BLM GJ, UN		S1
Vascular Plants					
Wideleaf bisquitroot (Canyonlands lomatium) *Aletes (Lomatium) latilobum*	Piñon-juniper, desert shrub, sandy soils from Entrada Formation, 5,000-7,000 feet	None	BLM GJ		S1
Jones Blue Star *Amsonia jonesii*	In runoff-fed draws on sandstone, desert-steppe	None	BLM GJ		S1
Debeque milkvetch *Astragalus debequaeus*	Varicolored, fine-textured, seleniferous, saline soils of Wasatch Formation-Shire Member; 5,100-6400 feet	None	BLM GJ		S2
Starvling milkvetch *Astragalus jejunus*	Rocky hills and ridges, barren hills	None	BLM GJ		S1
Grand Junction milkvetch *Astragalus linifolius*	Pinyon-juniper, sagebrush on Chinle, Morrison Formation. 4,800-6,200 feet	Possible	BLM GJ, UN		S3
Ferron milkvetch *Astragalus musiniensis*	Pinyon-juniper, desert shrub on shale, sandstone, or alluvium; 4,700-7,000 feet	None	BLM GJ		S1
Naturita milkvetch *Astragalus naturitensis*	Pinyon-juniper woodlands, sandstone mesas, ledges, crevices; 5,000-7,000 feet	Likely	BLM GJ, UN		S2S3
Fisher Tower's milkvetch *Astragalus piscator*	Sandy, gypsiferous soils in valley benches, gullied foot hills, 4,300-5,600 feet	None	BLM GJ		S1
San Rafeal milkvetch *Astragalus rafaelensis*	Gullied hills, washes, talus, seleniferous clay, silt, sand, 4,000-6,500 feet	None	BLM GJ		S1
Sandstone milkvetch *Astragalus sesquiflorus*	Banks of sandy clay gulches, in pockets at foot of sandstone outcrops, or among boulders along dry watercourses	Likely	BLM UN		S1
Rocky Mountain thistle *Cirsium perplexans*	Adobe hills derived from shale of Mancos or Wasatch Formation	None	BLM GJ, UN		S1
Osterhout cryptanth *Cryptantha osterhoutii*	Dry barren sites in reddish purple decomposed sandstone, or in dry, sandy soil	None	BLM GJ		S1S2
Kachina daisy	Saline soils in alcoves, seeps, 4,800-5,600 feet	None	BLM		S1

Common Name Scientific Name	Habitat [1]	Potential Occurrence [2]	Federal Sensitive[3]	State Status[4]	State Rank[5]
Erigeron kachinensis			GJ		
Grand buckwheat *Eriogonum contortum*	Mancos Shale badlands, shadscale saltbush, other salt desert shrubs; 4500-5100 feet	None	BLM GJ		S2
Tufted green gentian *Frasera paniculata*	Western Mesa County near Utah border, sandy soils	None	BLM GJ		S1
Narrowstem gilia *Gilia stenothysra*	Silt, loam, gravel soils from Green River/Uinta Formation, 5,000-6,000 feet	None	BLM GJ		S1
Piceance bladderpod *Lesquerella parviflora*	Shale in Green River Formation, ledges, canyon slopes; 6,200-8,600 feet	None	BLM GJ		S2S3
Montrose bladderpod (Good-neighbor bladderpod) *Lesquerella vicina*	Mancos shale between pinyon-juniper woodland and salt desert scrub; sandy soils from Jurassic sandstones; sagebrush steppe; disturbed areas	Unlikely	BLM UN		S1
Colorado Desert Parsley *Lomatium concinnum*	Barren adobe soils derived from shales of Mancos Formation in shrub-dominated communities	None	BLM UN		S1
Paradox Valley Lupine *Lupinus crassus*	Pinyon-juniper woodland; Mancos shale; quaternary alluvium derived from Chinle Formation; sparsely vegetated soil	Likely	BLM UN		S2
Dolores skeleton plant *Lygodesmia doloresensis*	Endemic on benches of Dolores River Valley	Unlikely	BLM GJ, UN		S1
Southwest stickleaf *Mentzelia argillosa*	Steeply sloping and constantly moving talus or scree slopes of the Green River Formation shale	None	BLM GJ		S2
Eastwood monkey-flower *Mimulus eastwoodiae*	Shallow caves, seeps, in canyon walls, 4,700-5,800 feet	None	BLM GJ, UN		S1S2
Paradox breadroot *Pediomelum aromaticum*	Open pinyon-juniper, sagebrush, shadscale zones, on sandy or clay soils, often on the sides of dry washes	Likely	BLM UN		S2

[1] Sources: CNHP, 2009a and 2009b, CDOW, 2009b, Weber and Wittmann, 2001; Andrews and Righter, Fitzgerald et al., 1994, 1992; Hammerson, 1986; Woodling, 1985.
[2] Potential Occurrence:
None: Does not occur within Montrose County and no suitable habitat is present.
Unlikely: May or may not occur in Montrose County but no suitable habitat is present.
Possible: Occurs in Montrose County, suitable habitat is present, but not observed at the Site.
Likely: Occurs In Montrose County, including the Site and/or immediate vicinity.
Present: Observed at or immediately adjacent to the Site and/or occupied habitat includes the Site.
[3] Federal Sensitive: BLM GJ, Grand Junction Field Office; BLM UN, Uncompahgre Field Office.
[4] State Status: SC = State Species of Special Concern, SE= State Endangered , ST = State Threatened.
[5] State Rank: S1= Critically Imperiled, S2= Imperiled, S3= Vulnerable, ranks with “B” indicate status of breeding occurrences.

Mammals. Four of the six species of bats that are included in Table 3.5-8 could occur at the Site. The Townsend's big eared bat (also called the pale lump-nosed bat) roosts in caves, tunnels, mines, and buildings, and can be found in lower elevation pinyon-juniper woodlands (Lyon and Sovell, 2000). In summer, male bats tend to roost as individuals in rock crevices and on walls, separate from the nursery colony (Fitzgerald et al*.* 1994), but in winter, non-migratory individuals roost in colonies. The species' distribution is strongly correlated with the availability of caves and cave-like roosting habitat, including abandoned mines. Population centers occur in areas dominated by exposed, cavity or caverniculous-forming rock and/or historic mining districts. Its habit of roosting pendant-like on open surfaces makes it readily detectable, and it can be the species most readily observed, when present (commonly in low numbers) in caves and abandoned mines throughout its range. There is suitable habitat in abandoned mines in the vicinity of the Site to the southwest. They have been documented by the CNHP (Lyon and Sovell, 2000) along the canyons of the San Miguel and Dolores rivers 7 to 8 miles north of the Site.

The spotted bat occurs in ponderosa pine woodlands, pinyon-juniper woodlands, and open semi-desert shrublands. Colorado is this species eastern-most range, although no breeding records exist in the state (Fitzgerald et al*.* 1994). It has been found roosting in crevices in cliff faces, but little is known about its winter status (Lyon and Sovell, 2000). The Yuma myotis is found in a variety of upland and lowland habitats, including riparian, desert scrub, moist woodlands, and forests, but generally near open water. Foraging is restricted to riparian corridors of the few major rivers. Nursery colonies are in buildings, caves, mines, and under bridges, and when disturbed, are either abandoned or reduced in numbers (Lyon, et al. 1996). CHNP have reported spotted bats and Yuma myotis in Coyote Wash, approximately 9 miles east of the Site (Lyon and Sovell, 2000).

Fringed myotis are known from western Montrose County, including the vicinity of the Site (Fitzgerald et al*.* 1994). The species commonly occupies oak and pinyon woodlands as well as Douglas-fir and ponderosa pine forests; mines, caves, and buildings provide roost sites (Adams, 2003). There are no records of fringed myotis in the vicinity of the project. Two unidentified bats were observed during spotlight surveys conducted at the Site during September 2007 (Kleinfelder, 2009h).

Suitable habitat does not exist at the Site for either the kit fox or for wolverines (Table 3.5-8). Both species are classified as endangered in Colorado. CNHP records indicate wolverines have been documented in eastern San Miguel County and kit fox have been observed in Mesa and Garfield counties, north of the Site. Likewise, northern river otters are classified as threatened in Colorado. They were present in most major drainages historically, but have been reintroduced from diverse geographic locations in North America since 1976 and have become established in the Dolores River and San Miguel River (Boyle, 2006). They are not expected to occur within the Site.

Botta's pocket gopher is a medium-sized rodent. The Botta's pocket gopher occurs in southern Colorado, where several local races have evolved (Fitzgerald et al*.,* 1994). This species can be found in a variety of vegetation types, including agricultural, grassland, along roadsides, parks, pinyon-juniper woodlands, open montane forest, montane shrublands, and semidesert shrublands. Northern pocket gophers are found in many different habitat types including agricultural and pasture lands, semidesert shrublands, and grasslands at lower elevations upwards into alpine tundra. Although there is suitable habitat at the Site for both species, neither was observed during surveys conducted in 2007 and 2008 (Kleinfelder, 2009h).

Birds. There are 14 bird species included in Table 3.5-8 that have been identified as sensitive species by the BLM GJFO or the BLM Uncompaghre Field Office, or are a protected species in Colorado. However, only four of the species are believed to possibly occur within the Site: Gunnison Sage-grouse, bald eagle, American peregrine falcon, and western burrowing owl. Gunnison Sage-grouse is a special status species that has been observed in the past in the project vicinity. Gunnison Sage-grouse was discussed above as a candidate species for listing under the ESA.

Two bird species that were removed from the list of threatened and endangered species may occur in the vicinity of the Site: the bald eagle and American peregrine falcon. Bald eagles are listed as threatened by the State of Colorado and as a sensitive species by the BLM. The USFWS proposed to remove the bald eagle from the list of endangered and threatened wildlife in 1999 because the bald eagle's population growth had exceeded most goals established in various recovery plans (USFWS, 1999a). The USFWS reopened the public comment period on February 16, 2006 (USFWS, 2006c), and on August 8, 2007, the bald eagle was delisted (USFWS, 2007d). Although no longer listed as threatened under the ESA, bald eagles remain protected under the Bald and Golden Eagle Protection Act (BGEPA) (16 USC 668-668d) and the Migratory Bird Treaty Act (MBTA) (16 USC 703-712). The BGEPA prohibits "take" of bald and golden eagles, which includes pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest, or disturb (50 CFR § 22.3). The USFWS defines "disturb" as "to agitate or bother a bald or golden eagle to the degree that it interferes with or interrupts normal breeding, feeding, or sheltering habits, causing injury, death, or nest abandonment" (USFWS, 2006c).

Historically, fewer than four pairs of bald eagles nested in Colorado; nesting has increased steadily since the 1980's to 38 confirmed nests in 1995 (Winternitz, 1998), and bald eagles are commonly observed throughout the state during winter. The annual midwinter count shows a stable population of 600 to 800 eagles (Lyon and Sovell, 2000). The entire Site and wider area vicinity is identified as bald eagle winter range (CDOW, 2009b), areas where bald eagles have been observed between November 15 and April 1. A winter concentration area is present along the San Miguel River, approximately 6.5 miles east of the Site. Communal bald eagle winter roosts are also located along the San Miguel River 8 miles east of the Site and about 12 miles northwest of the Site on a tributary to West Paradox Creek near Paradox. Communal winter roosts are usually in groups of trees or individual trees that provide diurnal and/or nocturnal perches for less than 15 wintering bald eagles, and include a buffer zone extending 0.25-mile around these sites. These trees are usually the tallest available trees in the wintering area and are primarily located in riparian habitats (CDOW, 2009b). A bald eagle was observed passing through the Site along Highway 90 during the on-site survey in winter 2008, but no suitable habitat for foraging or nesting was observed (Kleinfelder, 2009h).

American peregrine falcons are a species of concern in Colorado. The peregrine falcon was classified as an endangered species under the Threatened and Endangered Species Act of 1973. With the banning of DDT and other chlorinated hydrocarbons and successful captive breeding, rearing, and release of over thousands of peregrines annually, USFWS (1999b) determined that the species had recovered and removed peregrine falcons from the list of Threatened and Endangered Species in 1999. Primary threats include environmental toxins, habitat loss, human disturbance, and illegal take. The recovery objectives established for the species when it was listed under ESA have been met in most areas, and the bird is widely distributed. In Colorado, through intensive reintroduction efforts over the past 17 years, more than 300 peregrines have been released in various locations throughout the state. Throughout the 1990's, Colorado has had approximately 24 breeding pairs, including nest sites in Paradox Valley and Slick Rock Canyon along the Dolores River that were active in 1999 (Lyon and Sovell, 2000). There are nine active peregrine falcon eyries within an approximate 20 mile

radius from the Site, primarily on cliffs in the Dolores River Canyons upstream and downstream from the project site. The closest eyrie is 4 miles away near the confluence of East Paradox Creek and the Dolores River.

Western burrowing owls are classified as threatened in Colorado. The western burrowing owl is one of the smallest species of owls. They typically inhabit open, dry grasslands and semidesert shrublands, usually near prairie dog colonies (Andrews and Righter, 1992) and occupy the abandoned underground burrows of other animals, such as ground squirrels, rabbits, or prairie dogs. They can dig their own burrows, but usually prefer the deserted excavations of other animals. The owls commonly perch on fence posts or on top of mounds outside their burrows. Western burrowing owls typically arrive on breeding grounds in Colorado in late March or early April, with nesting beginning a few weeks later.

Western burrowing owl surveys were performed by Kleinfelder (2009h) in 2007 in accordance with the CDOW's wildlife survey protocol (CDOW, 2007). Western burrowing owl surveys are conducted between March 15 and October 31. Active nesting and fledging has been recorded and may be expected from late March through early August (CDOW, 2007). Adults and young may remain at nesting grounds until migrating to wintering grounds in late summer or early autumn (CDOW, 2007). Western burrowing owl are active throughout the day; however, peaks in activity in the morning and evening make these the best times for conducting surveys (Conway and Simon, 2003).

Surveys for owls were conducted in the early morning (one half hour before sunrise until two hours after sunrise) and early evening (two hours before sunset until one half hour after sunset). To increase the likelihood of detecting western burrowing owl, if present, call-broadcast methods are used in western burrowing owl surveys. Conway and Simon (2003) detected 22 percent more western burrowing owls at point-count locations by broadcasting the primary male (*coo-coo*) and alarm (*quick-quick-quick*) calls during surveys. Although call-broadcast may increase the probability of detecting western burrowing owl, most owls will still be detected visually (CDOW, 2007).

Kleinfelder (2009h) reported that western burrowing owls were observed adjacent to the Site during Spring 2008. Three owls responded to call-broadcasts. They were apparently between one-eighth mile and one-half mile west to southwest of the observation point (call-broadcast point), off the Site but in the vicinity of the 80-acre parcel in Section 7 (Township 46 North, Range 17 West). No prairie dog burrows were observed on the Site in 2008 (Kleinfelder, 2009g). WestWater (2009) searched the 80-acre parcel in August 2008 and found abandoned burrows (not occupied during the current year) of Gunnison's prairie dog in the same vicinity as the burrowing owl locations reported the year before. No burrowing owls or sign of owls were seen in any of the burrows (WestWater, 2009) but, based on their response to call-broadcasts, they may have been present on the 80-acre parcel in 2008.

Gunnison's prairie dogs have inhabited the Site in the past; abandoned burrows (not occupied during the current year) were found within and adjacent to the 80-acre parcel in Section 7 (Township 46 North, Range 17 West) (WestWater, 2009). These abandoned burrows were apparently occupied by western burrowing owls; three western burrowing owls in the vicinity of the abandoned burrows were heard broadcasting in response to the CDOW call-broadcast compact disc during surveys in May 2008 (Kleinfelder, 2009h).

Reptiles. Based on their known distributions within the state (Hammerson, 1986; CDOW, 2009f), neither the longnose leopard lizard or milk snake are known within western Montrose County and there are no county records of either species in the CNHP (2009b) element

database. However, midget faded rattlesnakes have been documented in proximity to the Site. Midget faded rattlesnakes are primarily found on the ground, but will occasionally climb into trees and shrubs, and are often associated with upland pinyon-juniper woodlands. When inactive during cold weather, individuals occupy mammal burrows, crevices, or caves, where they sometime congregate in large numbers. This subspecies ranges from southern Wyoming and eastern Utah south to the Four Corners area (Stebbins, 1985). Colorado is at the eastern margin of the subspecies' range where it occurs in Mesa, Delta, Garfield, Montrose, and San Miguel counties. There are no rangewide estimates available; however, midget faded rattlesnakes are visibly common in much of west central Colorado (Lyon and Sovell, 2000). Although suitable habitat for the species is present within the Site, none were observed during surveys conducted in 2007 and 2008 (Kleinfelder, 2009h).

Amphibians. Four amphibian species are included in Table 3.5-8 as BLM-sensitive species and species of special concern in Colorado. A fifth species, the boreal (or western) toad, is classified as endangered in Colorado, but the species does not occur in southwestern Colorado, including Montrose County (Hammerson, 1986; CDOW, 2009f, CNHP, 2009b). The Great Basin spadefoot has been documented in Mesa County and sporadically observed in counties north of Mesa County. Northern cricket frogs (once present in northeastern Colorado) have not been seen in Colorado since 1979, and may be extirpated in the state (CDOW, 2009f).

Northern leopard frogs were locally common throughout most of Colorado, but are now rare or extirpated in many areas, particularly in the mountains (CDOW, 2009f). Reasons for population declines are not known but appear to be complex, related to habitat loss or degradation and interactions with non-native species, particularly bullfrogs (Lyon and Sovell, 2000). Mortality from bacterial infection such as red-leg disease (Brodkin, 1992) may be contributing to their decline. Most location records in Colorado are below 11,000 feet elevation and the population in the state is estimated to be between 3,000 and 10,000 individuals (Lyon and Sovell, 2000). They have been reported along the San Miguel River upstream from the confluence with the Dolores River and near Utah in the headwaters of West Paradox Creek (CDOW, 2009f). They could occur within East Paradox Creek and the small stock pond or retention pond located in the southeastern corner of the Site, but none were observed during any of the on-site surveys conducted during 2007 and 2008 (Kleinfelder, 2009h), or in 2009 (WestWater, 2009).

Canyon treefrogs are fairly common in restricted habitats of west-central and southwestern Colorado where they occur only along rocky stream courses in canyons. There are no quantitative data on population size or trends. They feed in pools along intermittently flowing streams, primarily from April to June, but may breed after heavy summer rains. Larvae metamorphose into small frogs as early as late July. Adults may be found basking on rocks and they may hide in rock crevices (CDOW, 2009f). Of 32 observations for the species, four are from western Montrose County in the Dolores River drainage and its side canyons (Lyon and Sovell, 2000), approximately 6 to 7.5 miles west of the Site. There is no suitable habitat for the species within or near the Site and none were observed during any of the on-site surveys conducted during 2007 and 2008 (Kleinfelder, 2009h), or in 2009 (WestWater, 2009).

Fish. None of the four fish species that are of special concern in Colorado and BLM-sensitive species (Grand Junction and Uncompaghre field offices) occur within the Site (Table 3.5-8); none of the drainages on-site provide habitat for any of the species. However, the flannelmouth sucker has been reported in the Dolores River near the confluence with East Paradox Creek and is found throughout the Dolores River from Slick Rock downstream to the Montrose-Mesa county line (Lyon and Sovell, 2000). The roundtail chub is similarly distributed in the Dolores River (Lyon and Sovell, 2000) and generally occurs in the Colorado River mainstream and its larger tributaries, including the White, Yampa, Dolores, San Juan, and Gunnison rivers

(Woodling, 1985). Bluehead suckers have not been reported from or sampled in Montrose County, although they are generally found throughout the middle and upper Colorado River Drainage in Colorado, New Mexico, Arizona, Utah, and Wyoming (CDOW, 2009b). Bluehead suckers inhabit a variety of habitats from headwater streams to large rivers. Within Montrose County, Colorado River cutthroat trout are present in Red Canyon, a tributary to Horsefly Creek, which is a tributary to the San Miguel River. The trout are also present in the Dry Creek drainage, a tributary to the Uncompaghre River in western Montrose County. The Colorado River cutthroat trout is also present in the Dolores River headwaters (hydrologic unit 1403000202), but not downstream at the Site and vicinity.

Invertebrates. One invertebrate species identified as sensitive by the BLM, the Great Basin silverspot butterfly (also called the Nokomis fritillary butterfly), occurs within Montrose County. It has been recorded at least 7 miles west of the Site, and colonies documented in the past have been verified in Montrose County (Selby, 2007). In western Colorado, Great Basin silverspot butterfly populations are associated with spring-fed and/or subirrigated wetlands below 7,500 feet, meadows interspersed with willows and other woody wetland species, and depend on northern bog violets (*Viola nephrophylla*) as the larval host (Selby, 2007). No suitable habitats are present within the Site but, given the proximity of the species, it could occur while in pursuit of adult food sources during the adult flight period. Adult Great Basin silverspot butterflies utilize a variety of plant species as nectar sources, but thistles are strongly favored; they apparently prefer blue- and yellow-flowered composites. Documented nectar sources include native and introduced thistles (including *Cirsium*, *Carduus*, and *Onopordon* spp), horsemint (*Agastache*), and joe pye weed (*Eupatorium maculatum*) (Selby, 2007). Several introduced thistles including Canada thistle (*Cirsium arvense*), plumeless thistle (*Carduus acanthoides*), and musk thistle (*Carduus nutans*) have been documented in the project vicinity (see Sections 3.5.1.2 and 3.5.1.3, Vegetation and Invasive Non-Native Species) and could be utilized as nectar sources.

It should be noted that another fritillary butterfly, the Uncompahgre fritillary, is listed under the ESA as endangered but only occurs in the San Juan Mountains and southern Sawatch Range at elevations above 13,200 feet in Gunnison, Hinsdale, and possibly Chaffee counties in southwestern Colorado (USFWS, 1991b).

Vascular Plants. There are 24 species of vascular plants included in Table 3.5-8 that have been identified by the BLM as sensitive by the GJFO and/or by the Uncompaghre Field Office. Reported distributions for 13 of the species do not include Montrose County and habitats for six other species are not found within or adjacent to the Site including Rocky Mountain thistle, Osterhout cryptanth, grand buckwheat, Montrose bladderpod (or Good-neighbor bladderpod), Colorado desert parsley, and Eastwood monkey-flower. The five remaining species in Table 3.5-8 have been judged as likely or possible to occur within the Site: Grand Junction milkvetch, naturita milkvetch, sandstone milkvetch, Paradox lupine (Payson lupine), and Paradox breadroot.

Grand Junction milkvetch is usually found associated with pinyon and juniper on sandy or clay soils derived from the Morrison Formation, between 4,800 and 6,200 feet. Associated species include Indian rice grass, hairy golden aster, low rabbitbrush, and broom snakeweed (Lyon and Sovell, 2000) some of which occur within the Site (Section 3.5.1.2, Vegetation). Grand Junction milkvetch is usually found on the eastern side of the Uncompahgre Plateau, but specimens were collected in the vicinity of Uravan (Lyon and Sovell, 2000) approximately 7 to 9 miles north of the Site. However, the specimens may be of another, closely related species (San Rafael milkvetch, *Astragalus rafaelensis*) and there is some debate whether the two species are one (Lyon and Sovell, 2000). No Grand Junction milkvetch were detected during any of the on-site surveys conducted during 2007 and 2008 (Kleinfelder, 2009g), or in 2009 (WestWater, 2009).

Naturita milkvetch has been found along the Dolores River Canyon and multiple other sites from 6 to 10 miles southwest of the Site (Lyon and Sovell, 2000). The species is found in pinyon-juniper woodlands and in areas with shallow soils over exposed bedrock, though usually it occurs in small soil pockets or rock crevices in sandstone pavement along canyon rims. Sometimes it is found nearby in deeper sandy soils with or without soil crusts. The milkvetch seems to tolerate and even thrive on some disturbance such as sites around power poles and in the compacted tracks of dirt roads (Lyon and Sovell, 2000). A third species of milkvetch, the sandstone milkvetch, has been documented historically in the Paradox area, and it has been found recently in the Dolores River Canyon downstream from Uravan and the confluence of the San Miguel River (Lyon and Sovell, 2000). Sandstone milkvetch grows on sandstone ledges and crevices of slickrock pavement. Associated species usually include pinyon, juniper, large-flowered breadroot (*Pediomelum megalanthum*), yucca, and prickly pear cactus (Lyon and Sovell, 2000). Although some of these species' associates are present within the Site, no Naturita milkvetch or sandstone milkvetch were detected during any of the on-site surveys conducted during 2007 and 2008 (Kleinfelder, 2009g), or in 2009 (WestWater, 2009).

Two species in Table 3.5-8 most likely to be present within the Site are Paradox lupine (also Payson lupine) and Paradox breadroot. Paradox lupines have been found in pinyon-juniper woodlands at the base of sandstone cliffs adjacent to East Paradox Creek north of the Site, and large populations of Paradox breadroot have been found there, as well as in the bottoms and sides of washes downstream from the lupine populations. Both species grow in soils derived from the Chinle Formation (Lyon and Sovell, 2000). Paradox lupine also occurs extensively on the opposite side (south side) of the East Paradox valley on the slopes of Davis Mesa, which are contiguous with the south slopes at the Site. Those slopes were designated a Potential Conservation Area (PCA) by CNHP (Lyon and Sovell, 2000) and begin approximately 0.7 mile northwest of the Site. The Davis Mesa Slopes PCA follows the distinct pinyon-juniper zone, but does not include the steep cliffs above the sagebrush flats on the valley floor, below (Lyon and Sovell, 2000). The following describes the PCA and locations where Paradox lupine have been found (Lyon and Sovell, 2000 page 124):

> "Davis Mesa Slopes PCA is located on the south side of Paradox Valley, at the base of the pinyon-juniper hillside. The area includes both private and BLM land. An unimproved road and a powerline run through the PCA. Thousands of individuals of Payson lupine were found in the pinyon-juniper woodland on soils derived from the Chinle Formation. The plants were particularly abundant in dry washes, and were even found in the middle of the dirt road. Adjacent sagebrush flats do not support the lupine."

Paradox breadroot were not noted within the Davis Mesa Slopes PCA (Lyon and Sovell, 2000), and neither species was reported from any of the on-site surveys conducted during 2007 and 2008 (Kleinfelder, 2009g), or in 2009 (WestWater, 2009).

3.5.3 Wildlife

3.5.3.1 Terrestrial Wildlife Species

Introduction. Numerous wildlife species are recreationally valuable to the public as game species and are known to occur or could occur within Montrose County and in the vicinity of the Site. As such, those species have been classified as "important" by the NRC in Regulatory Guide 3.8, Section 2.9 (NRC, 1982a). Categories of such species included Big Game, Small Game, Waterfowl, and Game Birds. In addition to game species, there are many species likely to affect the well-being of other "important species" through food chains and other interspecies relationships, and may contribute to predictions or evaluations of the impact of the facility on the regional biota. Those species include Neotropical migratory birds and a wide variety of

terrestrial non-game species. Non-game species are protected in Colorado under the Nongame, Endangered, or Threatened Species Conservation Act (CRS §33-2-101-108) and are included here under the designation of "important" species. To the extent that information is available, species that are known to occur or that could potentially occur, including their seasons of occurrence, estimates of abundance, local flight patterns, and critical habitats, are discussed to describe the ecological setting of the project area, as required by the NRC in NUREG-1748 (NRC, 2003a).

Species Surveys. On-site surveys were conducted on multiple dates during four seasons: 1) Summer (August 20, through August 24, 2007); 2) Fall (September 18 and 19, 2007); 3) Winter (January 16 and 17, 2008); and 4) Spring (May 19 and 20, 2008) by Kleinfelder (2009h). Surveys were confined to the 880-acre Site. An additional 80-acre parcel for the well field, was examined by WestWater on August 24, 2009 (WestWater, 2009).

Surveys for wildlife, wildlife habitat, and migratory birds were conducted during 2007 and 2008 (Kleinfelder, 2009h). Diurnal pedestrian surveys were conducted along transects and the presence of wildlife and/or their sign was documented. Night-time observation points were located at each corner of the Site and one in the middle of the Site. Nocturnal surveys were conducted during the Fall, Winter, and Spring seasons. A bird survey was conducted each season using point count survey techniques.

In addition to on-site surveys, much of the following information about species and their potential occurrence on-site was obtained from databases that have been developed by the Colorado Division of Wildlife Natural Diversity Information Source (CDOW, 2009f) and game species harvest reports and big game population estimates (CDOW, 2009g) including spatial data provided in GIS formats. In addition, relevant state and federal agency reports and published literature and databases were reviewed, compiled, analyzed, and synthesized to develop the species' profiles provided in these sections to supplement results of on-site surveys.

Big Game. The Site coincides with Game Management Unit (GMU) 70. Mule deer (*Odocoileus hemionus*), elk (*Cervus elaphus*), black bear (*Ursus americanus*), and cougar (*Felis concolor*) are all big game species hunted within GMU 70. GMU 70 is part of a larger area, a Data Analysis Unit or DAU, which is a combination of one or more GMUs that represent a relatively discrete herd or population. Although the geographic area covered by a GMU is the same for each of the species, areas associated with DAUs are different for each big game species. A resident population of pronghorn (*Antilocapra americana*) also occurs within GMU 70, but no occupied pronghorn range coincides with the Site. The closest pronghorn range is over 4 miles south of the Property boundary, in the Dry Creek Basin. However, access routes from mines to the mill pass through pronghorn winter habitats.

The Site is entirely within mule deer overall range, mule deer winter range, and mule deer severe winter range. CDOW (see mule deer metadata in CDOW, 2009b) defines severe winter range as an area that supports 90 percent of the animals when annual snow depths are maximal and/or temperatures are minimal in two worst winters out of ten. Access to the Site on SH 90 from its junction with SH 141 west of Naturita is through a mule deer winter concentration area until 2.4 miles east of the Site. In addition, most of the access to the Site on SH 141 and SH 145 in Montrose County is through mule deer winter concentration areas, and all access routes, even those within Mesa and San Miguel counties, pass through extensive portions of mule deer winter range.

Winter concentration areas are parts of winter range where densities of animals are at least 200 percent greater than the surrounding winter range densities during an average of five winters out of ten. The CDOW has mapped approximate 4.6 miles of SH 90 where it passes through the winter concentration area, which corresponds to an area where mule deer traditionally cross the road (a mule deer road crossing area) presenting potential conflicts between mule deer and motorists (CDOW, 2009b). The Site does not coincide with mule deer summer range although much of the access to the Site along SH 141 west of Naturita passes through summer range. Mule deer tracks were observed in the project area during surveys conducted in January 2008 (Kleinfelder, 2009g).

GMU 70 is within Mule Deer DAU 24 along with two other, adjacent GMUs, 711 and 71, which both extend south into Montezuma County. CDOW (2009b) estimated the post-hunt mule deer population within DAU 24 in 2008 at 27,160 deer (Table 3.5-9). Population estimates by CDOW since 2004 appear to indicate a declining mule deer population within DAU 24, but the declining linear trend is not statistically significant (P>0.10).

Table 3.5-9
Population Estimates for Mule Deer and Elk
DAUs and Harvest in GMU 70 in the Vicinity of the Site, 2004 to 2008[1]

Big Game Year	Data Analysis Unit Post-Harvest Population Estimates	Big Game Harvest in Game Management Unit 70			
		Total Harvest	Total Hunters	Total Recreation Days	Average Days per Animal Harvested
Mule Deer	**Deer DAU 24**				
1999	no estimate	916	2,064	7941	8.7
2000	no estimate	1,077	2,107	8828	8.2
2001	no estimate	518	1,281	5394	10.4
2002	no estimate	593	1,053	4032	6.8
2003	no estimate	574	1,055	4,601	8.0
2004	32,560	721	1,129	4,513	6.3
2005	33,740	771	1,160	4,557	5.9
2006	36,710	842	1,230	6,121	7.3
2007	29,680	1,261	1,838	7,559	6.0
2008	27,160	1,373	2,016	9,351	6.8
Elk	**Elk DAU 24**				
1999	no estimate	702	3,162	17,519	25.0
2000	no estimate	1,155	3,927	18,485	16.0
2001	no estimate	872	2,916	13,548	15.5
2002	no estimate	1,074	2,942	13,603	12.7
2003	no estimate	1,262	3,275	15,349	12.2
2004	18,270	1,194	3,389	15,957	13.4
2005	15,160	1,378	4,013	19,382	14.1
2006	18,460	1,458	4,517	23,218	15.9
2007	19,760	1,306	4,193	21,378	16.4
2008	19,530	1,267	4,475	23,348	18.4

[1] Source: CDOW, 2009g.

There are no population estimates over time for mule deer in GMU 70. However, CDOW has provided harvest estimates for mule deer in the GMU since 1999. Among the many statistics available are estimates of total mule deer harvested per year and the total recreation days spent by hunters each year. The two data sets combined were used to derive an estimate of the average number of days hunters spent to harvest a mule deer each year since 1999 (Table 3.5-9). The estimate is an index, similar to a catch-per-unit-effort (CPUE) index often used in fisheries to track population change over time (Ricker, 1975; Malvestuto, 1983); with the assumption that many variables remain constant from year to year, the less time it takes to harvest a deer indicates a higher deer density and larger the population. Though there is

considerable year-to-year variation, the average number of days required to harvest a mule deer within GMU 70 appears to have been decreasing since 1999 (Figure 3.5-3), which may be interpreted as an increasing number of mule deer during that time in GMU 70, but perhaps not within the more-encompassing DAU 24.

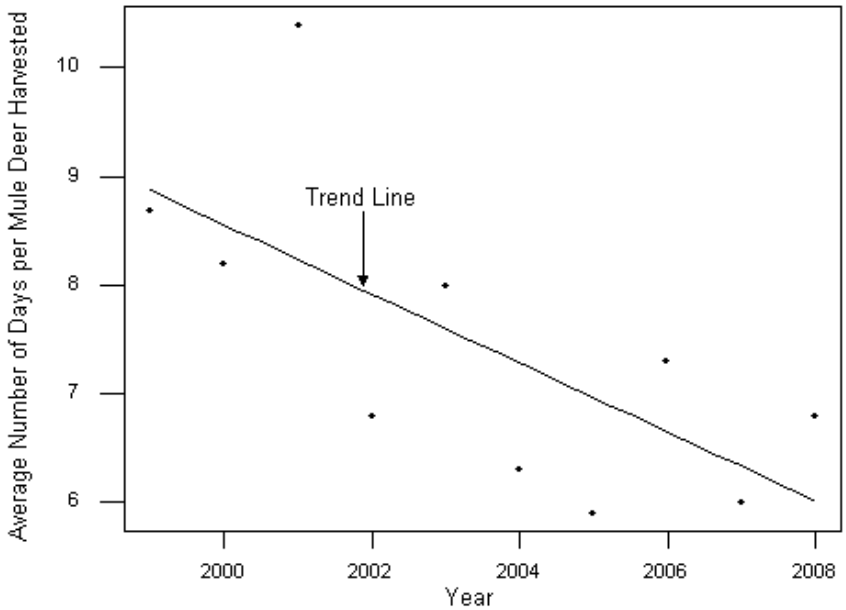


Figure 3.5-3
Trend for Harvest of Mule Deer per Unit Effort (Days per Deer Harvested) in GMU 70 Since 1999 (r^2 = 0.467, P = 0.029)
Source: CDOW, 2009b

In 2008, 1,373 male mule deer were harvested in GMU 70 (Table 3.5-9); 2,016 hunters spent 9,351 recreational days to harvest the 1,373 bucks, averaging 6.8 days per deer harvested in 2008. In 1999, hunters spent an average of 8.7 days per mule deer harvested (7,941 recreational days to harvest 916 mule deer) in GMU 70. The shorter amount of time required to harvest each deer in 2008 is consistent with an increasing population since 1999 (Table 3.5-9).

Similar to mule deer, elk in the vicinity of the Site utilize the entire Site as winter range and as severe winter range. In addition, a small area (1,341 acres) of elk winter concentration range coincides with most of the Site. As with mule deer, elk winter concentration areas are parts of winter ranges where densities of animals are at least 200 percent greater than the surrounding winter range densities during an average of five winters out of ten. All of the access routes in Montrose County and most of the access to the Site through Mesa and San Miguel counties on SHs 90, 141, and 145, pass through elk winter range and elk severe winter ranges. No elk summer range is in the project vicinity, although a small resident herd of elk utilizes an area about 5.5 miles northwest of the Site, in the vicinity of Bedrock. Elk tracks were observed in the project area during January 2008 surveys and one cow elk was seen during the May 20, 2008 survey (Kleinfelder, 2009h).

Elk are also harvested within GMU 70; however, elk in GMU 70 are within Elk DAU 24, which encompasses five GMUs and extends from Montrose County south, to Montezuma County and the borders with Utah and New Mexico, a much larger geographic area than Mule Deer DAU 24. The post-hunt elk population in DAU 24 was 19,530 in 2008, an increase from 18,270 elk in 2004 (Table 3.5-9). However, there is no statistically significant trend in the elk population over time (P>0.10). Likewise, there is no apparent trend in the average number of days spent by

hunters to harvest an elk in GMU 70 since 1999 (Table 3.5-9). In 2008, a total of 1,267 elk (666 bulls, 563 cows, and 38 calves) were harvested by all means in GMU 70. A total of 4,475 hunters spent 23,348 recreation days to harvest that many elk for an average of 18.4 days per elk harvested (Table 3.5-9).

The entire Site coincides with habitats utilized by black bears (black bear overall range). An area coinciding with most of Naturita (approximately 10 miles from the Site) is one of recurrent human conflicts with black bears, where two or more confirmed black bear complaints per season were received resulting in CDOW investigations, damage to persons or property (cabins, tents, vehicles, etc), and/or the removal of the problem bear(s) (CDOW, 2009b). The Site is within cougar (mountain lion) overall range, but no conflict areas with cougars have been delineated in Naturita, although scattered incidences of conflicts have occurred in the vicinity of the Site, including near the town of Paradox. No observations of black bear or cougar or their sign were reported during on-site wildlife surveys (Kleinfelder, 2009h; WestWater, 2009).

Harvest of black bears within GMU 70 has been variable since 2000, ranging from 23 in 2002 to 5 in 2004. Fourteen boars and four sows were harvested in GMU 70 in 2008, while nine boars and five sows were harvested in 2007. Likewise, harvest of cougars in the GMU ranged from 13 in 2008 to 5 in 2002 (CDOW, 2009g).

Small Game. Small game includes a variety of mammal and bird species. Harvest is compiled by county rather than by GMU. Furbearers are classified as small game and include bobcat (*Lynx rufus*), striped skunk (*Mephitis mephitis*), beaver (*Castor canadensis*), coyote (*Canis latrans*), red fox (*Vulpes vulpes*), and raccoon (*Procyon lotor*), all of which have been harvested within Montrose County. Other mammals harvested as small game within Montrose County include desert cottontail and mountain cottontail (*Sylvilagus audubonii* and *S. nuttallii*, respectively), jackrabbits (*Lepus californicus* and/or *Lepus townsendii*), snowshoe hares (*Lepus americanus*), squirrels (pine squirrel – *Tamiasciurus hudsonicus*, and Abert's squirrel – *Sciurus abertii*), marmots (*Marmota flaviventris*), and prairie dogs (*Cynomys* sp.). Numerous bird species are harvested as small game in Montrose County, including ring-necked pheasants (*Phasianus colchicus*), chukar (*Alectoris chukar*), Gambel's quail (*Callipepla gambelii*), bobwhite quail (*Colinus virginianus*), blue (dusky) grouse, (*Dendragapus obscurus)* and mourning doves (*Zenaida macroura*), but only those included in Table 3.5-10 were identified as harvested in Montrose County during the 2007-2008 harvest year and, based on their distributions, are likely to occur in or near the Site to provide a comparison of harvest effort among the various species.

Table 3.5-10
Comparative Harvest of Small Game Species
within Montrose County during the 2007-2008 Harvest Year[1]

Small Game	Total Harvest	Total Hunters	Total Recreation Days	Average Days per Animal Harvested
Mammals				
Cottontail	2,235	362	2,291	1.0
Coyote	777	404	2,616	3.4
Birds				
Blue Grouse	738	332	1,409	1.9
Mourning dove	2,535	167	725	0.3
Pheasant	179	120	374	2.1
Bobwhite Quail	30	15	15	0.5

[1] Source: CDOW, 2009g.

Cottontail rabbits were the most hunted small game mammals, although more recreational days were spent harvesting coyotes in 2007-2008. Harvest of other small game mammals was not

reported. Coyotes, cottontails, and black-tailed jackrabbits were seen on-site during summer 2007 and spring 2008 surveys, and cottontails and jackrabbits were present on-site during fall 2007 and winter 2008 surveys, as well (Kleinfelder, 2009h). Coyote and bobcat tracks were observed in damp soil in the vicinity of a recent well drilling site on the property during August, 2009. Bobcats have been harvested in Montrose County but harvest data has not been reported since 2002-2003. Desert cottontail and black-tailed jackrabbit were also observed during the August 2009 survey (WestWater, 2009).

Mourning doves were by far the most harvested game bird species in Montrose County in 2007-2008. Mourning doves occur within the project area; however, other harvested bird species in Table 3.5-10 are not expected; two mourning doves were observed on-site during summer 2007 and four were reported during spring 2008 surveys (Kleinfelder, 2009h). Mourning doves were also seen on-site in August 2009 (WestWater, 2009).

Waterfowl and Turkeys. Ducks, geese, and swans are classified as waterfowl rather than small game. Western Colorado and the Site are within the Pacific Flyway, though there may be some intermingling with waterfowl migrations along the Central Flyway (Bellrose, 1980 and Flyways, 2009). Harvest data for light geese are compiled on a statewide basis by CDOW. In 2008, 5,228 light geese were harvested south of Interstate-70 and 8,508 were harvested north of Interstate-70; all harvest reports in the state were for areas east of Interstate-25 (CDOW, 2009g). No waterfowl harvest specifically within western Colorado has been reported. Suitable habitat for most waterfowl is limited to the Dolores River and possibly the small impoundment at the Site. CDOW (2009g) has defined riparian zones along the San Miguel and Dolores rivers as snow goose (*Chen caerulescens*) production areas in which nesting and brooding geese occur, and as snow goose winter range used by geese from November 1 through March 1 for winter loafing, resting, and foraging (see geese metadata in CDOW, 2009b). The northern Paradox Valley, approximately 8.5 miles northwest of the Site, which includes multiple tributaries to West Paradox Creek, is mapped as winter range, production areas, and snow goose foraging habitat.

Merriam's turkey (*Meleagris gallopavo*) is in its own harvest category. CDOW (2009b) has mapped seasonal habitats occupied by Merriam's turkey but the Site does not coincide with any. Overall range occupied by turkeys is found along the Dolores River corridor downstream from the confluence with the San Miguel River. Access to the Site on SHs 141 and 145 passes through turkey overall range. No observations of waterfowl or turkeys or their sign were reported during on-site wildlife surveys (Kleinfelder, 2009h).

Migratory Birds. The Migratory Bird Treaty Act (MBTA) of 1918, as amended, implements treaties for the protection of migratory birds. The Act prohibits hunting, taking, capturing, killing, possessing, selling, purchasing, shipping, transporting, or exporting migratory birds, parts, nests, and eggs, covered by the Act. Non-native birds are not covered by the MBTA.

Executive Order (EO) 13186 issued in 2001 directs actions that would further implement the MBTA. This includes requiring federal agencies to develop a Memoradum of Understanding (MOU) with the USFWS through which each agency would promote the conservation of migratory bird species. As of late 2007, the BLM had not established a national MOU with the USFWS but had developed interim guidelines to consistently address migratory bird populations and habitats until a MOU is in place (BLM, 2007). BLM requires analysis of project effects to migratory birds in every National Environmental Policy Act (NEPA) analysis. Focus should be on effects to migratory bird species of concern that are within local Bird Conservation Areas (U.S. North American Bird Conservation Initiative - NABCI Committee, 2000). BLM guidance includes consideration of goals and objectives set out in various existing bird conservation strategies including those provided by Partners in Flight (PIF) Bird Conservation Plans. In EO 13186,

federal agencies are instructed to identify when unintentional take may have a negative effect on migratory bird populations in order to develop methods that may lessen take, focusing on species of concern, priority habitats, and key risk factors. The requirements of EO 13186 are included in this ER to be consistent with the EO implementation by federal agencies.

Colorado Partners in Flight (CPIF) developed a conservation plan for the various physiographic regions that coincide with the state, including the Colorado Plateau region (with which the Site coincides) and the adjacent Southern Rockies region, and specified strategies to implement the plan in habitats that support priority focal species (Beidleman, 2000). There are two habitats that are within the Site or adjacent to it, pinyon-juniper and sagebrush shrubland. Both habitats are included in CPIF's plan that identifies priority species and habitats, and establishes objectives for preserving or conserving bird populations and their habitats in Colorado. Mixed grassland habitat that is also found within the Site is not included in conservation plans for either the Colorado Plateau or the Southern Rockies regions (Beidleman, 2000). Focal land bird species associated with each of the two habitats and recent population trends (1993-2007) at the local level (based on 14 Breeding Bird Survey - BBS routes) and the regional level are provided in Table 3.5-11 (Sauer et al., 2008).

Table 3.5-11
Focal Land Bird Species Associated with Habitats within the Site with Regional and Local Population Trends (with levels of significance)

Habitat	Focal Land Bird Species	Population Trend Estimates, Past 15 Years		
		Pinyon-Juniper Woodlands[1]	Southern Rockies[1]	Local [2]
Pinyon-Juniper Woodland	Black-chinned Hummingbird *Archilochus alexandri*	Decreasing (P<0.10)	No trend (P>0.10)	Insufficient Data
	Gray Flycatcher *Empidonax wrightii*	Increasing (P<0.10)	Increasing (P<0.10)	Insufficient Data
	Cassin's Kingbird *Tyrannus vociferans*	No trend (P>0.10)	Increasing (P<0.05)	Insufficient Data
	Gray Vireo *Vireo vicinior*	Increasing (P<0.05)	No estimate	Insufficient Data
	Pinyon Jay *Gymnorhinus cyanocephalus*	Decreasing (P<0.10)	No trend (P>0.10)	No trend (P>0.10)
	Juniper Titmouse *Baeolophus griseus*	No trend (P>0.10)	No trend (P>0.10)	Insufficient Data
	Black-throated Gray Warbler *Dendroica striata*	No trend (P>0.10)	No trend (P>0.10)	Increasing (P<0.01)
	Scott's Oriole *Icterus parisorum*	No trend (P>0.10)	No estimate	Insufficient Data
Sagebrush Shrubland	Northern Sage Grouse *Centrocercus urophasianus*	No estimate	No estimate	No Data
	Gunnison Sage-Grouse *Centrocercus minimus*	No estimate	No estimate	Insufficient Data
	Brewer's Sparrow *Spizella breweri*	Decreasing (P<0.001)	No trend (P>0.10)	Decreasing (P<0.01)
	Sage Sparrow *Amphispiza belli*	No trend (P>0.10)	Decreasing (P<0.005)	Insufficient Data

[1] Regional trend analysis from USGS, Patuxent Wildlife Research Center (Sauer et al., 2008).
[2] Local trend analysis from National Biological Survey BBS routes in Rio Blanco, Garfield, Mesa, and Delta counties.

On a regional scale, three focal land bird species within habitats coinciding with the Pinyon-Juniper Woodlands region have statistically significant decreasing population trends since 1993 (two in pinyon-juniper habitat, and one in sagebrush shrubland habitat). Data compiled for the Southern Rockies region indicates that only one species (Brewer's sparrow in sagebrush shrubland habitat) has a statistically significant declining trend (Table 3.5-11);Brewer's sparrow

populations appear to be statistically significantly decreasing (P<0.01) on a local level, including the Site.

Data compiled for 14 National Biological Survey BBS routes in the project area vicinity [Mesa (2 routes), Montrose (3 routes), Delta (1 route), and San Miguel (2 routes) counties in Colorado, and San Juan (3 routes) and Grand (3 routes) counties in Utah] reveal 176 bird species have been observed on one or more routes since 1980 (Sauer et al., 2008). Of those, 124 species are listed as Neotropical migratory birds by the USFWS, Division of Bird Habitat Conservation, pursuant to the Neotropical Migratory Bird Conservation Act. Based on data from the 14 BBS routes, 18 species of Neotropical migratory birds have statistically significant declining (P<0.1) population trends (numbers observed per BBS route each year) during the past 15 years in the region surrounding the Site. Alternatively, four species of Neotropical migratory birds have statistically significant increasing (P<0.1) trends in the region during that period.

Species identified as Birds of Management Concern (BMC – a subset of all species protected under MBTA) include species listed under ESA, species with declining populations that were identified by USFWS (2008) as Birds of Conservation Concern (BCC), and various other species for which focused management was judged to be necessary. BCC within Bird Conservation Region 16 (Southern Rockies/Colorado Plateau region) include species identified as BCC that have been observed on BBS routes in the region surrounding the Site. Those species include Gunnison Sage-grouse, bald eagle, golden eagle (*Aquila chrysaetos*), prairie falcon (*Falco mexicanus*), long-billed curlew (*Numenius americanus*), burrowing owl, Lewis' woodpecker (*Melanerpes lewis*), willow flycatcher (*Empidonax traillii*), pinyon jay, juniper titmouse, veery (*Catharus fuscescens*), Brewer's sparrow, and Cassin's finch (*Carpodacus cassinii*). However, based on species' known distributions and habitats present, long-billed curlew, veery, Cassin's finch, and willow flycatcher are not expected to occur within any portions of the project area. One BCC species was observed during the August 2009 survey. A pair of juniper titmice was observed in the woodlands on the southeast side of the 80-acre parcel and suitable habitat for the species coincides with pinyon-juniper woodlands in the project area (WestWater, 2009).

Non-game Wildlife. CDOW (2009b) compiled a list of wildlife species that are expected to occur in Montrose County. For each species, the associated habitat types that occur within the project area were identified from species-habitat linkages developed by the CDOW (2009b) in their NDIS database with species' life-history profiles and distributions within the state (CDOW, 2009b). A total of 357 terrestrial vertebrate species are listed in NDIS for Montrose County of which 322 are known to occur (6 amphibian species, 18 reptiles, 223 birds, and 75 mammal species).

There are three habitat types within the project area: pinyon-juniper woodland, sagebrush shrubland, and mixed grassland. Open water is also present at a small retention pond located within the Site. However, no wildlife species have been reported at or in the pond (Kleinfelder, 2008c, 2009h; WestWater, 2009), and it is not included here as wildlife habitat for non-game species that otherwise might occur in the project area.

Based on the three habitat types present and the distribution of non-game species within Montrose County (not counting various game species discussed above and the sensitive species included in Table 3.5-8 in Section 3.5.2.3, above), there could be 23 species of reptiles, 65 species of birds, and 23 species of non-game mammals within the project area and vicinity (CDOW, 2009b).

Some non-game wildlife species potentially occur only in one habitat present while others are ubiquitous and potentially could occur in every habitat defined in the project area and vicinity. Most non-game species occur within the pinyon-juniper habitat on-site (Table 3.5-12), though not every species that could potentially occur in these and other habitats is expected to actually occur in the project area.

Table 3.5-12
Number of Nongame Wildlife Species Occurring within Montrose County that are Associated with Habitats[1] in the Project Area

Habitat	Amphibians	Reptiles	Birds	Mammals	Species Total
Pinyon-Juniper Woodland	0	5	32	10	47
Sagebrush Shrubland	0	3	18	9	30
Mixed Grasslands	0	3	15	4	22

[1] NDIS data from CDOW, 2009b.

Several of the wildlife species included in the totals of Table 3.5-12 have been observed in the project area during surveys conducted in 2007 and 2008 (Kleinfelder, 2009h) and in August 2009 (WestWater, 2009). Those species are included in Table 3.5-13, though several species reported in one cited report (Kleinfelder, 2009h) have been omitted because their distributions do not include Montrose County and/or Colorado.

Table 3.5-13
Non-game Wildlife Species Observed within the Project Area During On-Site Surveys

Common Name	Scientific Name	Season(s) Observed [1]
Reptiles		
Collared Lizard	*Crotaphytus collaris*	Summer 2009
Fence Lizard	*Sceloporus undulates*	Summer 2007, Spring 2008
Sagebrush Lizard	*Sceloporus graciosus*	Summer 2009
Short-horned Lizard	*Phrynosoma hernandesi*	Summer 2007
Western Whiptail	*Cnemidophorus tigris*	Summer 2009
Birds		
American Crow	*Corvus brachyrhynchos*	Spring 2008
Broad-tailed Hummingbird	*Selasphorus platycercus*	Summer 2009
Cliff Swallow	*Petrochelidon pyrrhonota*	Summer, Fall 2007
Common Raven	*Corvus corax*	Summer 2009
Dark-eyed Junco	*Junco hyemalis*	Winter 2008, Summer 2009
Dusky Flycatcher	*Empidonax oberholseri*	Summer 2007
European Starling	*Sturnus vulgaris*	Spring 2008
Golden Eagle	*Aquila chrysaetos*	Summer 2009
Juniper Titmouse	*Baeolophus griseus*	Summer 2009
Lark Sparrow	*Chondestes grammacus*	Summer, Fall 2007, Spring 2008
Loggerhead Shrike	*Lanius ludovicianus*	Summer 2007, Summer 2009
Mountain Bluebird	*Sialia currucoides*	Summer 2009
Rock Wren	*Salpinctes obsoletus*	Summer 2009
Sharp-shinned Hawk	*Accipiter striatus*	Summer 2007
Western Meadowlark	*Sturnella neglecta*	Summer 2007, Spring 2008
Western Scrub Jay	*Aphelocoma californica*	Summer 2007
Mammals		
Kangaroo Rat	*Dipodomys ordii*	Spring 2008
Mice	*Peromyscus* sp.	Spring 2008
Bats	Unknown	Fall 2007

[1] Sources: Summer, Fall 2007 and Winter, Spring 2008 - Kleinfelder, 2009h; Summer 2009- WestWater, 2009.

Bird surveys were conducted each season in 2007 and 2008 by means of point count surveys that allow determinations of bird species diversity. The four-season point count bird survey

observed 196 individual birds at 30 sample point locations. In a total of 77 point count surveys, the species observed were lark sparrows, dusky flycatchers, cliff swallows, western scrub-jays, a ruby-throated hummingbird, western meadowlarks, a loggerhead shrike, mourning doves, dark-eyed juncos, American crows, and a European starling (Table 3.5-13; and Appendix A in Kleinfelder, 2009h). The Simpson's Diversity Reciprocal Index yielded a value of 3.05 for the combined observations during the four seasonal surveys. The spring survey yielded an index value of 2.91 on a scale that ranges from zero to eleven. This result suggests that the diversity of birds on-site is higher in the spring than in the summer, fall, and winter seasons, because observations during those seasons yielded diversity index values of 2.12, 1.99, and 1.0, respectively (Kleinfelder, 2009h).

3.5.3.2 Aquatic Species

There are no permanently flowing waterbodies within the Site. Nine ephemeral drainages on-site have been described as discontinuous; however, the ephemeral drainage crossing the northwest portion of the Site appears to have connections to East Paradox Creek (Kleinfelder, 2008c). No Aquatic Species or habitats occur within the Site.

Several species of native non-game fish are possible within East Paradox Creek if flows are sufficient to provide habitat, and downstream in the Dolores River. Speckled dace (*Rhinichthys osculus*) likely inhabit riffles and gravel substrates, longnose suckers (*Catostomus catostomus*) inhabit pools and riffles, and mottled sculpins (*Cottus bairdii*) are associated with cobbles and rubble bottoms of cool clear streams (Woodling, 1985). Native flannelmouth suckers and roundtail chubs may be present but are more typical inhabitants of larger streams, including the Dolores River. Flannelmouth suckers and roundtail chubs are BLM-sensitive species and Colorado species of concern (see Table 3.5-8 in Section 3.5.2.3). Other species including fathead minnows (*Pimephales promelas*) and white suckers (*Catostomus commersoni*) may also be present. They are native to Colorado, but were originally restricted to eastslope streams. Over time, they and many other fish species have been introduced to the upper Colorado River Basin.

3.6 METEOROLOGY, CLIMATOLOGY, AND AIR QUALITY

Kleinfelder prepared a *Work Plan for Ambient Air Monitoring Energy Fuels Resources Corporation Uranium Mill Licensing Support Piñon Ridge Mill* – Work Plan (Kleinfelder, 2008d). The Work Plan was submitted to CDPHE for review and comment and formed the basis for baseline data collection at the Site.

Three air monitoring stations and two meteorology towers on the Site and two additional off-site air monitoring stations were installed and monitored starting in March 2008. The baseline analysis presented here is based on the first four quarters of baseline data collected at the Site (April 2008 through March 2009). The monitoring sites for the project were chosen according to NRC and EPA guidance (NRC, 1988 and EPA, 2000).

Selection of monitoring station locations is based on both pre-operational and operational air monitoring criteria set forth in NRC RG 4.14 (NRC, 1980a). Three monitoring locations were located near the Property Boundary. A fourth location was selected as a background location and was located to the northwest and a fifth location was selected at the nearest residence located to the southeast.

Monitoring sites 1 and 2 are equipped with meteorological, particulate matter less than 10 microns (PM_{10}), and radionuclide monitoring instrumentation, while sites 3, 4, and 5 only support radionuclide monitoring. Site 1 is located near the Property Boundary on the north, and has a

10-meter tower with meteorological sensors, and precipitation and evaporation gauges. Site 2 is near the eastern edge of the Property Boundary and has meteorological sensors on a 30-meter tower. Site 3 is near the western edge of the Property Boundary. Site 4 is located upwind in accordance with NRC guidance and is approximately 2 miles northwest of the Site near SH 90. Site 5 is located at the nearest residence in accordance with NRC guidance and is in a downwind location approximately 3 miles southeast of the Site. The locations of the air and meteorological monitoring sites are provided in Figure 3.6-1 and mapping coordinates are provided in Table 3.6-1.

Table 3.6-1
Monitor Site Locations[1]

Site ID	UTM Zone 12 (NAD 83)	
	Easting	**Northing**
Site #1 (North Site) – 10m Tower	695211.43	4237487.24
Site #2 (East Site) – 30m Tower	695930.42	4235452.56
Site #3 (West Site)	694443.09	4235724.28
Site #4 (Cooper Site) – Upwind (Background)	691782.99	4239297.89
Site #5 (Carver Site) – Downwind Resident	700135.95	4232939.27

[1] Source: Kleinfelder, 2009i.

Data from the monitoring sites were summarized in quarterly reports (Kleinfelder, 2008e-g and Energy Fuels, 2009g). The quarterly reports include data recovery statistics, analysis of the data, details about station operations, and audit and calibration reports. The results from the quarterly reports are combined in the *Meteorology, Air Quality, and Climatology Report* (Kleinfelder, 2009i).

3.6.1 Meteorology

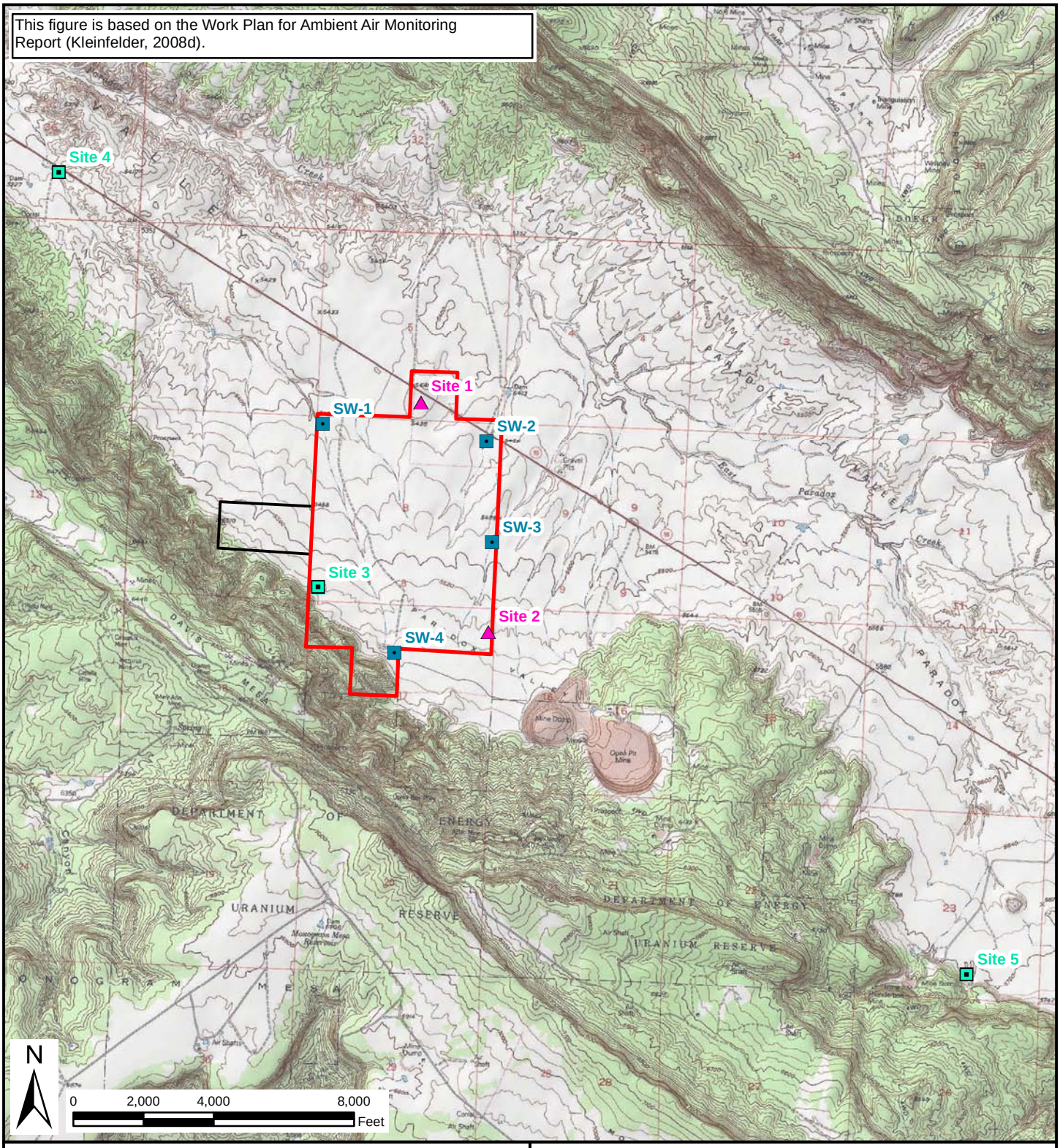
The meteorological sensors were operated based on EPA guidance (EPA, 2000). A summary of the monitoring guidelines and the specifications for the instruments are outlined in the Work Plan (Kleinfelder, 2008d). The parameters monitored by the sensors are provided in Table 3.6-2.

Table 3.6-2[1]
Parameters Monitored by EFR Meteorological Sensors

Site #1 (10-meter tower)	Site #2 (30-meter tower)
Wind Speed	Wind Speed
Wind Direction	Wind Direction
Temperature (2 meters and 10 meters)	Temperature (2 meters and 10 meters)
Delta Temperature	Delta Temperature
Relative Humidity	Relative Humidity
Solar Radiation	Solar Radiation
Barometric Pressure	Barometric Pressure
Precipitation	----
Evaporation	----

[1] Source: Kleinfelder, 2009i.

Site Data Summary. Monthly summaries of the 2-meter temperature, relative humidity, solar radiation, wind speed, and maximum wind gust collected at sites 1 and are shown in Table 3.6-3.



Meterological Tower, PM10 Samplers, & Radionuclide Monitoring

Radionuclide Monitoring Only

Surface Water Sampler Location and ID (Includes Manual Rain Gauge)

Property Boundary

Well Field Boundary

Figure 3.6-1

Air and Meteorological Monitoring Sites

Table 3.6-3
Monthly Meteorology Data from Sites 1 and 2[1]

Monitoring Quarter	Month	Site	Temp[2] 2m °F	Relative Humidity %	Solar Radiation W/m²	Solar Radiation Kwh/m²	Wind Speed mph	Max Wind Gust Mph
Q2 2008 (Q1 baseline)	Apr 2008	Site 1	48.3	29.6	285.23	205.4	8.5	55.3
		Site 2	49.0	28.1	282.88	203.7	8.1	57.6
	May 2008	Site 1	57.1	34.9	297.36	221.2	8.1	61.7
		Site 2	57.7	33.0	300.51	223.6	8.0	51.2
	June 2008	Site 1	70.1	21.6	342.03	246.3	7.6	55.7
		Site 2	70.8	20.3	338.39	243.6	7.2	57.9
Q3 2008 (Q2 baseline)	Jul 2008	Site 1	76.2	32.9	291.75	217.1	6.5	42.0
		Site 2	76.7	31.5	288.03	214.3	6.5	47.6
	Aug 2008	Site 1	74.1	34.0	279.35	207.8	6.4	49.2
		Site 2	74.7	32.4	277.98	206.8	6.2	43.0
	Sep 2008	Site 1	64.0	34.8	241.30	173.7	5.9	45.6
		Site 2	65.1	32.1	240.61	173.2	5.5	50.1
Q4 2008 (Q3 baseline)	Oct 2008	Site 1	51.4	37.2	173.97	129.4	6.0	54.4
		Site 2	52.6	34.7	175.46	130.5	5.4	59.7
	Nov 2008	Site 1	40.2	50.5	125.49	90.4	4.3	48.0
		Site 2	41.7	47.7	121.73	87.6	3.7	49.9
	Dec 2008	Site 1	27.7	70.5	96.53	71.8	5.2	50.8
		Site 2	28.6	67.3	91.25	67.9	5.0	53.1
Q1 2009 (Q4 baseline)	Jan 2008	Site 1	27.5	69.5	120.56	89.7	4.0	45.5
		Site 2	28.2	66.3	114.86	85.5	3.2	43.8
	Feb 2008	Site 1	35.8	54.1	160.59	107.9	5.6	47.0
		Site 2	36.5	51.1	155.01	104.2	5.2	43.8
	Mar 2008	Site 1	43.5	39.0	215.22	160.1	7.8	57.3
		Site 2	44.0	37.3	212.23	157.9	7.3	63.5

[1] Source: Kleinfelder, 2009i.
[2] Temperature from the 2-meter instruments at both site 1 and 2.

Evaporation. Monthly total pan evaporation data collected at Site 1 between April and October 2008 are presented in Table 3.6-4. Pan evaporation measurements were not taken during the months when freezing conditions interfered with the measurements. The total pan evaporation for the 7-month period is 55.26 inches.

Table 3.6-4
Summary of Evaporation Data[1,2]

Monitoring Period	2008 Apr	May	Jun	Jul	Aug	Sep	Oct
Inches	6.64	7.40	10.84	10.12	10.06	6.31	3.89

[1] Source: Kleinfelder, 2009i.
[2] The evaporation instrument was taken offline to avoid freezing, thus, measurements were not collected for November through March 2009.

Precipitation. Monthly and annual total precipitation data from the sources at the Site (recording gauge at Site 1 and the surface water gauges) are shown in Table 3.6-5 for the 12-month period from May 2008 through April 2009. The precipitation data includes the data collected from the surface water network gauges from May through October 2008 and from the Site 1 precipitation gauge from November 2008 through April 2009. The table also contains precipitation totals from two National Weather Service (NWS) Cooperative Observer Network (COOP) stations and one Remote Automated Weather Station (RAWS) operated by the BLM. These stations include the Uravan and Paradox 2N COOP Stations and the Nucla RAWS station. The COOP and BLM RAWS stations were active during the monitoring program. Other nearby COOP stations in the Paradox Valley were not operating during the monitoring program, but historic data from these stations is discussed in Section 4.6.2, Climatology.

The total precipitation measured at the Site for the 12-month period was 10.01 inches, with monthly totals ranging from 0.20 inches in July to 2.62 inches in December. The total for the 4-month period from September through December 2008 is 6.05 inches, which is 60 percent of the annual total. The annual precipitation totals at the nearby COOP stations during this baseline period were 9.52 and 9.53 inches. These totals are approximately 5 percent less than the annual total measured at the Piñon Ridge Site. With the exception of the winter months, monthly precipitation totals at the Nucla RAWS station were similar to totals from the other stations. The lower values shown at the Nucla RAWS station during December through March may be due to the Nucla gauge being unheated or to natural differences due to terrain exposure and location.

Table 3.6-5
Summary of Precipitation Data[1]

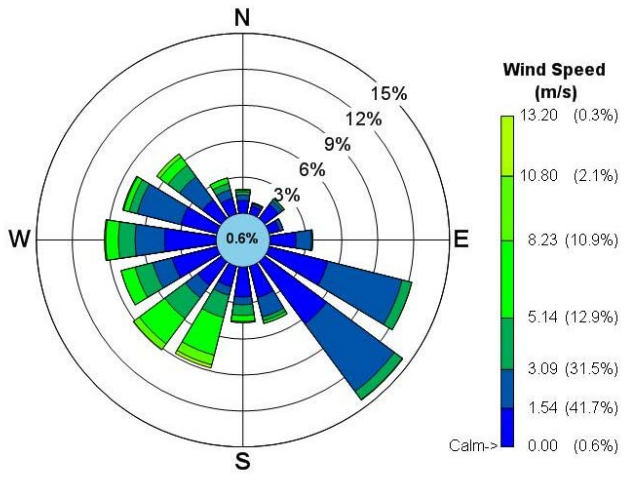
Totals in inches	**Data Sources**			
Period 2008-09	**Mill Site (combined)[2]**	**Uravan**	**Paradox 2N**	**Nucla**
May	0.61	0.73	0.62	0.98
June	0.45	0.42	0.48	0.37
July	0.20	0.13	0.48	0.60
August	0.84	1.79	1.78	1.37
September	1.08	0.38	0.49	0.17
October	1.16	0.69	0.68	0.51
November	1.19	0.89	0.89	0.89
December	2.62	2.72	2.40	0.83
January	0.46	0.27	0.45	0.07
February	0.32	0.36	0.73	0.20
March	0.61	0.59	0.17	0.39
April	0.47	0.55	0.36	0.91
Annual Total	10.01	9.52	9.53	7.29
Difference[3]	----	-4.9%	-4.8%	-27.2%

[1] Source: Kleinfelder, 2009i.
[2] Precipitation data was collected from the surface water network from May to October 2008 and from the Site 1 gauge from November 2008 to April 2009.
[3] The differences of the annual totals relative to the combined data.

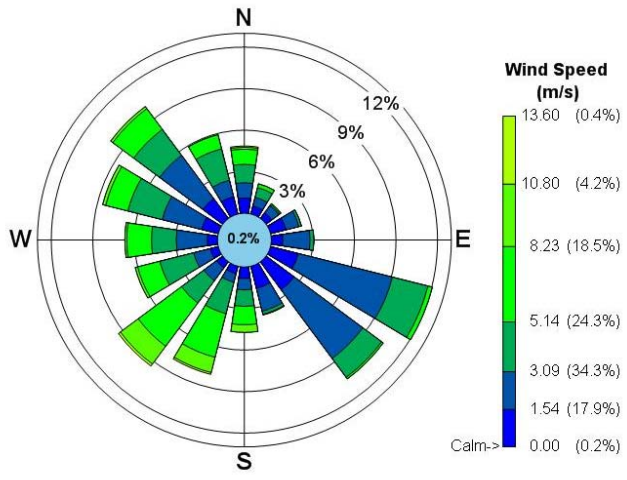
Because the surface water network did not monitor precipitation on an hourly schedule, annual hourly precipitation results are not available for the entire monitoring period. However, a summary of the results from the precipitation gauge at Site 1 has been completed. From November 1, 2008 through April 1, 2009 the precipitation gauge at Site 1 recorded 155 hours with greater than 0.01 inches of precipitation for a total of 5.22 inches. The hourly average precipitation rate for this period was 0.03 inches per hour.

Wind Summary. Wind direction and wind speed are summarized in the “wind rose” presentations which are included in the *Meteorology, Air Quality, and Climatology Report* (Kleinfelder, 2009i). In the wind rose, each hourly measurement of wind direction is assigned to a sixteen-point sector of the compass, and the frequency of occurrence of wind from a direction is proportional to the length of the solid line beginning in the central circle and extending outward. The color bars within each compass direction indicate the frequency of specific wind speeds within each wind direction. Figures 3.6-2 and 3.6-3 show quarterly wind roses for Sites 1 and 2. The quarterly wind roses for Site 1 in Figure 3.6-2 show the nighttime southeast valley flow through each quarter. In Figure 3.6-3, the wind roses for Site 2 indicate that the various westerly winds persist through the entire year. Both sites recorded more measurements with higher wind speeds in the second quarter of 2008 than in the other quarters.

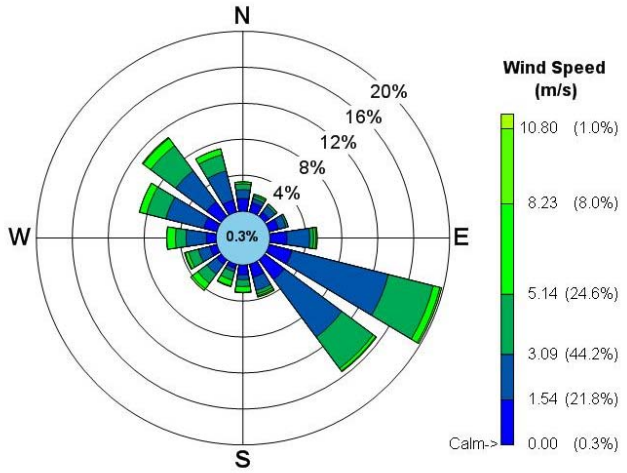
This figure is based on the Meteorology, Air Quality and Climatology Report (Kleinfelder, 2009i).



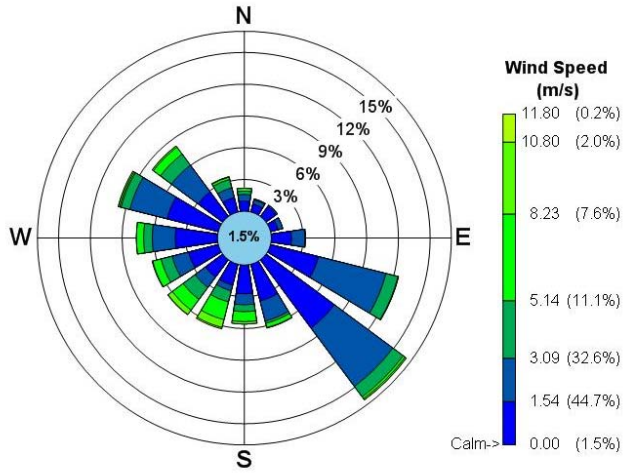
Q2 2008: April 1, 2008 - June 30, 2008 (Q1 baseline)



Q3 2008: July 1, 2008 - September 30, 2008 (Q2 baseline)



Q4 2008: October 1, 2008 - December 31, 2008 (Q3 baseline)

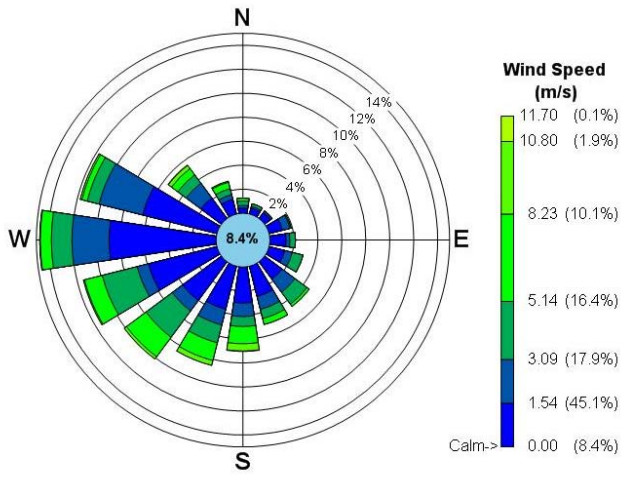


Q1 2009: January 1, 2009 - March 31, 2009 (Q4 baseline)

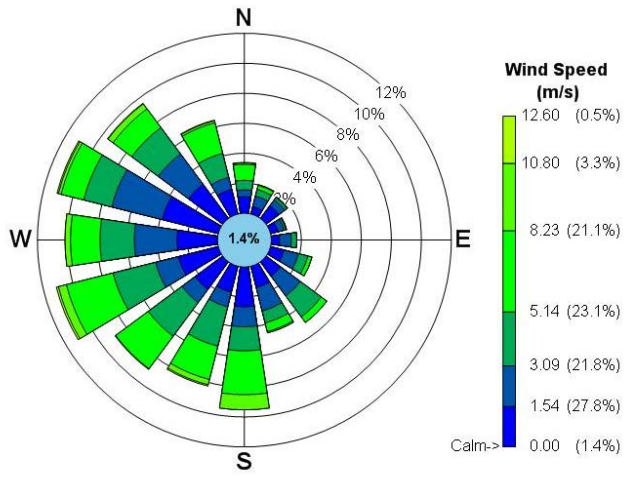
Figure 3.6-2

Site 1 Quarterly Wind Roses
10-m Level, April 2008 through March 2009

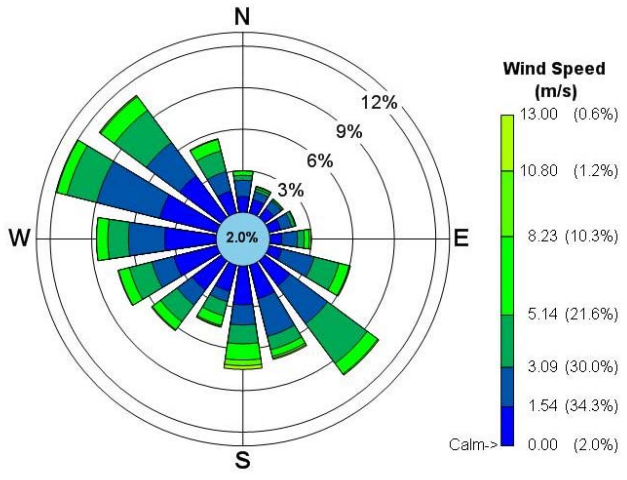
This figure is based on the Meteorology, Air Quality and Climatology Report (Kleinfelder, 2009i).



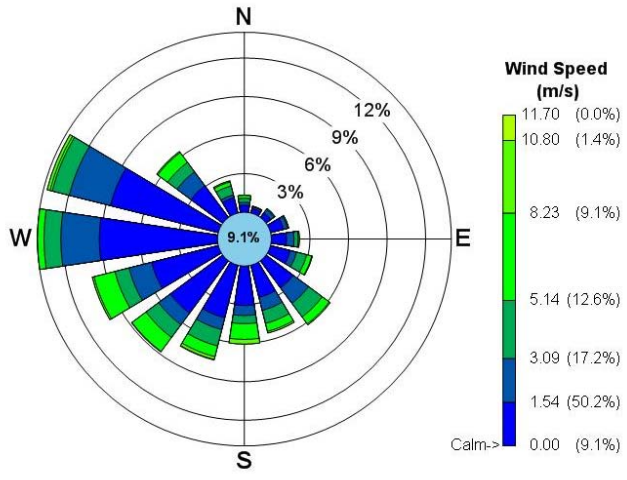
Q2 2008: April 1, 2008 - June 30, 2008 (Q1 baseline)



Q3 2008: July 1, 2008 - September 30, 2008 (Q2 baseline)



Q4 2008: October 1, 2008 - December 31, 2008 (Q3 baseline)



Q1 2009: January 1, 2009 - March 31, 2009 (Q4 baseline)

Figure 3.6-3

Site 2 Quarterly Wind Roses
30-m Level, April 2008 through March 2009

Wind roses are presented in Kleinfelder (2009i) for the annual 10-m winds at Site 1, which is located in the northwest corner of the Site towards the middle of the Paradox Valley and for the annual 30-m winds at Site 2, which is located at the southeast corner of the Site closer to mesas along the southwestern edge of the valley. The various westerly winds with many speed groups are associated with the daytime hours. The wind rose for Site 1 shows two dominant directions (ESE and SE) with very light wind speeds. These are associated with nighttime, stable, drainage breezes that flow parallel along the axis of the Paradox Valley. Site 2 experiences westerly and southwesterly winds during both day and nighttime hours, and the wind patterns do not resemble the persistent nighttime valley flow observed at Site 1. The calm winds at Site 2 are most likely the result of local canyon drainage flows from the mesa located west and southwest of Site 2.

Wind roses for the months in each quarter for Sites 1 and 2 are also presented in Kleinfelder (2009i) and represent a more detailed wind summary for each site. At Site 1, westerly winds with higher speeds were observed in April, May, and June of 2008. March of 2009 recorded similar patterns. The southeasterly breezes were observed in all months, but the calmest conditions were recorded in the months of November, December, January, and February. Similar to Site 1, Site 2 exhibited westerly winds with higher speeds in April, May, and June of 2008, and March of 2009. Calm, nighttime westerly breezes were observed in all months, but the calmest conditions were recorded in November, December, and January.

Atmospheric Stability. Atmospheric stability is typically used for assessing dispersion of emissions, because the stability describes the potential for vertical motion in the atmosphere. Unstable conditions encourage positive vertical motion or movement toward the sky, and stable conditions encourage negative vertical motion or movement toward the ground. Atmospheric stability conditions for Sites 1 and 2 were estimated by Kleinfelder (2009i) using the Solar Radiation/Delta T (SRDT) Method as outlined by EPA (2000). The SRDT method assigns a Pasquill-Gifford Stability Class (P-G Class) to each hourly measurement based on specific conditions of solar radiation, vertical temperature differences, and wind measurements. The P-G Classes range from A through F with A being unstable and F being the most stable.

For daytime hours, P-G Classes are assigned based on solar radiation and wind speed. Lower wind speeds and higher solar radiation result in more unstable conditions while higher wind speeds and lower radiation result in more stable conditions. For nighttime hours, P-G Classes are assigned based on the vertical temperature gradient (Delta T) and the wind speed. At night, only stable conditions (D, E, F) are assigned, but positive vertical temperature conditions and low wind speeds result in very stable conditions. The specific criteria for daytime and nighttime conditions are provided in Table 3.6-6.

The atmospheric stability summary for Sites 1 and 2 is provided in Figure 3.6-4. The data from both sites exhibit similar patterns with neutral to stable conditions being the most frequent. Site 2 does have a larger percentage of hours with very stable conditions than recorded at Site 1. These very stable conditions at Site 2 are most likely a result of the calmer nighttime, canyon winds.

Annual joint frequency tables with wind speed, wind direction, and stability class were produced to describe the wind patterns at Sites 1 and 2. The tables list the occurrence of 16 wind directions as measured in each stability class with specific wind speeds. The joint frequency tables quantitatively summarize the trends described above. The tables are provided in Appendix C in the *Meteorology, Air Quality, and Climatology Report* (Kleinfelder, 2009i).

This figure is based on the Meteorology, Air Quality and Climatology Report (Kleinfelder, 2009i).

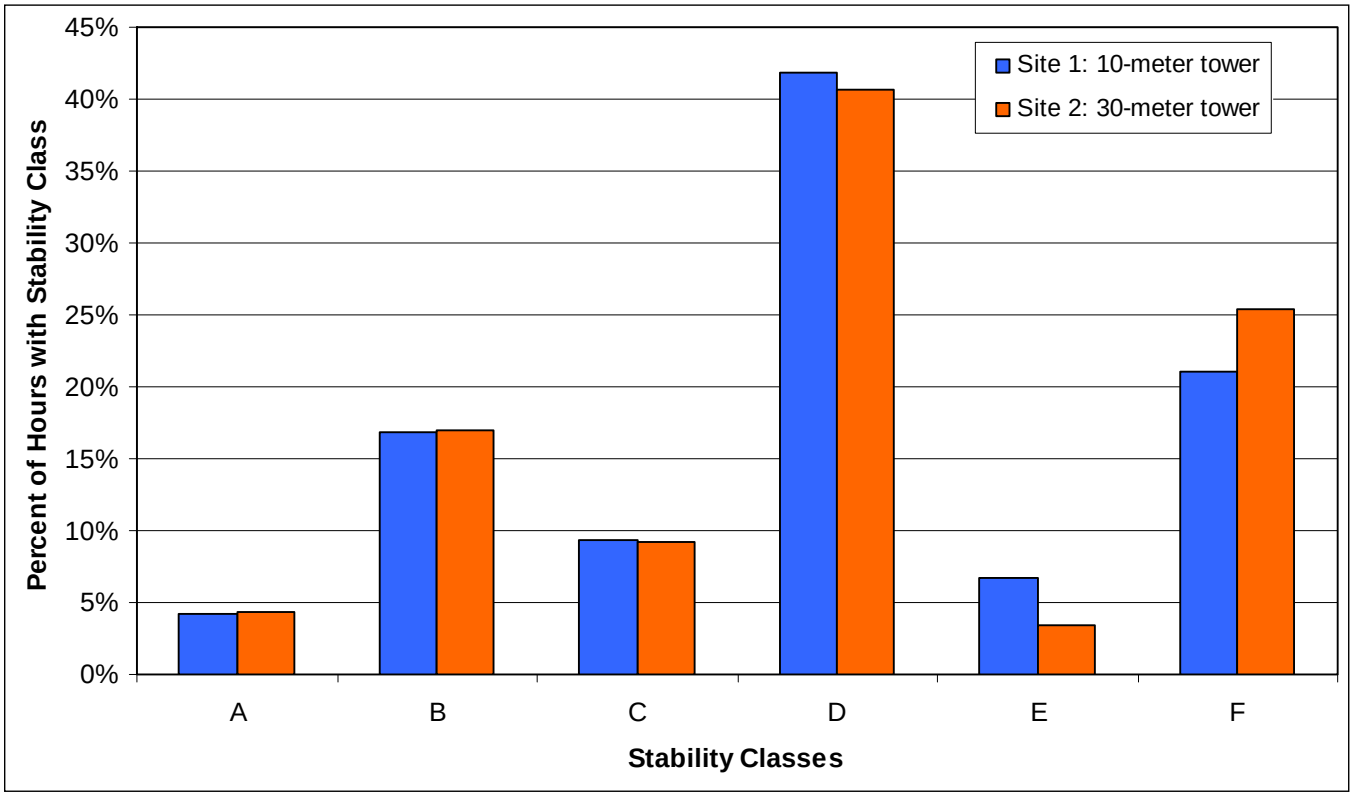


Figure 3.6-4

Summary of Stability Conditions at Sites 1 and 2

Table 3.6-6
SRDT Method Criteria for P-G Stability Classes[1]

Daytime				
Wind Speed (m/s)	**Solar Radiation (W/m^2)**			
	.≥925	925-675	675-135	<175
<2	A	A	B	D
2-3	A	B	C	D
3-5	B	B	C	D
5-6	C	C	D	D
.≥6	C	D	D	D
Nighttime				
Wind Speed (m/s)	**Vertical Temperature Gradient**			
	<0		.≥0	
<2.0	E		F	
2.0 – 2.5	D		E	
.≥2.5	D		D	

[1] Source: Kleinfelder, 2009i.

3.6.2 Climatology

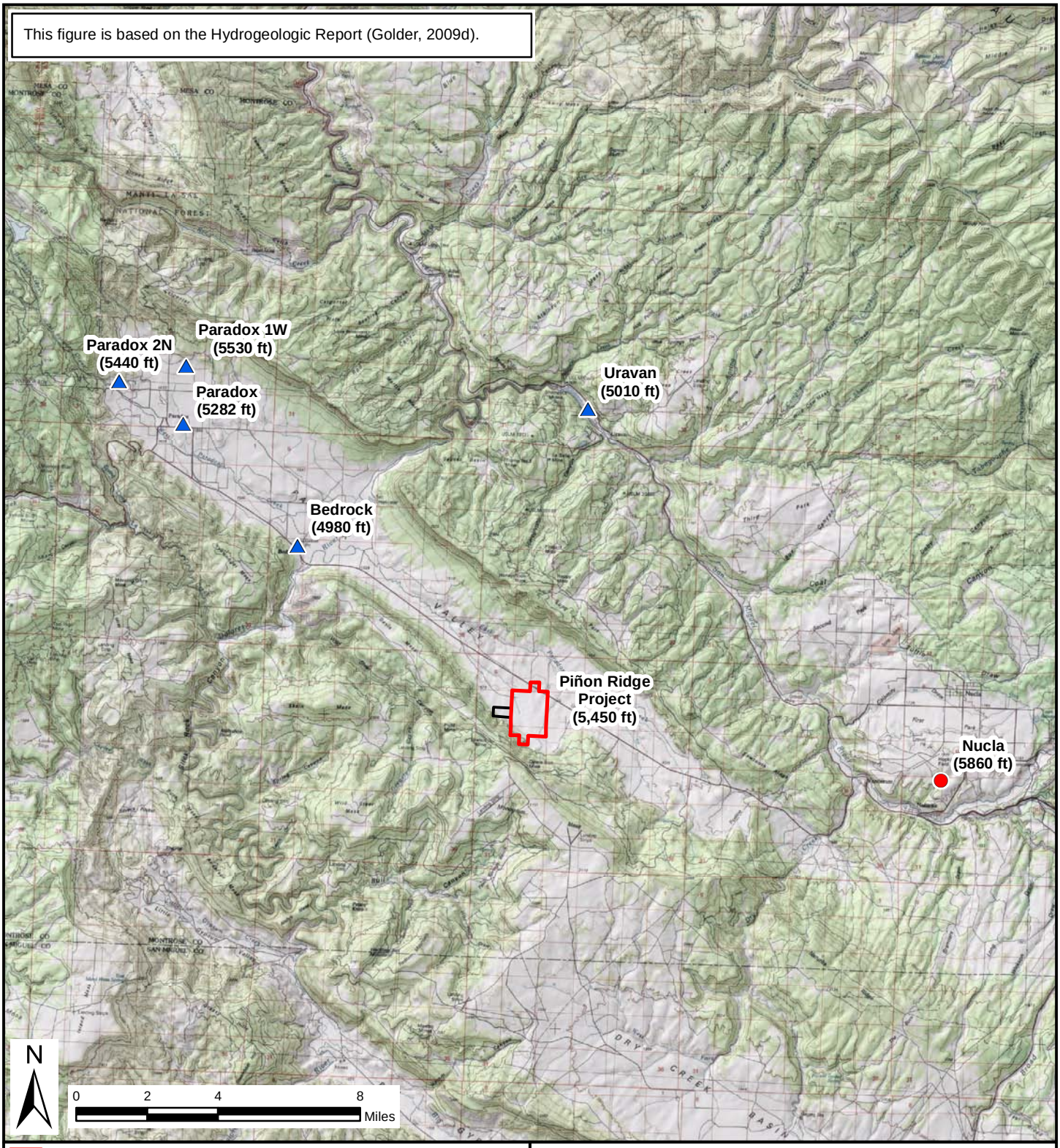
3.6.2.1 Regional Climate Data Sources

Climate descriptions involve averaging meteorological records over a period of time. The National Oceanic and Atmospheric Administration's National Climatic Data Center uses 30 years of data to calculate the classical "normal" values often used to describe long-term climate conditions. In some cases, climate can be adequately described with shorter or longer periods of records, depending on the purpose of the data. Sources of meteorology data in the region of the Site were evaluated by Kleinfelder (2009i) based on data availability, location, and topography to assess if the station was representative of the Site conditions. The stations chosen as representative of climate conditions at the Site are summarized in Table 3.6-7.

The La Sal, Utah and the La Sal 2 SE, Utah COOP stations, the Big Indian RAWS station, and the evaporation station in Moab, Utah were not considered to be as representative as other sites and were therefore excluded as a basis of climate data because elevation differences can have a large influence on temperatures and precipitation totals. The evaporation station in Moab, Utah was also not used in the analysis due to distance from the Site and elevation.

The locations of the COOP and RAWS sites listed in Table 3.6-7 are shown with the Paradox Valley topography in Figure 3.6-5. The summary tables of the climate data discussed in this section are provided in Appendix D of the *Meteorology, Air Quality and Climatology Report* (Kleinfelder, 2009i).

Data from the COOP sites were obtained from the Western Region Climate Center and are included in the *Meteorology, Climatology, and Air Quality Report* (Kleinfelder, 2009i). The Uravan COOP station was identified as the long-term continuous data source for temperature and precipitation trends at the Site and vicinity. The Nucla RAWS station is the primary source of long-term data for temperature, wind speed, humidity, and solar radiation; however wind direction data from the Nucla RAWS station is not representative of long-term wind directions at the Site. Kleinfelder (2009i) provides discussion and justification for use of data from various COOP sties.



Property Boundary
Well Field Boundary
Approximate NWS Coop Observers Sites
Approximate BLM RAWS Site

Figure 3.6-5

Climate Data Site Locations

Table 3.6-7
Summary of Meteorology Stations Used for Climate Analysis[1]

Station Type	Site Locations	Elevation (feet)[5]	Period of Record	Available Parameters for Climate Analysis
COOP[2]	Paradox, CO (Pdox1E)	5,282	1948 – 1977	Precipitation[8] Temperature[8]
	Paradox, CO (Pdox1W)	5,530	1977 – 1995	
	Paradox, CO (Pdox2N)	5,440	2005 – 2008	
	Bedrock, CO	4,980	1997 – 2005	
	Uravan, CO	5,010	1960 – 2008	
RAWS[3]	Nucla, CO	5,860	1999 – 2008	Precipitation Temperature[8] Dew Point Temp[8] Relative Humidity[8] Wind Speed[8] Wind Direction Solar Radiation[8] Barometric Pressure
NWS[4]	Grand Junction, CO[6]	4,859	1962-2005	Evaporation[8]
	Montrose-1, CO[7]	5,758	1948-1982	

[1] Source: Kleinfelder, 2009i.
[2] COOP Stations refer to National Weather Service (NWS) Cooperative Observer Network.
[3] RAWS stations refer to the BLM Remote Automatic Weather Station.
[4] NWS stations are official stations operated by NWS offices.
[5]. The Site elevation is approximately 5,450 ft.
[6] NWS at Grand Junction includes information shown for Nucla, CO; only evaporation data were used
[7] NWS evaporation stations Montrose-1 is also a COOP station
[8] Parameters are used in the Site climate analysis.

3.6.2.2 Long Term Statistics and 30-year Normal Values

Climate data from nearby stations relevant to characterizing the Site area are presented in this section, with a focus on precipitation data. In addition to the 30-year normal values often used in climate analyses, data from other time periods are presented when available.

Precipitation Averages and Extremes. The full period of record precipitation data taken at the five COOP stations and the Nucla RAWS station are summarized in Appendix D of the *Meteorology, Climatology, and Air Quality Report* (Kleinfelder, 2009i). The COOP summary tables include the following information:

- Monthly, seasonal and annual mean and extreme totals, and the year the extreme event occurred;
- One-day maximum amounts, with the date it occurred;
- Average number of days that the precipitation total exceeded 0.01, 0.10, 0.50 and 1.00 inches, and
- Average and maximum snowfall accumulation, with the year the monthly maximum occurred.

The data for Uravan (Kleinfelder, 2009i) show the annual average precipitation for the period from 1960 through 2008 is 12.63 inches. Note that the Uravan annual total of 9.52 inches over the baseline monitoring period (Table 3.6-5) was 24.6 percent less than the long-term annual average of 12.63 inches. The extreme annual values range from 7.13 inches in 1989 to 21.40 inches in 1965. The monthly averages range from 0.48 inches in June to 1.51 inches in September. The extreme one-day total was 1.90 inches, which occurred on August 21, 1971. The annual average number of days with measurable precipitation, that is at least 0.01 inch, is 76. The average occurrences of days with precipitation at least 0.10 and 0.50 inch are 39 and 6, respectively. The average annual snowfall is 10.0 inches; the maximum year was 1979, when 40.9 inches of snowfall was measured.

Thirty year normal values for the period 1971-2000 for Uravan, the station identified as the most representative of the Site area, are presented in Appendix D in Kleinfelder (2009i). The precipitation data include monthly and annual mean and extreme totals. The 30-year normal values for the preceding statistics were very similar to the long-term results.

During the baseline year of onsite monitoring, 10.01 inches of precipitation were recorded as representative of the Site area as presented in Section 4.6.1. During the same period, Uravan recorded 9.52, which is 4.9 percent less than the monitored total. Applying the difference observed between the monitored and Uravan annual totals during the monitoring year, -4.9 percent, to the long-term average annual total for Uravan, 12.63 inches, the expected average annual total precipitation for the Site area is 13.28 inches.

Wind and Local Airflow Patterns. Data of the average annual wind speed and maximum wind gusts for the Nucla RAWS station is provided in Appendix C in the *Meteorology, Climatology, and Air Quality Report (*Kleinfelder, 2009i). The average annual wind speed from 1999 through 2008 at the Nucla RAWS station is 5.2 miles per hour (mph). The ten-year monthly averages range from 3.6 mph in December and January to 6.7 mph in April and June.

Extreme values of wind gusts are less likely to show regular patterns than the monthly average and total values that are typically presented. The monthly average wind gusts for the 1999 through 2008 period ranged from 40.3 mph to 54.0 mph, with a tendency for the higher speeds to occur during April through June. The overall maximum gust speed recorded was 76 mph in June 2005. The next highest maximum gust speed was 60 mph in May 2004.

The Nucla RAWS station wind sensor is located approximately 3 meters above ground surface while the Site 1 and 2 wind sensors were installed at 10 meters and 30 meters for Sites 1 and 2, respectively. Average wind speeds typically increase with height. Accordingly, the monthly wind speed averages from Sites 1 and 2 are higher than the Nucla RAWS long-term averages, however, both data sets exhibit similar annual patterns. Both the RAWS station and the data from Sites 1 and 2 record the highest monthly wind speed averages in the months of March, April, May, and June, and the lowest wind speeds are collected during the winter months.

Humidity. Long-term dew-point temperature monthly summaries for the Nucla RAWS station are provided in Appendix D in the *Meteorology, Climatology, and Air Quality Report* (Kleinfelder, 2009i). The overall annual average dew-point temperature at Nucla is 24.8ºF. The monthly mean values range from 16.1ºF in January to 42.8ºF in August.

The average annual relative humidity for the period from 1999 through 2008 at the Nucla RAWS station is 41.9 percent. The monthly averages are provided in Appendix C in Kleinfelder (2009i). June has the lowest monthly average relative humidity, with 22.7 percent. The highest monthly

average is December, with 58.4 percent. This opposite cycle (summer minimum) to the temperature data is, in part, due to the opposite relation between relative humidity and temperature.

For the monitoring period, April 2008 through March 2009, the monthly average relative humidity values at Sites 1 and 2 are very similar to the data from the Nucla RAWS station. The overall average of monthly differences for the Piñon Ridge Sites 1 and 2 compared to the Nucla RAWS Station are 2.4 percent and -0.2 percent, respectively.

Solar Radiation. The monthly total incoming solar radiation values on a flat surface, in langleys (cal/cm^2), were obtained for the Nucla RAWS station. The average monthly values ranged from 6,727 langleys in December to 20,350 langleys in June. To facilitate using this information in the metric form, the values in langleys were calculated in kilowatt-hours per square meter (kwh/m^2) by a multiplication factor of 0.01163. The corresponding average monthly values for the 10-year period in kwh/m^2 were 78.2 in December and 236.7 in June. The monthly totals for each year, and the overall monthly averages of the totals, are summarized in Appendix D in Kleinfelder (2009i).

The comparisons between the Nucla RAWS station and Piñon Ridge Sites 1 and 2 show that measured solar radiation from Sites 1 and 2 occurred within the range of values measured at the Nucla RAWS station.

Evaporation. Kleinfelder (2009i) obtained summaries of pan evaporation data from the two NWS stations to estimate pan evaporation in the region. The Grand Junction data were taken from 1962 through 2005; and Montrose data were taken from 1948 through 1982. A summary of the monthly and annual totals is provided in Appendix D in Kleinfelder (2009i).

The long-term pan evaporation rate for the Site was estimated by taking an average of the available monthly values from Grand Junction and Montrose. The calculated values for the Site are averages of the two sites, except the Montrose data were taken from the months when the Grand Junction data were not provided. The calculated results for the Site are provided in Appendix D in Kleinfelder (2009i). The estimated long-term monthly average pan evaporation rates ranged from 1.30 inches (33.0 mm) during December to 10.7 inches (270.5) mm) in June. The annual total estimated pan evaporation is 64.75 inches (1,644.7 mm). An accepted pan evaporation coefficient to calculate lake (free water) evaporation is 0.77 (Linacre, 1994). According to this method, the corresponding lake evaporation would be 49.9 inches (1,266 mm) per year.

Evaporation data were collected at Site 1 during the non-freezing months and resulted in a seven-month total of 55.26 inches. The total for the same seven months for the calculated average of Montrose and Grand Junction is 55.1 inches, which is very nearly identical to the measured value of 55.26 inches. Evaporation at the Site during the winter period was also estimated based on the data available from Montrose because winter evaporation measurements were taken at Montrose. Accordingly, the evaporation from April through June accounts for 84 percent of the evaporation at Montrose. Kleinfelder (2009i) applied this factor to the evaporation data collected at Site 1and estimated that the total annual Site evaporation as 65.8 inches (55.26/0.84). This is only a 1.5 percent difference from the average annual pan evaporation from Grand Junction and Montrose of 64.8 inches. A graph of the long-term monthly averages from the two NWS stations, the seven-month results from the Piñon Ridge Site 1 data, and the estimated Site evaporation rate based on the NWS data are shown in Figure 3.6-6.

This figure is based on the Meteorology, Air Quality and Climatology Report (Kleinfelder, 2009i).

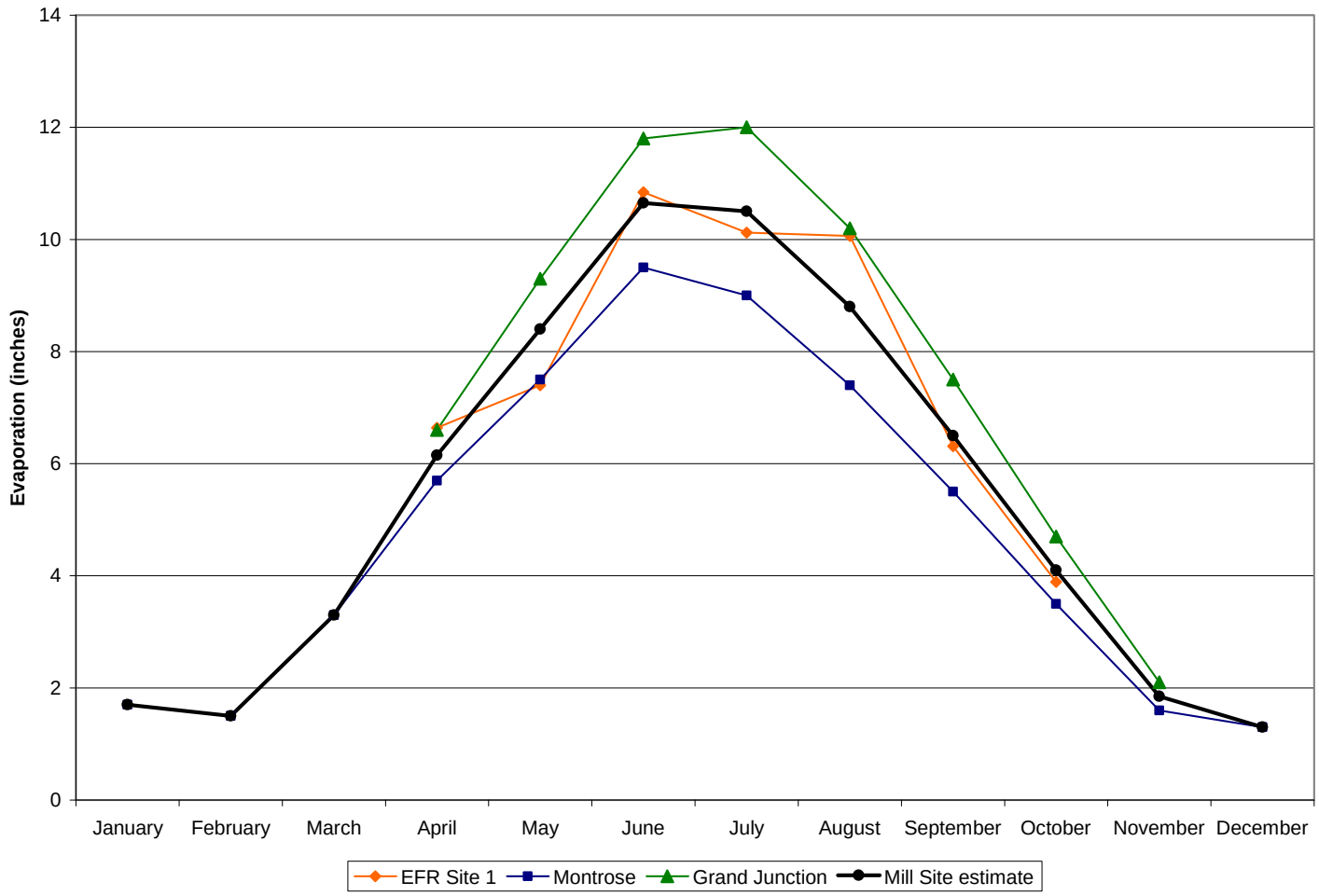


Figure 3.6-6

Summary of Evaporation Data

Severe Weather Phenomena. Kleinfelder (2009i) reports excerpts from Doesken et al. (2003) as follows:

> *Thunderstorms are quite prevalent in the eastern plains and along the eastern slopes of the mountains during the spring and summer. No specific mention is made of these occurrences in southwestern Colorado. Tornadoes are relatively rare in the mountains and western valleys but do occur. Lightning has emerged as one of the greatest weather hazards in Colorado. Each year there are typically several fatalities and injuries. Unlike tornadoes that are most common in selected areas of the state, lightning occurs everywhere.*
>
> *Heavy snows in the high mountains are common. Avalanches pose a serious problem to residents, road maintenance crews and back country travelers. Considerable effort is made each year to predict and manage avalanches.*
>
> *A spring flood potential results from the melting of the snow pack at the higher elevations. In a year of near-normal snow accumulations in the mountains and normal spring temperatures, river stages become high, but there is no general flooding. In years when snow cover is heavy, or when there is widespread lower elevation snow accumulation and a sudden warming in the spring, there may be extensive flooding.*

Avalanches could not occur at the Site due to its relatively low elevation (i.e., as compared to high mountains); however, the other severe weather phenomena discussed above could occur at or in the vicinity of the Site.

Climate Change. Most of the data presented in the preceding sections and in Kleinfelder (2009i) describe conditions occurring during the last 10-year period, 1999 through 2008. Data from longer periods of time are available from more distant sites and could have been included. However, the issue of how well data from more distant sites with differing geography represent conditions in the Paradox Valley resulted in using data from closer sites that have data availability over a shorter period of time. Trends in climate change are not clearly evident in the data evaluated. Therefore, in addition to that data, information from a recent report on climate change in Colorado was evaluated to assist with projecting the climatic conditions that could occur during the lifetime of the Site, a period of approximately 40 years.

As reported in Kleinfelder (2009i), the Western Water Assessment (WWA) group associated with the University of Colorado prepared a report for the Colorado Water Conservation Board in 2008, *Climate Change in Colorado* (WWA, 2008). The report acknowledges the difficulty in projecting regional changes in response to global-scale changes in climate conditions and weather system occurrences, though temperature and precipitation trends on a regional basis are shown. Montrose, Colorado, is one of the stations depicted in the WWA report, which is located approximately 50 miles north northeast of the Site.

The primary points from this report relevant to the Site are:

- Temperature: climate models project Colorado will warm by 4ºF by 2050, relative to the 1950-99 baseline values.
- Precipitation: climate models do not agree on changes in annual mean precipitation, though seasonal shifts may occur, including a lower snowpack occurring by 2050.

The WWA report shows that since 1970 10-year average observed temperatures have increased across the state. The increase from 1977 through 2006 for the southwestern regional corner of the State is reported as 2ºF. The Montrose data in the WWA report are representative of trends at other regional stations in the report. Year-to-year variations of average temperature have exceeded 1ºF, including during the most recent period. The warming trend could include shorter periods during the year of freezing temperature occurrences. Although not documented in the WWA report, evaporation rates are expected to increase associated with warmer temperatures.

In the WWA report, no apparent precipitation trends in the water-year (October through September) were presented for the regional stations. This lack of trend is also found in the climate model projections. The WWA report also discusses that annual values can range from one-half to twice the long-term average values. The annual variation in annual precipitation at the Uravan COOP station was nearly a factor of three, demonstrating the large year-to-year variability that occurs in the Site area. In another section of the WWA report, the regional drought during 2000 through 2007 is seen to be consistent with natural variability observed in the long-term and paleoclimatic records covering thousands of years.

Because of complex interactions between climatic elements and factors affecting water use, the lack of apparent trend and projected changes in total precipitation do not carry through to future water resource expectations. The WWA report concludes that a reduction in total water supply will occur during the projection period. Drought severity could be increased due to higher temperatures alone. Runoff in the Upper Basin of the Colorado River is expected to decline by 6 to 20 percent by the year 2050 (WWA, 2008).

3.6.3 Air Quality

Attainment Status. The EPA sets National Ambient Air Quality Standards (NAAQS) and CDPHE sets Colorado Ambient Air Quality Standards (CAAQS) which are health-based criteria for the maximum acceptable concentrations of air pollutants at all locations to which the public has access. According to the Colorado Air Quality Control Commission's *Annual Report to the Public 2008-2009*, all of Montrose County is designated as "attainment" for all criteria pollutants (CDPHE, 2009a). Criteria pollutants for which CAAQS and NAAQS exist include carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), particulate matter less than 10 microns in effective diameter (PM_{10}), particulate matter less than 2.5 microns in effective diameter ($PM_{2.5}$), sulfur dioxide (SO_2), and lead (Pb).

Nearby Sources. Most of the Paradox Valley including the land surrounding the Site is considered unincorporated. Most of the valley is utilized for open ranching, but some agricultural sources exist near Bedrock and Nucla, Colorado. There are several minor sources throughout the valley including aggregate processing operations, concrete batch plants, and uranium/vanadium ore mining. These operations are primarily sources of particulate matter, but can also utilize processes and/or equipment that emit nitrogen oxides (NO_x), sulfur dioxide (SO_2), carbon monoxide (CO), and some Hazardous Air Pollutants (HAPs). Tri-State Generation and Transmission also operates a coal strip mine and a coal-fired power plant in Nucla. The mining activities are another source of particulate matter, while the power plant is a major source for NO_x, SO_2, CO, particulate matter, and HAPs.

Air Quality Data Summary. The Energy Fuels air monitoring program collected data to examine both PM_{10} and radionuclide trends at the Site. Radionuclide trends are discussed in Section 3.11, Public and Occupational Health. The PM_{10} data collected at Sites 1 and 2 are presented in Appendix E in the *Meteorology, Climatology, and Air Quality Report* (Kleinfelder, 2009i). Also in Kleinfelder (2009i), the PM_{10} concentrations are summarized in Appendix E and the PM_{10} concentrations are plotted as a function of time in Figure 3.6-7. The monthly and annual PM_{10} averages are presented in Table 3.6-8. Site area concentrations for PM_{10} were calculated from the data and the results were below the NAAQS and the CAAQS.

Table 3.6-8
PM_{10} Monthly and Annual Averages[1]

Year	2008									2009			ANNUAL
Month	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	JAN	FEB	MAR	
Location	Concentration in ug/m^3												
Site 1	19	13	10	10	8	7	9	7	3	4	4	6	9
Site 2	22	14	10	9	8	7	8	7	3	3	4	6	8

[1] Source: Kleinfelder, 2009i.

The Site area air quality is required to meet both the NAAQS and the CAAQS. The EPA monitors PM_{10} attainment status with a 24-hour standard. During the course of one year, PM_{10} concentrations may only exceed 150 microgram per cubic meter (ug/m^3) one time. If the PM_{10} concentrations exceed the 150 ug/m^3 more than once during the year, the area is designated as nonattainment for PM_{10}. The CDPHE enforces the 24-hour standard, but also requires areas to comply with an annual PM_{10} standard. To attain this standard, the 3-year average of the weighted annual mean PM_{10} concentrations from one or several monitors must not exceed 50.0 ug/m^3. In comparison with the Piñon Ridge PM_{10} results, both Site 1 and 2 had 24-hour and annual PM_{10} concentrations less that the NAAQS and the CAAQS.

During the monitoring program, the annual averages for Sites 1 and 2 were 9 ug/m^3 and 8 ug/m^3, respectively, both well below the CAAQS of 50 ug/m^3. April 2008 had the highest monthly average PM_{10} concentration, 22 ug/m^3, and December 2008 had the lowest average PM_{10} concentration of 3 ug/m^3. The maximum 24-hour concentration recorded was 66 ug/m^3 recorded on April 30, 2008, at both Site 1 and 2 which is considerably less than the NAAQS 24-hour standard of 150 ug/m^3.

3.7 NOISE

Noise measurements are not available for the vicinity of the Site. Local conditions such as traffic, topography, and winds characteristic of the region can alter background noise conditions. In general, sound levels (decibels – dB) at outdoor rural residential locations are about 40 dBA - decibels on the A-weighted scale - averaged for day and night periods (EPA, 1974). The A-weighted decibel scale is frequency-weighted to approximate human hearing of noise propagated through air. The A scale begins at zero, the faintest noise that humans can hear. Decibels are measured on a logarithmic scale, so a noise level of 70 dBA is twice as loud to the listener as a noise of 60 dBA. The existing average ambient noise levels at the Site are expected to be in the range of 35 to 45 dBA and probably near an average of 40 dBA for day and night conditions.

This figure is based on the Meteorology, Air Quality and Climatology Report (Kleinfelder, 2009i).

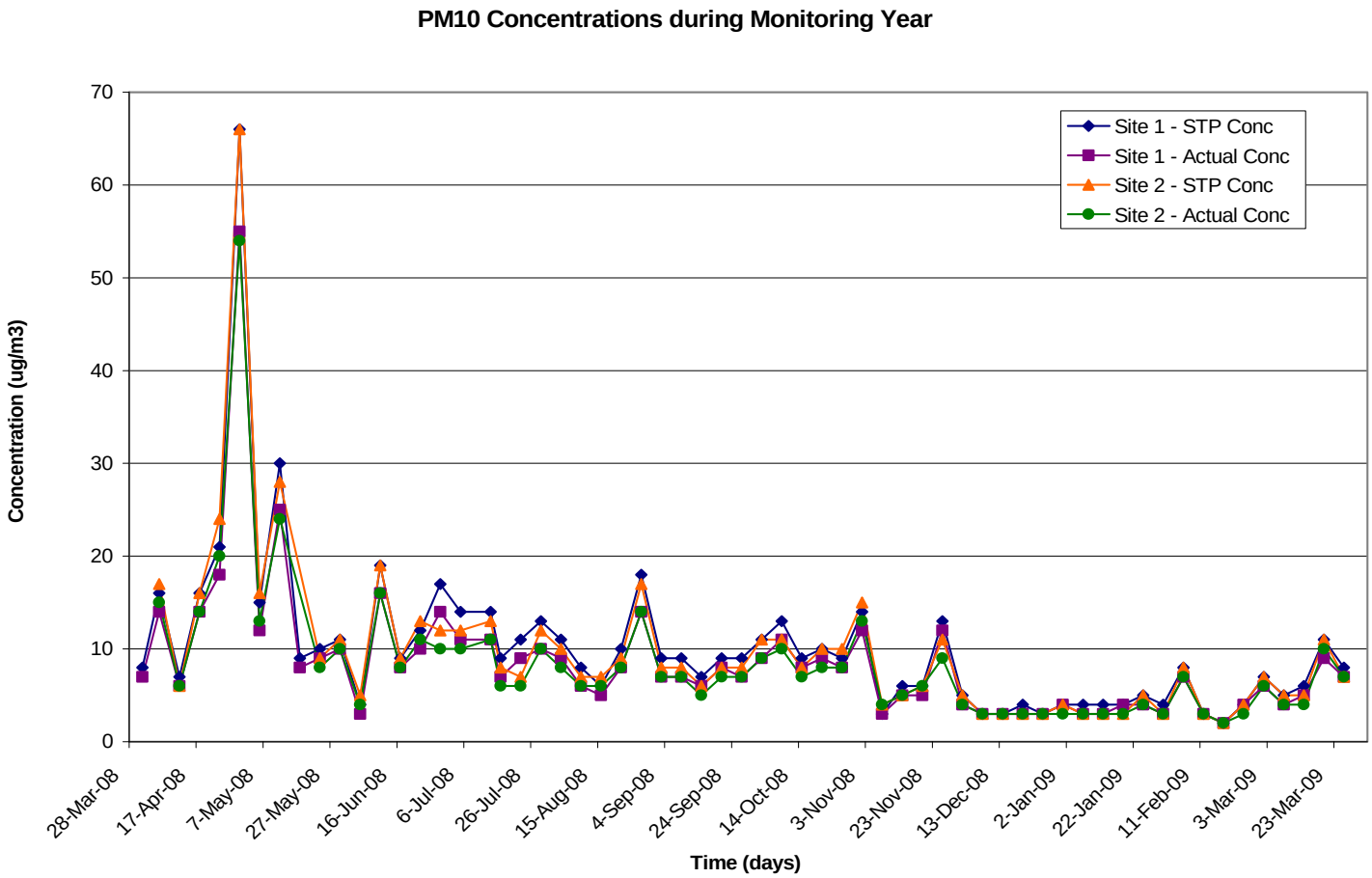


Figure 3.6-7

PM_{10} Concentrations at Sites 1 and 2

The existing ambient noise in the vicinity of the Site is dominated by the traffic noise from SH 90. SH 90 provides access to the local residences in the communities of Paradox and Bedrock from La Sal, Utah and Naturita, Colorado, for natural resource development, ranching activities, and recreational users, and for connecting traffic to SH 141 at Vancorum, east of Naturita.

Existing levels of vehicular traffic on SH 90, between Bedrock and Vancorum are reported as 530 vehicles per day, including 82 trucks per day (CDOT, 2009d). An estimate of existing hourly traffic on SH 90 would be approximately 10 percent of the daily traffic volume (Washington State Department of Transportation-WSDOT, 2008) or 53 vehicles per hour.

For traffic at an approximate volume of 125 vehicles per hour (the lowest traffic volume tabulated) and traveling at speeds of 65 miles per hour WSDOT (2008, see Table 7-3) estimated noise levels at 63.8 dBA from 50 feet away from the highway. Using the progressive relationship between traffic volume and associated noise provided in WSDOT's Table 7-3, an hourly traffic volume of 53 vehicles per hour, traveling at 65 miles per hour, would produce an estimated noise level of 60.7 dBA at 50 feet from the roadway.

For analytical purposes, traffic is considered a line source of noise rather than as a point source. Noise from a line source spreads out cylindrically along the length of a line. The standard reduction for line source noise is 3 dB per doubling of distance from the source - compared to 6 dB for a point source of noise (WSDOT, 2008). With a reduction rate of 3 dB per doubling of distance ("hard site reduction" rate), noise generated by traffic on SH 90 would be expected to attenuate to the background average of 40 dBA at 6,460 feet (1.2 miles) away if traffic volume was 53 vehicles per hour. Ground cover or normal unpacked earth present between the source and receptor will be a "soft site"; the ground becomes absorptive of noise energy and will reduce the attenuation from line sources by 1.5 dB in addition to the to 3.0 dB reduction per doubling of distance. Under soft site conditions (reduction of 4.5 dB per doubling of distance), estimated traffic noise associated with 53 vehicles per hour would attenuate to 40 dBA at 1,267 feet (0.24 mile) away, which is the estimated distance away from SH 90 that existing traffic noise would be louder than average estimated background noise at the Site.

3.8 HISTORIC AND CULTURAL RESOURCES

According to guidance provided in the NRC's NUREG-1748 (NRC, 2003a), Section 106 of the National Historic Preservation Act (NHPA) requires staff to consider the impacts on cultural resources associated with a Proposed Action. If there is potential for impacts to cultural resources, consultation with the State Historic Preservation Officer (SHPO) is required.

Cultural resources are definite locations of past human activity. These resources encompass archaeological, historic, traditional, religious, and built environment locales of importance. Qualified cultural resources professionals, consulting with their peers, Native Americans, or review authorities, conduct studies of those resources having potential to possess significance and which could be affected by development projects. In most cases, cultural resources are evaluated based on eligibility criteria for listing in the National Register of Historic Places (NRHP). NRHP significance criteria are codified under 36 CFR 60.4 and are summarized below:

The quality of significance in American history, architecture, archaeology, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association, and:

a) that are associated with events that have made a significant contribution to the broad patterns of our history; or

b) that are associated with the lives of persons significant in the past; or
c) that embody the distinctive characteristics of a type, period, or method of construction, or that represents the work of a master, or that possess high artistic value, or that represent a significant or distinguishable entity whose components may lack individual distinction; or
d) that have yielded, or are likely to yield, information important in prehistory or history.

In local and regional contexts, research questions posed in Reed and Metcalf's *Colorado Prehistory: A Context for the Northern Colorado River Basin* (1999) are often used as an additional guide for resource analyses. The book provides more specific guidance for the application of NRHP criteria and was used in the Piñon Ridge project reconnaissance inventories described in the section below.

Energy Fuels contracted with ERO Resources Corporation (ERO) to conduct archeological investigations at the Site. ERO conducted a file and literature review with the Colorado Office of Archaeology and Historic Preservation (OAHP) in Denver. The review indicated that three previous cultural resource inventories were conducted within 0.5-mile of the Site. No previously documented cultural resources occur within the 880-acre portion of the Site (ERO, 2007).

A survey conducted by Lone Mountain Archaeological Services in 1999 is the only project that resulted in the location of cultural resources - two isolated finds - within 0.5 mile of the Site. The other two previous inventories include a 6,000-acre survey by Fort Lewis College in 1975 in Montrose and San Miguel counties that resulted in the location of 22 archaeological sites, none within 0.5 mile of the Site (ERO, 2007).

ERO conducted Class III cultural resource inventories and evaluative testing for the site (ERO, 2007 and 2009a).The Site contains 880 acres located on the floor and southern edge of the Paradox Valley between Sawtooth Ridge and Davis Mesa and an additional 80 acres to the west of the Site (see Figure 1.1-1). The purpose of the inventories was to comply with Section 106 of the NHPA, as amended. The full report and its addendum provide detailed descriptions of methodology, regional temporal frameworks, and area prehistoric and historic contexts (ERO, 2007 and 2009a). ERO submitted the full report and its addendum to the SHPO and SHPO concurred with ERO's finding of "no historic properties affected". Copies of SHPO's letters to ERO indicated their concurrence is included in ERO (2007, 2009a and 2009b). On behalf of CDPHE, ERO also notified Native American tribal affiliates (ERO, 2007, 2009a and 2009b).

The 2007 ERO inventory covered the Site (all on privately owned lands) and resulted in documentation of 20 new archaeological sites and 14 isolated finds. Table 3.8-1 summarizes the newly documented sites. The sites consisted of 16 prehistoric open artifact scatters, one sheltered artifact scatter, and three historic habitation sites. Of the 20 sites documented, four are recommended eligible for listing on the NRHP and 16 are recommended not eligible. The isolated finds are not sites, buildings, structures, objects, or districts and do not meet the minimum requirements for consideration for eligibility to the NRHP. Thirteen of the prehistoric sites were located in the sagebrush flats of Paradox Valley. Four prehistoric sites were located in the pinyon-juniper woodlands of Davis Mesa. Controlled collection took place at eight sites, and six archaeological sites were trenched in order to evaluate their potential for subsurface cultural deposits (ERO, 2007).

Table 3.8-1
Cultural Resource Sites Documented at the Site[1]

Smithsonian Number	Site Type	Temporal Period	NRHP Eligibility	Status	Management Recommendation
5MN8269	Open Camp	Early Archaic to Late Prehistoric	Eligible	Collected/Excavated/Mitigated	Avoid and Monitor
5MN8270	Sheltered Camp	Late Formative	Eligible	Fully Collected	No further work
5MN8271	Open Lithic Scatter	Late Archaic/Early Formative to Late Formative	Not Eligible	Partially Collected	No further work
5MN8272	Open Lithic Scatter	Late Archaic or Early Formative	Not Eligible	Baseline Documentation	No further work
5MN8273	Open Lithic Scatter	Unknown Prehistoric	Not Eligible	Collected/Trenched	No further work
5MN8274	Open Camp	Early to Late Archaic/ Protohistoric Ute	Not Eligible	Collected/Trenched	No further work
5MN8275	Historic Habitation	EuroAmerican	Not Eligible	Baseline Documentation	No further work
5MN8276	Open Artifact Scatter	Late Paleoindian – Jimmy Allen	Not Eligible	Collected	No further work
5MN8277	Open Lithic Scatter	Unknown Prehistoric	Not Eligible	Collected/Trenched	No further work
5MN8278	Historic Habitation	EuroAmerican	Not Eligible	Baseline Documentation	No further work
5MN8279	Open Artifact Scatter	Middle Archaic – Humboldt	Not Eligible	Collected/Trenched	No further work
5MN8280	Open Lithic Scatter	Unknown Prehistoric	Not Eligible	Baseline Documentation	No further work
5MN8281	Open Lithic Scatter	Unknown Prehistoric	Not Eligible	Baseline Documentation	No further work
5MN8282	Open Lithic Scatter	Unknown Prehistoric	Not Eligible	Baseline Documentation	No further work
5MN8283	Open Camp	Basketmaker II	Not Eligible	Collected/Scraped	No further work
5MN8284	Open Lithic Scatter	Late Archaic or Terminal – Elko Series	Eligible	Baseline Documentation	Avoid and protect
5MN8285	Open Lithic Scatter	Unknown Prehistoric	Not Eligible	Baseline Documentation	No further work
5MN8286	Open Artifact Scatter	Unknown Prehistoric	Eligible	Baseline Documentation	Avoid and protect
5MN8287	Historic Habitation	EuroAmerican	Not Eligible	Baseline Documentation	No further work
5MN8288	Open Artifact Scatter	Unknown Prehistoric	Not Eligible	Baseline Documentation	No further work

[1] Source: ERO, 2007.

The 2009 ERO inventory resulted in documentation of four new archaeological sites and two isolated finds (see Table 3.8-2). Most sites are open lithic scatters. Two sites include a historic component – one consists of a historic can scatter and the other is the remains of a homestead. All but one site are recommended not eligible for listing on the NRHP due to their limited research potential beyond current documentation. A portion of site 5MN9206 is recommended eligible for the NRHP based on the potential for a buried thermal feature (ERO, 2009a).

Table 3.8-2
Cultural Resource Sites Documented at the 80-acre Well Field[1]

Smithsonian Number	Resource Type	NRHP Eligibility	Management Recommendation
5MN9206	Prehistoric	Eligible	Protect and avoid
5MN9207	Prehistoric	Not Eligible	No future work
5MN9208	Prehistoric/Historic	Not Eligible	No future work
5MN9209	Prehistoric/Historic	Not Eligible	No future work

[1] Source: ERO, 2009a.

3.9 VISUAL/SCENIC RESOURCES

Visual resources are the visible physical features of a landscape that convey scenic value and are often the dominant resource value involved in providing recreational opportunities. In bulletin NUREG-1748 the NRC environmental review guidance for licensing requests that ratings for visual resources at proposed sites follow the BLM's Visual Resource Management (VRM) System, where applicable (NRC, 2003a). An earlier guide adopted by CDPHE, USNRC Regulatory Guide 3.8 Preparation of Environmental Reports for Uranium Mills, provides no direct guidance for visual resources (NRC, 1982a).

The BLM VRM system consists of two stages – inventory and analysis. The inventory stage involves identifying the visual resources of an area and assigning them to inventory classes using BLM's visual resource inventory process. Visual quality, sensitivity, and public visibility are considered, resulting in VRM classifications. This process results in assigning VRM classes to visual resources within a BLM district and becomes an important component of an area's Resource Management Plan (RMP). For the analysis stage, the BLM uses its Manual 8431: Visual Resource Contrast Rating as a guide to analyze and mitigate potential visual impacts from proposed developments. The rating system was devised to ensure that an earnest attempt is made to minimize potential visual impacts (BLM, 1986).

The BLM lands surrounding the Site (which is located on private lands) are currently managed under the San Juan/San Miguel Planning Area RMP (BLM, 1985). According to this document, none of the BLM lands within immediate vicinity of the Site have designated VRM classifications. In most cases, proposed development activities on these lands would require site-specific visual quality objectives and design guidelines (BLM, 1985). BLM's Dolores River Canyon Wilderness Study Area, the eastern-most edge of which lies approximately 2 miles west of the Site, is managed as VRM Class I area, the most sensitive class (BLM, 1985). Here, the objective is to preserve the existing character of the landscape. The level of change to the characteristic landscape should be very low and must not attract attention (BLM, 1984). Some other BLM lands in the region are managed as VRM Class II areas. The objective in Class II areas is to retain the existing character of the landscape. The level of change to the characteristic landscape should be low. Management activities may be seen, but should not attract the attention of the casual observer. Any changes must repeat the basic elements of form, line, color, and texture found in the predominant natural features of the characteristic landscape (BLM, 1984).

The Site is located in the relatively isolated and unaltered landscape near the center of the Paradox Valley, in an area known locally as East Paradox Valley. The valley lies on the eastern edge of Montrose County near the Utah border. Paradox Valley is atypical for the area in that it is a wide plane sharply defined by the steep mesa cliffs and bluffs that bound it – an area known as Carpenter Ridge on the north and Davis Mesa on the south. A huge trough-like feature, the valley was formed when a salt dome collapsed (USDI, 2009). Elsewhere in the vicinity, landscapes more common to the Colorado Plateau are found, including the rugged, tight-twisting canyonlands carved out by the Dolores and San Miguel river drainages.

Most visitors to the valley use Colorado SH 90 to access nearby small towns, recreation sites in the Manti La Sal National Forest and area BLM lands, and sites along the scenic gorges of the Dolores and San Miguel rivers. Figures 3.9-1 and 3.9-2 show two key observation points (KOPs) from which observers might be exposed to the Site from SH 90. Other visitors to the valley include recreationists on the Dolores River. The Dolores River bisects Paradox Valley near the unincorporated settlement of Bedrock, Colorado, about 7.2 miles northwest of the Site. The nearby Dolores River Canyon Wilderness Study Area is on BLM-administered lands adjacent to the Paradox Valley. Hunters also utilize both the valley bottom lands and adjacent mesa and ridge forest lands (see Section 3.1.2.3 for more information on hunter use). Figure 3.9-3 represents a view of the Site and Paradox Valley hunters or other recreationists might encounter from near the top of Davis Mesa. Remnants of past mining activity can be seen in the foreground.

Figure 3.9-1
KOP 1: Northbound State Highway 90 Viewpoint Showing Visual Resources and Site

Figure 3.9-2
KOP 2: Southbound State Highway 90 Viewpoint Showing Visual Resources and Site

Figure 3.9-3
View from Davis Mesa to the Piñon Ridge Site and Paradox Valley

At an average width of about 2 miles, the Paradox Valley provides dynamic background vistas of the La Sal Mountains to the northwest, a grand focal feature for travelers heading northwest on SH 90. Observers traveling southbound toward Naturita can find panoramic views that include Davis Mesa and the snow-capped peaks of Mount Wilson in the distance. Foreground views for SH 90 observers are comprised of flat to gently rolling planes covered with sagebrush dominated vegetation commonly used by elk and mule deer in the winter. Middleground landscapes are dominated by the red, beige, and brown striated cliff faces of Carpenter Ridge, and the coarse greenish flanks of Davis Mesa, shrouded in pinyon-juniper vegetation cut with jagged horizontal rock formations. Figures 3.9-4 and 3.9-5 show some landscapes encountered by observers traveling on SH 90. Near Bedrock, irrigated agricultural land is a common foreground landscape feature. Occasional scattered piles of multi-colored badlands round out the diverse landscape characteristics of the Paradox Valley.

Figure 3.9-4
La Sal Mountains and the Paradox Valley from Northbound State Highway 90

Figure 3.9-5
Davis Mesa, Open Pit Mine, and Distant Mt. Wilson from Southbound State Highway 90

Currently, a straight dirt road paralleled by a timber-poled powerline and primitive cattle fence run south from SH 90 along the Site's eastern boundary. Sagebrush has been removed in some portions of the Site creating swaths of mixed grasslands along the west and southern portions of the Site. Southeast of the Site, the topsoil from the nearby surface mine was spread over approximately 80 acres and seeded with grass. These activities have created bands of sagebrush alternating with bands of grasses. Adjacent to the Site's southeastern boundary is an open pit mine and overburden pile (material stripped during mining operations), both of which cover approximately 190 acres total. The overburden pile (see Figure 3.9-6) is about 0.45 miles wide and over 200 feet high, and is most visible to SH 90 observers traveling south through the Paradox Valley. The landscape feature's form blends in with the existing natural contours of surrounding Davis Mesa, but the pile's light color and lack of congruent vegetation signal a marked contrast. The vegetation band pattern, overburden pile, waste rock dumps, mine buildings, and the circuitous mesh of access roads in the nearby forested bluffs are among the few existing human developments in the Paradox Valley that attract attention of the casual observer.

Figure 3.9-6
Overburden Pile from Open Pit Mine Adjacent to the Site

Most of the land in the vicinity of the Site is zoned as general agricultural districts. However, through a comprehensive public process, the Montrose County Commissioners recently approved a Special Use Permit for Energy Fuels to construct and operate the Mill in the Paradox Valley (Montrose County, 2009a).

3.10 SOCIOECONOMICS

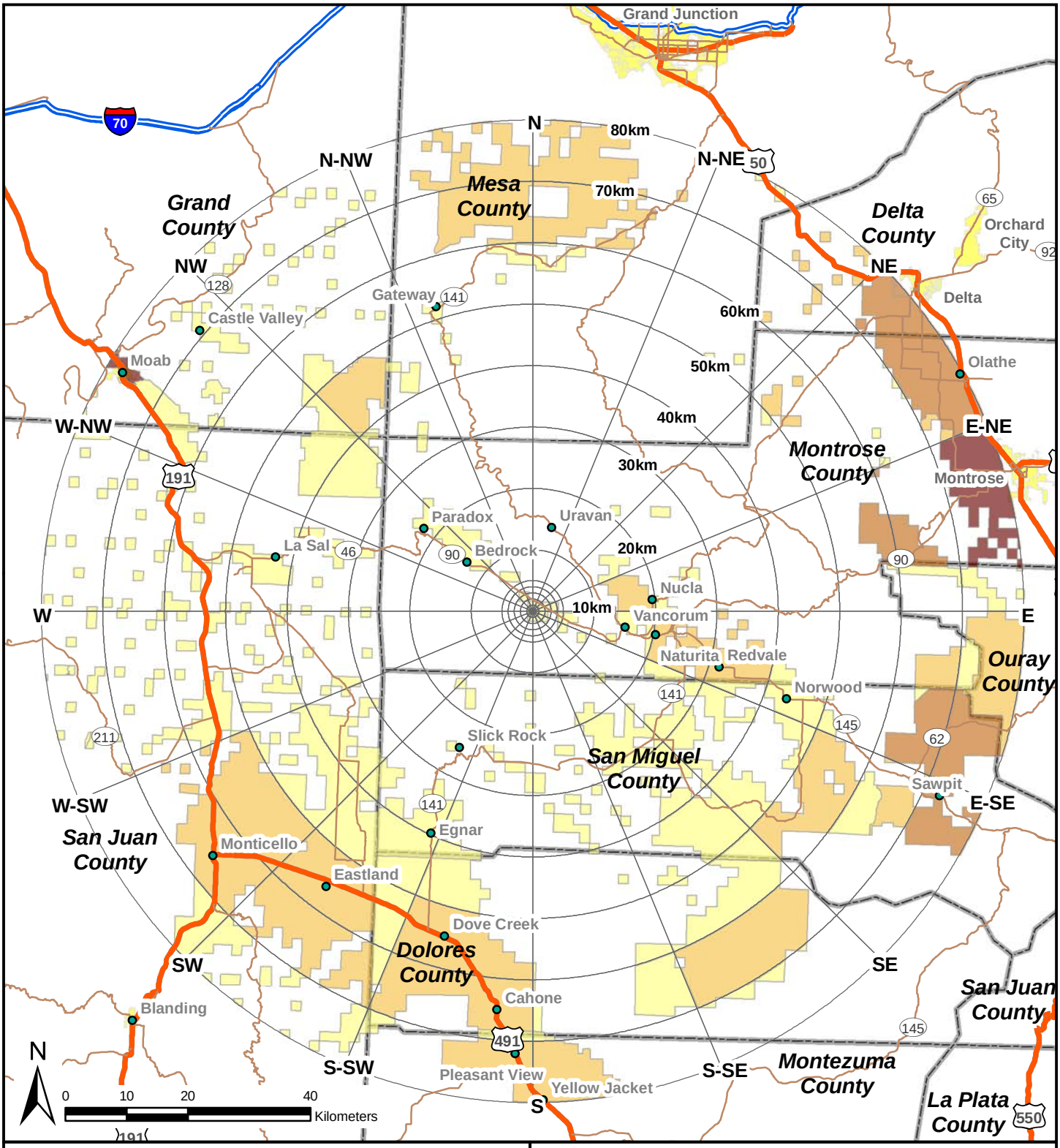
Information presented in this section addresses the demographic and social characteristics of the counties and communities that may be affected by the Proposed Action. The Site is located in a sparsely populated, rural region of western Colorado/eastern Utah that has been characterized historically by ranching and mining activities. Most of the region experienced substantial population growth during the 1990s, which has decreased since 2000. The economy of western Montrose County, where the Site is located, has contracted since uranium mining and milling activities slowed in the 1980s.

3.10.1 Regional Population

NRC Guidance for Environmental Reports for Uranium Mills requires that a proposed project's impacts on population distribution be evaluated for all areas within 50 miles (80 km) of the Site (NRC, 1982a). A 50 mile (80 km) radius around the Site includes portions of Delta, Dolores, Mesa, Montezuma, Montrose, Ouray, and San Miguel counties in Colorado, and Grand and San Juan counties in Utah. Figure 3.10-1, which is based on population estimates compiled by the Colorado State Demography Office and Utah Governor's Office of Planning and Budget, illustrates current population distributions within 50 miles (80 km) of the Site (Colorado Department of Local Affairs - CDOLA, 2009a; Utah Governor's Office of Planning and Budget, 2009).

Tables B1 through B4 in Appendix B show the expected residential population in each segment shown on Figure 3.10-1 for the expected first year of mill operation (year 2012) and census years through the anticipated life of the Mill Facility (2020 and 2030). Appendix B also discusses the methodology used to estimate future populations within each segment. Although the Mill Facility has an anticipated operational life of 40 years, the Colorado State Demography Office forecasts population through 2035 only. Therefore, within this analysis, 2035 is the final year of estimated population within each sector.

Table 3.10-1 shows the populations of all counties included in the 50 mile (80 km) radius around the Site. This discussion of regional population trends addresses county-wide populations for all counties that are partially included within a 50 mile (80 km) radius of the Site, and not the populations contained within the 50 mile (80 km) radius. As the center of commercial activity in western Colorado, Mesa County is the most populated county in the region. Montrose and Delta counties follow as the second and third most populous counties, respectively. Ouray and Dolores counties are the least populated counties in the area. During the 1980s, population growth in western Colorado was checkered. The populations of Delta and Dolores counties decreased, while population growth in Montrose County was stagnant (see Table 3.10-2). The populations of Mesa, Montezuma, Ouray, and San Miguel counties increased. Although Ouray and San Miguel counties had the highest growth rates (due in large part to their low populations), Mesa and Montezuma counties gained the most people. During this time, growth in eastern Utah was below the Utah state average. Grand County, Utah had the greatest population losses across the nine-county region, both in absolute and percentage terms. Overall, the region's population increased by 7.6 percent (0.8 percent per year) between 1980 and 1990.



Population

- 0 - 200
- 201 - 1000
- 1001 - 2500
- 2501 - UP

Figure 3.10-1

Population Distribution within 50 miles (80 km) of the Site 2009

Table 3.10-1
Population Estimates and Projections for Counties within 50 miles (80 km) of the Site[1,2]

Area	1980	1990	2000	2008	2010	2020	2030	2035
State of Colorado	2,907,856	3,304,042	4,301,261	4,939,456	5,218,144	6,287,021	7,331,876	7,819,775
Delta, CO	21,225	20,980	27,834	30,923	33,372	44,518	56,486	60,809
Dolores, CO	1,658	1,504	1,844	1,986	1,998	2,391	2,841	3,069
Mesa, CO	81,530	93,145	116,255	143,171	153,457	188,396	230,087	249,963
Montezuma, CO	16,510	18,672	23,830	25,384	26,645	32,293	38,556	41,455
Montrose, CO	24,352	24,423	33,432	40,539	44,675	59,813	74,439	80,444
Ouray, CO	1,925	2,295	3,742	4,560	4,864	6,420	6,876	7,020
San Miguel, CO	3,192	3,653	6,594	7,552	8,471	11,324	14,284	15,625
State of Utah	1,461,037	1,722,850	2,233,169	2,736,424	2,927,643	3,652,547	4,387,831	4,772,204
Grand, UT	8,241	6,620	8,485	9,589	9,693	11,007	11,827	12,141
San Juan, UT	12,253	12,621	14,413	14,969	15,053	15,319	16,653	17,333

[1] Sources: CDOLA, 2009a and Utah Governor's Office of Planning and Budget, 2009.
[2] Includes all counties that are partially within a 50 mile (80 km) radius of the Site.

Table 3.10-2
Historic and Projected Population Growth in Counties within an 50 mile (80 km) Radius of the Site, 1980 - 2035[1]

Area	1980 – 1990 (percent)	1990 – 2000 (percent)	2000 – 2010 (percent)	2010 – 2020 (percent)	2020 – 2035 (percent)
State of Colorado	13.6	30.2	21.3	20.5	24.4
Delta County	-1.2	32.7	19.9	33.4	36.6
Dolores County	-9.3	22.6	8.4	19.7	28.4
Mesa County	14.2	24.8	32.0	22.8	32.7
Montezuma County	13.1	27.6	11.8	21.2	28.4
Montrose County	0.3	36.9	33.6	33.9	34.5
Ouray County	19.2	63.1	30.0	32.0	9.3
San Miguel County	14.4	80.5	28.5	33.7	38.0
State of Utah	17.9	29.6	31.1	24.8	30.7
Grand County	-19.7	28.2	14.2	13.6	10.3
San Juan County	3.0	14.2	4.4	1.8	13.1
Nine-county region	7.6	28.6	26.1	24.6	31.3

[1] Includes all counties that are partially within a 50 mile (80 km) radius of the Site.

The 1990s were a growth period for all counties across the region. Counties regained population losses from the 1980s, and population growth rates in all counties exceeded those of the previous decade. Mesa, Montrose, and Delta counties gained the most people, and Dolores County gained the fewest. Overall, the region's population increased by 28.6 percent (2.9 percent per year) between 1990 and 2000.

Between 2000 and 2010, population growth in western Colorado is expected to outpace the statewide average growth rate. Population growth in eastern Utah is expected to remain below the (Utah) statewide average. Mesa, Montrose, and Delta counties continue to gain the most people, while Dolores and San Juan counties have gained the fewest. Overall, the region's population is expected to increase 26.1 percent (2.6 percent per year) between 2000 and 2010.

The Colorado State Demography Office and Utah Governor's Office of Planning and Budget forecast populations for their respective states. According to these agencies' forecasts, Mesa, Montrose, and Delta counties will gain the most people between 2010 and 2020, and Dolores and San Juan counties will gain the fewest (CDOLA, 2009a, Utah Governor's Office of Planning and Budget, 2009). Overall, the region's population is projected to increase 24.6 percent

between 2010 and 2020. Relative population trends within the nine-county region are expected to remain generally consistent between 2020 and 2035 (a projected decline in Ouray County's growth rate and a projected increase in San Juan County's growth rate are the exceptions). Overall, the region's population is expected to increase 31.3 percent (2.1 percent per year) between 2020 and 2035.

3.10.1.1 Age Distribution of the Regional Population

The 2008 population by age for counties within 50 miles (80 km) of the Site is shown in Table 3.10-3. Overall, 39.5 percent of the population within the nine-county region was within the prime working years of 20 to 49. As a portion of county-wide population, this age group ranged from a low of 35.8 percent in Delta County to a high of 51 percent in San Miguel County, Colorado. Persons under the age of 20, who will be entering the workforce in the next 10 to 20 years, comprised 27 percent of the region's population. This age group ranged from a low of 21.1 percent in San Miguel County to a high of 34.8 percent in San Juan County, Utah.

Table 3.10-3
Population by Age for Counties within a 50 mile (80-km) Radius of the Site, 2008[1,2]

Area	Under 5 Years	5 to 19 Years	20 to 34 Years	35 to 49 Years	50 to 64 Years	65 Years and Older
Number of people						
Delta County, CO	1,788	6,000	5,278	5,905	6,329	5,977
Dolores County, CO	116	341	304	398	454	324
Mesa County, CO	10,010	29,277	30,610	28,464	26,517	20,793
Montezuma County, CO	1,613	5,486	4,264	5,057	5,388	3,953
Montrose County, CO	2,795	8,725	7,605	8,286	7,778	6,370
Ouray County, CO	211	842	741	976	1,183	673
San Miguel County, CO	451	1,219	1,565	2,480	1,877	340
Grand County, UT	522	1,892	1,925	1,807	1,941	1,236
San Juan County, CO	959	4,251	3,588	2,522	2,049	1,600
Percent of county population						
Delta County, CO	5.7%	19.2%	16.9%	18.9%	20.2%	19.1%
Dolores County, CO	6.0%	17.6%	15.7%	20.5%	23.4%	16.7%
Mesa County, CO	6.9%	20.1%	21.0%	19.5%	18.2%	14.3%
Montezuma County, CO	6.3%	21.3%	16.6%	19.6%	20.9%	15.3%
Montrose County, CO	6.7%	21.0%	18.3%	19.9%	18.7%	15.3%
Ouray County, CO	4.6%	18.2%	16.0%	21.1%	25.6%	14.5%
San Miguel County, CO	5.7%	15.4%	19.7%	31.3%	23.7%	4.3%
Grand County, UT	5.6%	20.3%	20.6%	19.4%	20.8%	13.3%
San Juan County, CO	6.4%	28.4%	24.0%	16.8%	13.7%	10.7%

[1] Sources: CDOLA, 2009a and Utah Governor's Office of Planning and Budget, 2009.
[2] Includes all counties that are partially within a 50 mile (80 km) radius of the Site.

The portion of the region's population that is within retirement years (age 65 and older), comprised 14.6 percent of the region's population. This age group ranged from a low of 4.3 percent in San Miguel County to a high of 19.1 percent in Delta County.

3.10.1.2 Minority and Low Income Populations within the Regional Population

In 2008, 80.4 percent of the total population of the nine counties within a 50 mile (80 km) radius of the Site was classified as white. Indians and persons of Hispanic origin comprised 5.3 percent and 12 percent, respectively. The populations of all other racial categories accounted for less than 1 percent of the population across all nine counties (U.S. Census Bureau, 2009a).

With the exception of lower proportions of African-American populations, the racial characteristics of Delta, Dolores, Mesa, Montrose, Ouray, and San Miguel counties are similar to the racial characteristics of the State of Colorado. Similarly, the racial characteristics of Grand

County, Utah are comparable to the racial characteristics of the state of Utah (see Table 3.10-4). American Indians account for 13.8 percent of the population of Montezuma County, Colorado, and 54.3 percent of the population of San Juan County, Utah. These are larger proportions than the share of American Indian populations within the statewide populations. American Indians comprise 1.2 percent of Colorado's population and 1.4 percent of Utah's population. This is because Montezuma County contains the Ute Mountain Indian Reservation and San Juan County contains Navajo Nation tribal lands. Both reservations are outside the 50 mile (80 km) region that is centered on the Site.

Table 3.10-4
Percent of Minorities in Counties within a 50 mile (80 km) Radius of the Site, 2008[1]

Area	African American (percent)	American Indian (percent)	Asian or Pacific Islander (percent)	Hispanic, any Race[3] (percent)	Total Minority (percent)
State of Colorado	4.3	1.2	2.8	20.2	28.5
Delta County	0.7	0.9	0.6	13.4	15.5
Dolores County	0.1	2.7	0.5	5.3	8.5
Mesa County	1.0	1.1	0.8	12.1	15.0
Montezuma County	0.5	13.8	0.5	9.7	24.4
Montrose County	0.7	1.4	0.7	17.6	20.4
Ouray County	0.1	0.9	0.3	5.6	6.9
San Miguel County	0.3	0.9	1.0	9.0	11.1
State of Utah	1.3	1.4	2.7	12.0	17.4
Grand County	0.4	5.3	0.3	6.6	12.6
San Juan County	1.4	54.3	0.8	5.2	61.9

[1] U.S. Census Bureau, 2009a.
[2] Includes all counties that are within a 50 mile (80 km) radius of the Site.
[3] Hispanic origin is considered an ethnicity, not a race. Hispanics may be of any race.

In 2000 (the most recent year for which household poverty data are available from the U.S. Census Bureau), persons in poverty comprised 9.3 percent of the population in Colorado and 9.4 percent of the population in Utah (U.S. Census Bureau, 2000a). In that year, 12.8 percent of the total population of the nine counties within an 80 km radius of the Site had incomes below the poverty level. San Juan County, Utah, and Montezuma County, Colorado had the highest portions of low-income households; 31.4 percent of the households in San Juan County and 16.4 percent of the households in Montezuma County had incomes below the poverty level (see Table 3.10-5).

Table 3.10-5
Percent of Persons in Poverty in Counties within a 50 mile (80 km) Radius of the Site, 2000[1,2]

Area	Median Household Income	Percent of Households with Incomes Below Poverty Level
State of Colorado	$47,203	9.3
Delta County	$32,785	12.1
Dolores County	$32,196	13.1
Mesa County	$35,864	10.2
Montezuma County	$32,083	16.4
Montrose County	$35,234	12.6
Ouray County	$42,019	7.2
San Miguel County	$48,514	10.4
State of Utah	$45,726	9.4
Grand County	$32,387	14.8
San Juan County	$28,137	31.4

[1] Source: U.S. Census Bureau, 2000a.
[2] Includes all counties that are partially within a 50 mile (80 km) radius of the Site.

3.10.2 Local Population

Communities in western Montrose County are most likely to experience the socioeconomic impacts from the Proposed Action. The towns of Naturita and Nucla, and the unincorporated communities of Bedrock and Paradox, are within 20 miles (32 km) of the Site and have the highest potential for population, job, and/or income growth or destabilization associated with the project. According to local sources, the Mill Facility would be likely to attract most of its workers from western Montrose County (Lear, 2009 and Sullivan, 2009). Energy Fuels also expects to draw some workers from Norwood, in northern San Miguel County, and from unincorporated communities composed of former miners near La Sal in eastern San Juan County, Utah (Filas, 2009). Both of these areas are approximately 35 miles from the Site. While the project may attract some workers from Norwood and La Sal, the majority of mill workers would be likely to reside in western Montrose County. Thus, the potential for growth or destabilization to housing, schooling, and public safety and emergency services is also highest in communities in western Montrose County.

Growth that has occurred in Montrose County since 1980 has largely been on the east side of the county. In 1980, the City of Montrose and Town of Olathe, which are located along the U.S. Highway 50 corridor in eastern Montrose County, accounted for 41 percent of the county's population (Table 3.10-6). By 2008, almost 49 percent of the county's residents lived in these two municipalities. As of 2008, the towns of Naturita and Nucla, in western Montrose County had not yet recovered their population losses from the 1980s. Although the populations of both towns grew during the 1990s, only Naturita's population increased between 2000 and 2008. U.S. Census population data are not available for the unincorporated communities of Bedrock and Paradox. According to on-line sources, the Bedrock community had approximately 230 residents in 2008 (RealTravel, 2008) and Paradox community had approximately 250 residents in 2009 (Paradox Valley School, 2009).

Table 3.10-6
Population of Montrose County Jurisdictions, 1980 – 2008[1]

Area	Population				Population Change		
	1980	1990	2000	2008	1980-1990	1990-2000	2000-2008
Montrose County	24,352	24,423	33,432	40,539	0.3%	36.9%	21.3%
City of Montrose	8,722	8,854	12,334	17,989	1.5%	39.3%	45.8%
Town of Naturita	819	434	635	655	-47.0%	46.3%	3.1%
Town of Nucla	1,027	656	734	732	-36.1%	11.9%	-0.3%
Town of Olathe	1,262	1,263	1,573	1,742	0.1%	24.5%	10.7%
Unincorporated areas	12,552	13,216	18,156	19,421	5.5%	37.4%	7.0%

[1] CDOLA, 2009a.

Norwood and La Sal are small communities. Population trends in the Town of Norwood are consistent with those in western Montrose County. Between 1980 and 1990, Norwood's population fell from 478 to 429 residents. Although the town's population has increased since 1990, its 2008 population of 462 residents remained below its 1980 population (CDOLA, 2009a). The 2000 Census provides the most recent population count for the unincorporated community of La Sal. Unlike Bedrock and Paradox, La Sal is a Census Designated Place, or CDP. In 2000, the La Sal CDP had 339 residents (U.S. Census Bureau, 2000a).

3.10.2.1 Resident Tenure

The limited data available on households' residency patterns suggest that most of the people who live in Montrose County are year-round residents, and that people who live in western Montrose County tend to be long-term residents of the county. Information on housing vacancies and length of residency is collected in the decennial census. According to the 2000 Census, 17.7 percent of the vacant housing units in Montrose County were unoccupied because they were used for seasonal, recreation or occasional use. By way of contrast, 79.7 percent of the vacant housing units in San Miguel County, where Telluride is located, were unoccupied due to seasonal, recreation, or occasional use. In 2000, 75.2 percent of the residents of the Nucla Census County Division (CCD) had lived in Montrose County for at least 5 years, compared to 72 percent of residents of the Olathe CCD and 69 percent of Montrose CCD residents (U.S. Census Bureau, 2000a).

3.10.2.2 Transient Populations

Historically, farms and orchards in eastern Montrose County have attracted seasonal farm workers. For the past several years, the number of migrant workers in the county has been declining. The decrease in seasonal workers is due to several factors, including a decreasing number of orchards in Montrose County, a reduction in the amount of hand-work required in agriculture, an increase in the presence and enforcement activities of the U.S. Citizenship and Immigration Services, and a reduction in the need for independent migrant labor as several companies employ their own laborers (Economic and Planning Systems, Inc., 2003). The CDLE estimates that 368 non-immigrant farm workers will be working in Delta and Montrose counties between June and December 2009 (CDLE, 2009). Most of these workers are likely to be working on orchards on the eastern side of Montrose County (Leon, 2009).

3.10.3 Surrounding Population

NRC Guidance for Preparation of Environmental Reports for Uranium Mills requires the tabular description of neighboring schools, plants, hospitals, and residential areas within 5 miles (8 km) of the Site (NRC, 1982a). In order to identify the population within 5 miles (8 km) of the Site, in June 2009, Energy Fuels conducted a review of the Montrose County Assessor's Office GIS database available through the Southwest Data Center (Southwest Data Center, 2009). Based on the property data available, 70 parcels with 41 unique owners were identified as being partially within 5 miles (8 km) of the Site. In addition to the mill, only seven of these parcels had addresses. Energy Fuels obtained two of the addresses for off-site monitoring locations and identified the remaining five properties as having potential residences. Five residences on four of the properties were field-verified by Energy Fuels personnel between June 13 and June 17. No residence was observed on the fifth property. Based on consultation with local law enforcement officials, Energy Fuels identified a possible additional residence on Monogram Mesa. Field verification on June 18 identified this residence as a hogan with various out-buildings. Although no residents were on the property, nor did it have an address or utility services, the buildings appeared to be maintained. Based on information provided by local law enforcement officials, two full-time residents are assumed to occupy the structures. Table 3.10-7 summarizes the results of Energy Fuels' residential field verifications.

Table 3.10-7[1]
Population within 5 miles (8 km) of Site[1]

Owner Name	Full-Time Residents	Part-Time Residents	Distance from the Site
Herron[2]	0	1	5.1 km west, 4.7 km north
Boren	2	1	7.6 km west, 6.1 km north
Kinder	1	0	7.6 km west, 6.1 km north
Davis/Fehlman[3]	0	3	5.3 km east, 2.7 km south
Hurdle	1	0	6.4 km east, 3.2 km south
Unknown (hogan structure)	2	0	3.7 km west, 1.0 km south
Total	6	5	

[1] Source: Rogers, 2009.
[2] In mid-June 2009, this residence was occupied on a part-time basis by one person and the property was for sale. For modeling purposes, two full-time residents were assumed, dependent on the future sale of the property.
[3] In mid-June 2009, this residence was occupied on a part-time basis by three people. For modeling purposes, two full-time residents were assumed based on the residents' future plans.

Figure 3.10-2 shows this information graphically and extends the analysis to a 6 mile (10 km) radius. There are currently no community or commercial facilities with associated populations or visitors within 6 miles (10 km) of the Site.

3.10.4 Economic Trends

3.10.4.1 Income

Since 2000, real per-capita income levels (as measured in constant 2008 dollars) in Montrose County have been lower than real per-capita income levels for the state and many neighboring counties in western Colorado (see Figure 3.10-3). In 2007, real per-capita income was $30,156 in Montrose County, $28,211 in Delta County, $33,668 in Mesa County, $43,488 in Ouray County, $51,510 in San Miguel County, and $42,775 averaged across the State of Colorado (U.S. Bureau of Economic Analysis, 2009).

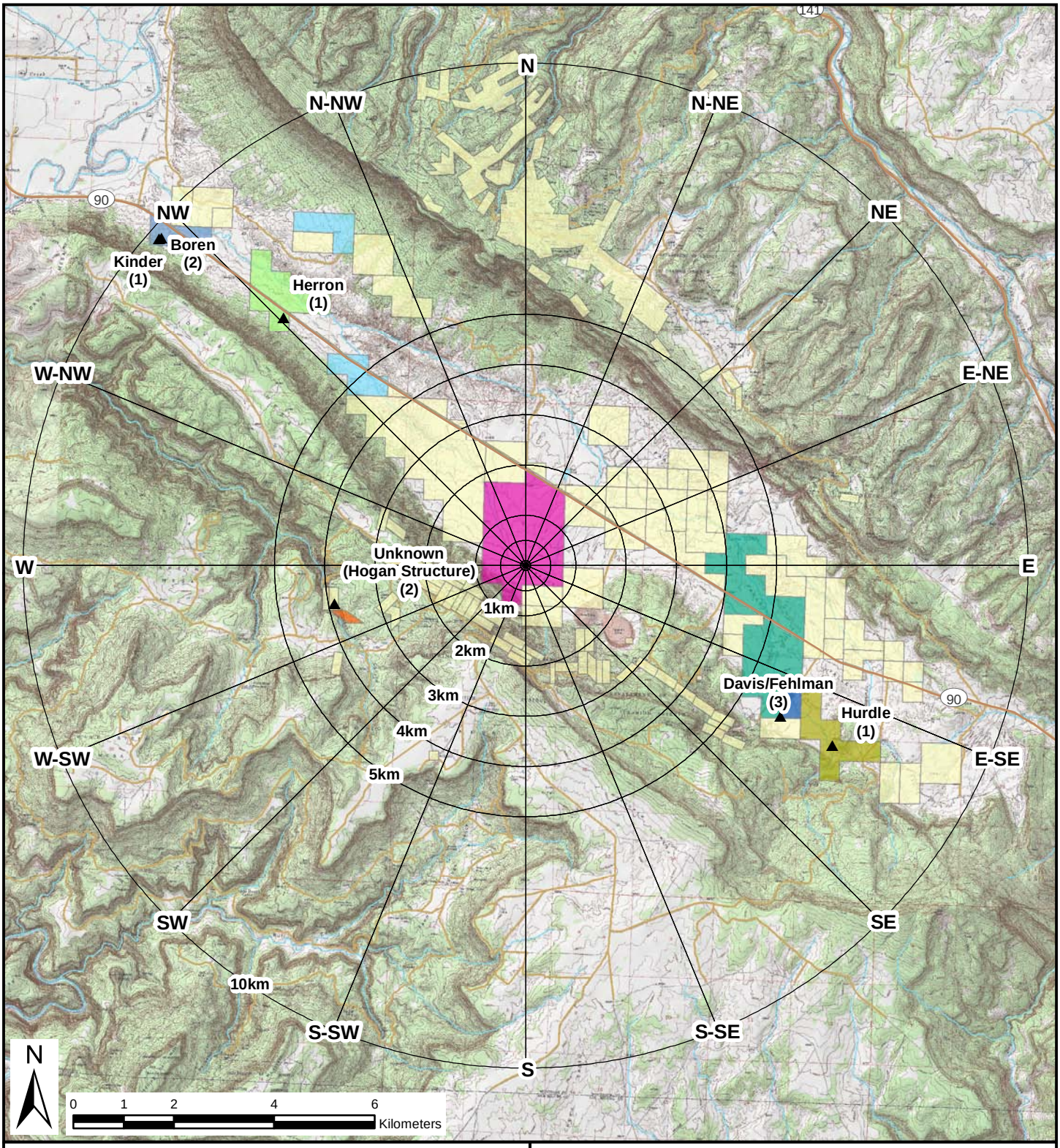
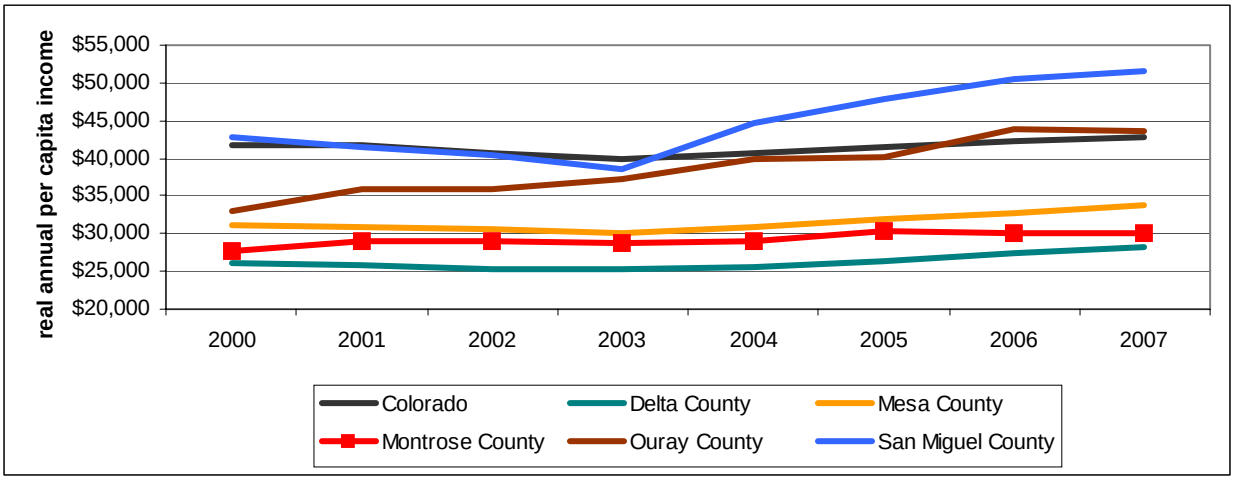


Figure 3.10-2

Population Distribution within 6 miles (10 km) of the Site 2009

Figure 3.10-3
Real Per-Capita Income in Montrose County and Surrounding Colorado Counties, 2000 – 2007[1,2]



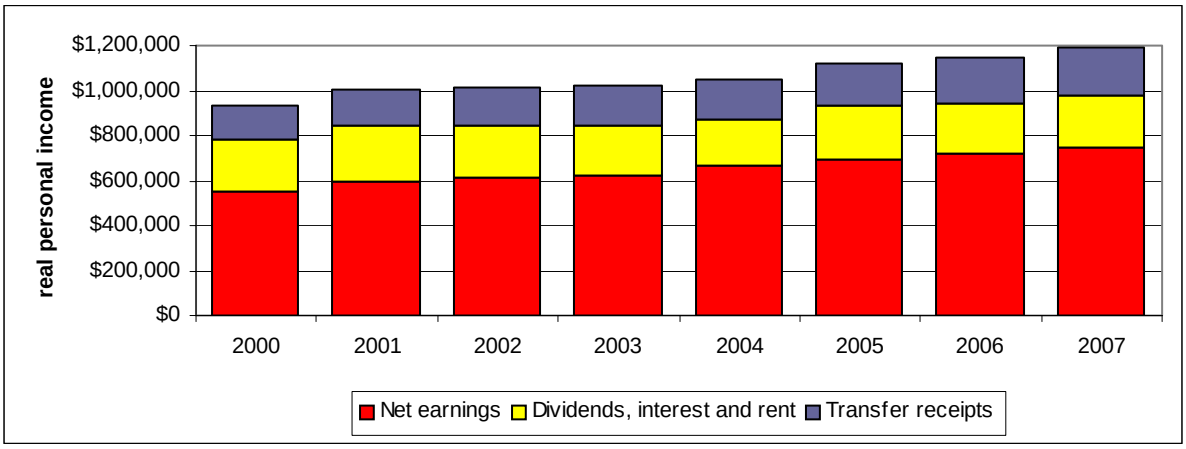
[1] Source: U.S. Bureau of Economic Analysis, 2009.
[2] All dollars expressed in constant 2008 dollars.

Between 2000 and 2007, real per capita income in Montrose County increased 8.9 percent. This was comparable to income growth in relatively-heavily populated neighboring counties. During this time, real per-capita income increased 8.1 percent in Delta and Mesa counties. Real per-capita income increased more substantially in counties with lower populations. Between 2000 and 2007, real per-capita income increased 31.6 percent in Ouray County and 20.4 percent in San Miguel County. Over this period, real per-capita income increased 2.6 percent across the State of Colorado.

Personal income is made up of net earnings, dividends, interest and rent, and personal current transfer receipts. Net earnings consist of total earnings less contributions for government social insurance adjusted to place of residence. Income from personal dividends, interest, and rent is also referred to as “investment income”. Transfer receipts are income for services not currently rendered, and include retirement, disability insurance benefits, medical payments (primarily Medicare and Medicaid), income maintenance benefits, unemployment insurance benefits, veterans benefits, and federal grants and loans to students.

Figure 3.10-4 shows that earnings comprise the majority of personal income in Montrose County. Between 2000 and 2007, net earnings comprised between 59 and 62 percent of personal income in Montrose County. During this time, investment income comprised between 20 and 25 percent of personal income, and transfer receipts comprised between 16 and 18 percent (U.S. Bureau of Economic Analysis, 2009).

Figure 3.10-4
Components of Personal Income in Montrose County, 2000 – 2007[1,2]



[1] Source: U.S. Bureau of Economic Analysis, 2009.
[2] All dollars expressed in constant 2008 dollars.

3.10.4.2 Employment

According to the CDLE, employment in Montrose County increased 28.6 percent between 2000 and 2008 (see Table 3.10-8). The decrease in employment between 2007 and 2008 reflected the national slowdown in economic activity.

Table 3.10-8
Montrose County Employment Level, 2000 - 2008[1]

Year	Employment Level
2000	15,654
2001	16,203
2002	16,855
2003	17,178
2004	18.095
2005	18.914
2006	19,608
2007	20,137
2008	19,840

[1] Source: CDLE, 2009.

Employment by Industry. The Construction, Manufacturing, Retail Trade, Health Care and Social Assistance, and Accommodation and Food Services sectors provide over 60 percent of wage employment in Montrose County (see Table 3.10-9). In 2008, average annual wages varied from a low of $14,338 in Accommodation and Food Services to highs of $56,628 in Utilities, $69,576 in Mining, and $143,312 in Management of Companies and Enterprises (U.S. Bureau of Labor Statistics, 2009a).

Table 3.10-9
Montrose County Non-Farm Employment and Wages by Industry, 2000 and 2008[1,2]

Industry	2000		2008	
	Average Employment	Average Annual Wages	Average Employment	Average Annual Wages
Total industry employment	11,869	$23,464	13,064	$32,734
Agriculture, Forestry, Fishing, Hunting	269	$18,460	229	$25,272
Mining	115	$42,692	179	$69,576
Utilities	281	$41,392	300	$56,628
Construction	1,091	$28,184	1,452	$38,480
Manufacturing	1,472	$24,440	1,325	$29,744
Wholesale trade	469	$25,948	510	$40,768
Retail trade	1,875	$20,904	2,324	$25,792
Transportation & Warehousing	515	$24,180	607	$30,628
Information	212	$22,256	241	$30,316
Finance & Insurance	302	$28,184	402	$42,744
Real Estate, Rental & Leasing	197	$19,084	326	$34,320
Professional & Technical Services	391	$27,404	537	$41,132
Mgmt of Companies & Enterprises	25	$37,128	25	$143,312
Administrative & Waste Services	413	$15,444	498	$24,076
Educational Services	NA[3]	NA	NA	NA
Health Care & Social Assistance	1,606	$24,076	2,225	$33,696
Arts, Entertainment & Recreation	156	$12,636	271	$20,176
Accommodation & Food Services	1,154	$9,204	1,192	$14,300
Other services	368	$21,320	413	$30,732
Public Administration	958	$33,748	1,037	$47,528

[1] Source: U.S. Bureau of Labor Statistics, 2009a.
[2] These employment levels exclude proprietors and farm employment.
[3] NA=not available.

Tourism-related Employment. Tourism also contributes to employment in Montrose County. A wide range of businesses, primarily within the leisure and hospitality, transportation, and retail sectors, provides travel-related goods and services. Due to its economic diversity, the tourism industry is not categorized as a distinct industry sector that can be readily evaluated through employment data reported by the Bureau of Labor Statistics. In 2008, the travel consultancy firm of Dean Runyan Associates evaluated the economic impacts of travel in Colorado (Dean Runyan Associates, 2008). This study estimated that, in 2007, approximately 990 full and part-time jobs in Montrose County were generated by overnight and day visitor spending in the county. (Note that these tourism-related employment estimates are expressed in jobs rather than workers.) One worker may have more than one job). Table 3.10-10 shows that, after rising to a high of 1,190 jobs in 2005, tourism-related employment in Montrose County fell to 990 jobs in 2007. This represents a 1 percent decrease in tourism-related jobs between 2000 and 2007.

Hunting and fishing contribute to tourism-related employment in Montrose County. In 2004, the CDOW commissioned a study estimating the economic impacts of hunting and fishing in Colorado (BBC Research & Consulting - BBC, 2008a). This study, which was revised in 2008, estimated that, in 2002 (the latest year for which hunting and fishing data have been analyzed), the total economic impacts of hunting and fishing were $23.6 million in Montrose County. The study also estimated that, in 2002, 310 jobs in Montrose County were related to hunting and fishing. These findings suggest that, while hunting and fishing contribute to economic activity in Montrose County, a substantial portion of tourism-related employment in the county is not related to hunting and fishing activities.

Table 3.10-10
Montrose County
Tourism-Related Employment, 2000 - 2008

Year	Employment (jobs)	Average Annual Earnings
2000	1,000	$16,500
2001	970	$18,454
2002	950	$18,211
2003	1,080	$21,111
2004	1,150	$20,783
2005	1,190	$20,504
2006	1,150	$23,130
2007	990	$27,374

[1] Source: Dean Runyan Associates, 2008.

Basic Industries. Several industries that are substantial sources of employment in Montrose County (*e.g.* Retail Trade, Health Care and Social Assistance, and Accommodation and Food Services) circulate money within an economy to provide local goods and services. Although they provide jobs, these industries do not inject investment from outside the county into the local economy to create industries that will export goods and services outside the county and support ancillary industries. Industries that fall into this latter category are the types of industries that drive an economy and are known as “direct basic industries” (BBC, 2008b).

Basic industries have a higher concentration of employment within the local economy as compared to a reference economy, and are identified through location quotients. Location quotients are calculated by dividing the percent of employment in an industry sector within the local economy (Montrose County) by the percent of employment in the same industry sector in the reference region (Colorado). A location quotient greater than 1.0 implies that there is a greater concentration of employment in an industry sector within a local economy as compared to the reference region. A location quotient of 1.0 implies that the concentration of employment in that industry sector is the same in the local economy as the reference region. A location quotient less than 1.0 implies that there is less employment in an industry sector as a percentage of total employment in the local economy than in the reference region. Basic industries are identified as having a location quotient greater than 1.0.

Montrose County location quotients for 2000 and 2007 for all industry sectors compared to the State of Colorado are shown in Table 3.10-11. The location quotients for 2000 and 2007 for all industrial sectors compared to the State of Colorado are shown in Table 3.10-8. The location quotients indicate several industries in Montrose County that employ a greater portion of the county’s workforce than the statewide average. These industries include Agriculture, Forestry, Fishing and Hunting, Utilities, Manufacturing, and Transportation and Warehousing. These are all typical basic industries (BBC, 2008b).

Historically, the mining industry has been a basic industry in Montrose County. Although employment in Montrose County’s mining sector increased between 2000 and 2008, the portion of the county’s workforce employed within the mining sector fell below the statewide average. Table 3.10-11 shows that employment growth in Montrose County’s mining sector has lagged the statewide average. The mining sector’s location quotient of 1.8 in 2000 indicates that there was a greater concentration of employment in Montrose County’s mining sector as compared to the statewide average. The location quotient of 0.84 shows that, in 2007, there was a lower

concentration of employment in Montrose County's mining sector as compared to the statewide average.

Table 3.10-11
Location Quotients
by Industry for Montrose County, 2000 and 2007[1]

Industry	2000	2007
Agriculture, Forestry, Fishing, Hunting	3.32	3.10
Mining	1.80	0.84
Utilities	3.85	3.49
Construction	1.20	1.53
Manufacturing	1.42	1.56
Wholesale Trade	0.86	0.79
Retail Trade	1.40	1.38
Transportation & Warehousing	1.11	1.24
Information	0.36	0.52
Finance & Insurance	0.54	0.60
Real Estate, Rental & Leasing	0.78	1.10
Professional & Technical Services	0.47	0.52
Mgmt of Companies & Enterprises	0.25	0.11
Administrative & Waste Services	0.52	0.53
Educational Services	0.09	0.06
Health Care & Social Assistance	1.55	1.47
Arts, Entertainment & Recreation	0.61	0.83
Accommodation & Food Services	1.03	0.89
Other Services	1.03	0.98
Public Administration	1.41	1.17

[1] Source: BBC, 2008b.

Major Employers in Montrose County. Most of the major employers in Montrose County are located along the Highway 550 corridor in eastern Montrose County (see Table 3.10-12).

Tri-State Generation is the largest employer in western Montrose County. Approximately 70 workers are employed at Tri-State Generation's Nucla Station coal plant. Another 28 workers are employed at the New Horizon Mine, which is owned by Western Fuels of Colorado, of which Tri-State Generation is the parent company (Sullivan, 2009). The second largest employer in western Montrose County is the San Miguel Power Association, which has 25 employees in its Nucla office (Spangler, 2009).

Some residents of Naturita and Nucla work in construction, education, small local businesses, and government offices. According to an informal survey of Bedrock and Paradox residents, many people in these communities reported that they work in ranching, truck driving, the local charter school, government (*e.g.* Colorado and Montrose County Departments of Transportation, BOR's desalination plant), and small businesses that include retail, lodging, and agricultural activities. Some residents reported that they work in construction and service industries in Telluride, and a few reported that they work out of their homes (Berger, 2009).

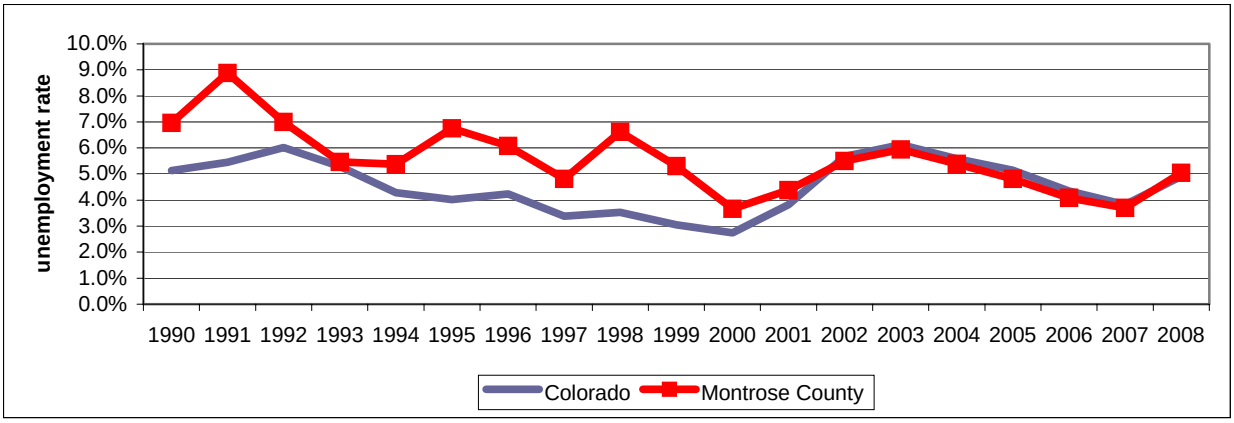
Table 3.10-12
Major Employers in Montrose County[1]

Employer	Location	Number of Employees
Montrose County School District	County-wide	850
Montrose Memorial Hospital	Montrose	530
Russell-Stover Candies	Montrose	400
Wal-Mart	Montrose	380
Volunteers of America	Montrose	350
Montrose County	Montrose	340
City Market	Montrose, Olathe	210
City of Montrose	Montrose	175
Community Options	Montrose	160
Home Depot	Montrose	120
Delta-Montrose Electric Assn.	Montrose	115
Hansen-Weatherport	Olathe	96
Gordon Composites	Montrose	90
Wells Fargo	Montrose	85
Rocky Mountain Steel	Olathe	72
Nucla Station	Nucla	70
Best Sign Systems	Montrose	59

[1] Source: Montrose Economic Development Corporation, 2009.

Unemployment Rates. During the 1990s, the unemployment rate in Montrose County was generally higher and more volatile than the unemployment rate across the State of Colorado (see Figure 3.10-5). Between 1990 and 1999, the unemployment rate varied between a low of 4.8 percent and a high of 8.9 percent in Montrose County, and 3.0 percent and 6.0 percent in Colorado (U.S. Bureau of Labor Statistics, 2009b). The county's unemployment rate has been less volatile and followed the statewide average more closely since 2000. Both unemployment rates increased between 2000 and 2003, and fell through 2007. Between 2007 and 2008, the unemployment rate increased from 3.7 percent to 5.0 percent in Montrose County and from 3.8 percent to 4.9 percent across the state.

Figure 3.10-5
Unemployment Rates in Colorado and Montrose County, 1990 – 2008[1]

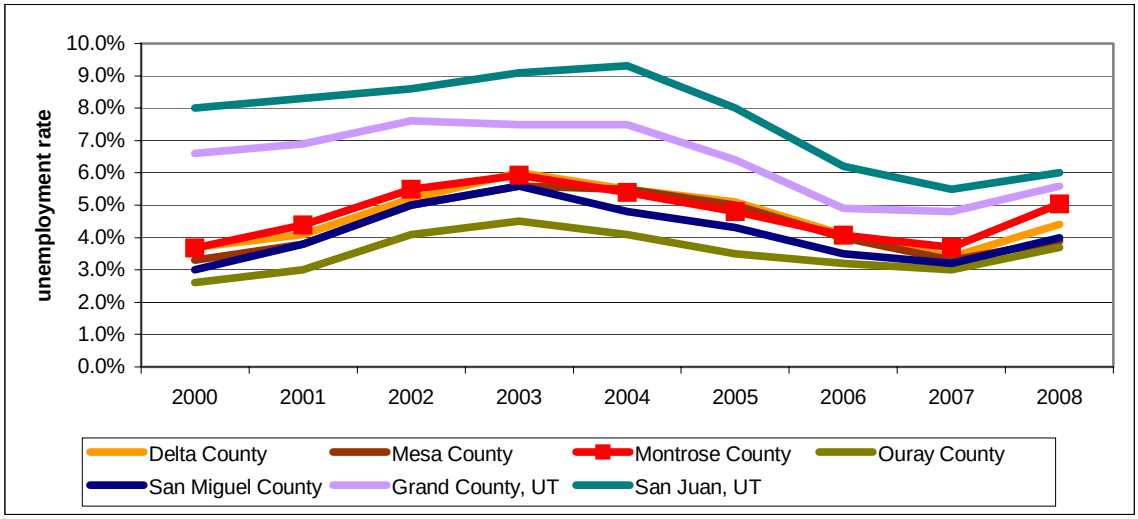


[1] Source: U.S. Bureau of Labor Statistics, 2009b.

As shown in Figure 3.10-6, the unemployment rate in Montrose County has generally been higher than unemployment rates in neighboring Colorado counties and lower than

unemployment rates in adjacent Utah counties since 2000 (U.S. Bureau of Labor Statistics, 2009b).

Figure 3.10-6
Unemployment Rates in Montrose County and Surrounding Colorado Counties, 2000 – 2008[1]



[1] Source: U.S. Bureau of Labor Statistics, 2009b.

Commuting Patterns. The decennial census collects information on commuting patterns. In 2000, 85.3 percent of Montrose County residents worked in the county (U.S. Census Bureau, 2000b). Most residents of Montrose County who worked outside the county worked in San Miguel and Delta counties (see Table 3.10-13). In 2000, 5.4 percent of Montrose County workers worked in San Miguel County and 3.7 percent worked in Delta County. Another 1.6 percent worked in Ouray County and 1.2 percent worked in Mesa County.

Table 3.10-13
Percent of Residents of Montrose County and Surrounding Counties who work in Neighboring Counties, 2000[1]

County of Work	County of Residence						
	Delta (percent)	Dolores (percent)	Mesa (percent)	Montezuma (percent)	Montrose (percent)	Ouray (percent)	San Miguel (percent)
Delta	78.6	0.0	0.3	0.2	3.7	0.3	0.1
Dolores	0.0	56.7	0.0	0.3	0.0	0.0	0.4
Mesa	3.6	0.3	95.7	0.2	1.2	0.6	0.0
Montezuma	0.0	22.3	0.0	85.5	0.0	0.0	0.8
Montrose	9.0	0.3	0.2	0.0	85.3	11.9	1.0
Ouray	0.2	0.0	0.0	0.0	1.6	72.2	0.5
San Miguel	0.5	10.6	0.1	0.9	5.4	12.4	95.3

[1] Source: U.S. Census Bureau, 2000b.

In 2000, the greatest number of non-residents working in Montrose County lived in Delta and Ouray counties. These counties are adjacent to the north and south of Montrose County, respectively, and are connected to Montrose County by U.S. Highway 50. In 2000, 9 percent of the workforce in Delta County and 11.9 percent of the workforce in Ouray County commuted to Montrose County.

The Census Bureau does not report the county in which out-of-state commuters work. In 2000, 2.7 percent of workers residing in Grand County, Utah and 10.4 percent of workers living in San Juan County, Utah worked outside the state (U.S. Census Bureau, 2000b).

Table 3.10-14 shows that, in 2000, a higher percentage of residents of western Montrose County (Nucla CCD) commuted outside the county for work than residents of eastern Montrose County (Montrose and Olathe CCDs). This is most likely due to limited employment opportunities in western Montrose County. In 2000, 31.4 percent of workers living in the Nucla CCD worked outside the county, 12.1 percent of workers living in the Montrose CCD worked in another county, and 17 percent of workers living in the Olathe CCD worked in another county (U.S. Census Bureau, 2000b).

Table 3.10-14
Montrose County Residents – Place of Employment by Percent, 2000[1]

	Resident of		
Place of employment	**Montrose CCD (percent)**	**Nucla CCD (percent)**	**Olathe CCD (percent)**
Worked in Montrose County	87.9	68.6	83.0
Worked in another Colorado county	11.2	29.1	16.5
Worked in another state	0.9	2.3	0.5

[1] Source: U.S. Census Bureau, 2000b.

3.10.5 Housing

3.10.5.1 Permanent Housing

Most of Montrose County's housing stock consists of owner-occupied single-family homes. In 2000, the latest year for which housing tenure data are available, 88 percent of Montrose County's housing units were single-family and mobile homes, and owners occupied 75 percent of occupied housing units (U.S. Census Bureau, 2000a). Between 2000 and 2008, 87 percent of residential building permits authorized in Montrose County were for single-family homes and 13 percent were for multi-family units (U.S. Census Bureau, 2009b).

According to housing estimates generated by the CDOLA, Montrose County's housing supply increased 21.5 percent between 2000 and 2008 (CDOLA, 2009b). Consistent with population trends, most housing growth has been on the eastern side of the county. According to CDOLA, between 2000 and 2008 the number of housing units increased 44 percent in the City of Montrose, 12 percent in Olathe, 4 percent in Naturita, 0 percent in Nucla, and 7 percent in other parts of the county (see Table 3.10-15).

Montrose County's housing market has slowed since 2006. According to the Montrose Economic Development Corporation, the number of residential sales in the City of Montrose fell from 797 in 2006 to 678 in 2007 and 472 in 2008. Housing prices in Montrose increased modestly: the average residential sale price increased from $218,171 in 2006 to $220,334 in 2007 (a 1 percent increase) and $223,679 in 2008 (a 1.5 percent increase) (Montrose Economic Development Corporation, 2009). According to information provided by the Montrose County Assessor's Office, between 2007 and 2008, the average residential sale price was $116,060 in Naturita, $138,915 in Nucla, and $347,440 in the Redvale/Norwood area (Johnson, 2009 and Montrose County, 2009c).

Table 3.10-15
Housing Units in Montrose County Jurisdictions, 2000 – 2008[1]

Year	Montrose County	City of Montrose	Naturita	Nucla	Olathe	Other Areas
2000	14,202	5,581	314	369	571	7,367
2001	14,475	5,948	316	369	581	7,261
2002	14,774	6,165	231	369	589	7,330
2003	15,191	6,476	323	369	598	7,425
2004	15,571	6,759	325	369	607	7,511
2005	16,070	7,121	326	369	617	7,637
2006	16,517	7,557	326	369	628	7,637
2007	17,027	7,928	326	369	633	7,771
2008	17,251	8,039	326	369	640	7,877

[1] Source: CDOLA, 2009b.

The Colorado Multi-Family Housing Vacancy and Rental Survey indicates that Montrose County's residential rental market has weakened since 2007 (see Table 3.10-16). According to the survey, which is conducted quarterly for the Colorado Division of Housing, the average vacancy rate in Montrose County increased from 4.0 percent to 5.5 percent between the third quarters of 2007 and 2008. The rental market weakened further between the first quarters of 2008 and 2009, when the average vacancy rate increased from 4.8 percent to 9.4 percent and the average rental rate fell from $611 to $595 (Von Stroh, 2009).

Table 3.10-16
Residential Vacancy and Rental Rates in Montrose County[1]

Quarter/ Year	Average Vacancy Rate	Average Rent	Quarter/ Year	Average Vacancy Rate	Average Rent
3rd Qtr – 2000	3.8%	$519	1st Qtr – 2005	1.9%	$577
1st Qtr – 2001	1.6%	$550	3rd Qtr – 2005	3.8%	$584
3rd Qtr – 2001	3.3%	$542	1st Qtr – 2006	5.1%	$573
1st Qtr – 2002	3.3%	$534	3rd Qtr – 2006	6.1%	$556
3rd Qtr – 2002	2.4%	$505	1st Qtr – 2007	5.1%	$569
1st Qtr – 2003	6.3%	$513	3rd Qtr – 2007	4.0%	$601
3rd Qtr – 2003	4.6%	$574	1st Qtr – 2008	4.8%	$611
1st Qtr – 2004	3.4%	$548	3rd Qtr – 2008	5.5%	$612
3rd Qtr – 2004	3.5%	$553	1st Qtr – 2009	9.4%	$595

[1] Source: Von Stroh, 2009.

Most housing units near the Site are single-family or mobile homes on large acreage parcels. In 2000, single-family and mobile homes accounted for 94 percent of the housing stock in the Nucla CCD, and owners occupied 77 percent of the occupied housing units (U.S. Census Bureau, 2000a). Table 3.10-17 reports housing characteristics for the towns of Naturita, Nucla, and Norwood, and the La Sal CDP. Census data on housing characteristics in the unincorporated communities of Bedrock and Paradox are not available. In 2000, single-family and mobile homes comprised 91 percent of the housing supply in Naturita, 93 percent in Nucla, 86 percent in Norwood, and 95 percent in La Sal. Owners occupied 82 percent of the occupied housing units in Naturita, 66 percent in Nucla, 63 percent in Naturita, and 58 percent in La Sal (U.S. Census Bureau, 2000a).

Multi-listing service (MLS) data from early June 2009 included 50 houses for sale in the Naturita and Nucla areas. According to local sources, the local rental market, which includes a 10-unit apartment complex in Nucla, fluctuates greatly. A local developer has plans to develop 36 two-

and three-bedroom townhouses in Naturita. Four units are currently under construction and market conditions will determine when the additional units will be built. The owner plans to sell or rent the units, depending on demand (Davis, 2009).

Table 3.10-17
Housing Characteristics in Towns near the Site, 2000[1]

Housing Characteristic	Town of Naturita	Town of Nucla	Nucla CCD	Town of Norwood	La Sal CDP
Miles from Piñon Ridge Site	13	16	NA	35	34
Population	635	734	1,258	438	339
Housing units	312	378	1,434	253	126
Occupied housing units	259	318	1,169	194	104
Owner occupied housing units	213	209	902	122	60
Renter-occupied housing units	46	109	267	72	44
Single-family and mobile homes	284	353	1,354	217	120
Multi-family units and RVs	26	23	65	34	6

[1] Source: U.S. Census Bureau, 2000a.

3.10.5.2 Short-term Housing

Short-term housing accommodations near the Site include motels, apartments, houses, mobile homes, and recreational vehicle (RV) parks. There are approximately 77 motel rooms, 11 short-term apartment/house/mobile home rentals, and 119 RV sites in the Naturita and Norwood areas (see Table 3.10-18). A mobile home park in La Sal may provide additional opportunities for RV placement.

Table 3.10-18
Short-term Housing near the Site[1]

Establishment	Location	Number of Rooms
Blake House	Naturita	9 rooms
Naturita Lodge	Naturita	10 rooms, 2 apartments
Ray Motel	Naturita	42 rooms, 4 bedroom house
Paradox Valley Inn	Paradox	3 bed & breakfast suites with kitchen, 1 room
Charley's Place	Norwood	2 bedroom house
Norwood Inn	Norwood	12 rooms
Stella's Farmhouse	Norwood	3 bedroom house
High Country RV Park	Naturita	21 full service hookups, 98 pull-through sites
San Miguel Trailer Park	Norwood	2 2-bedroom trailers, 2 3-bedroom trailers
La Sal Mobile Home Park	La Sal	Variable number of sites

[1] Sources: Nucla-Naturita Area Chamber of Commerce, 2009; Norwood Inn and Rental Properties, 2009; and Cannon, 2009.

3.10.6 Community Services

3.10.6.1 Schools

The Site is located in Montrose County's West End RE-2 school district. With the exception of the Redvale area, the West End RE-2 school district covers the portion of Montrose County that lies west of the Uncompahgre Plateau. The district includes an elementary school located in Naturita, a junior/senior high school in Nucla and a charter school in Paradox. Student enrollments in the West End RE-2 school district fell 23 percent between 2000 and 2008: from 448 students in October 2000 to 345 students in the October 2008 (see Table 3.10-19). According to enrollment records maintained by the Colorado Department of Education, grades 9 through 12 had the greatest student losses during this period (Colorado Department of

Education, 2009). Between 2000 and 2008, the pupil/teacher ratio within the West End RE-2 school district ranged between a low of 11.9 in 2005 and 2006 and a high of 15.8 in 2002.

Table 3.10-19
Student Enrollments, West End RE-2 and Norwood R-2J School Districts, Fall 2000 – Fall 2008[1]

District	2000	2001	2002	2003	2004	2005	2006	2007	2008
West End RE-2									
Student Enrollment	448	431	416	407	402	381	353	335	345
Pupil/Teacher Ratio	13.2	14.7	15.8	12.2	14.3	11.9	11.9	12.1	12.5
Norwood R-2J									
Student Enrollment	299	326	317	304	292	285	276	296	300
Pupil//Teacher Ratio	11.8	11.4	12.5	12.3	12.8	12.1	11.7	13.2	12.3

[1] Source: Colorado Department of Education, 2009.

San Miguel County's Norwood R-2J school district also serves students in western Montrose County. A portion of the Norwood R-2J school district, the majority of which covers San Miguel County west of the Uncompahgre National Forest, extends into the Redvale area of Montrose County, north of Norwood. The district has one pre-K through 12th grade school, located in Norwood. District-wide enrollments ranged from a high of 326 students in October 2001 to a low of 276 students in October 2006, and were nearly the same level in October 2008 (300 students) that they were in October 2000 (299 students). Between 2000 and 2008, the pupil/teacher ratio within the Norwood R-2J school district ranged between a low of 11.4 in 2001 and a high of 13.2 in 2007 (Colorado Department of Education, 2009).

3.10.6.2 Medical Services

Physicians and other medical practitioners in Naturita, Norwood, Montrose, and Grand Junction provide medical services to residents of western Montrose County. The Basin Clinic in Naturita is operated by Montrose Memorial Hospital to provide primary family care and 24-hour emergency medical services. The clinic's medical staff includes one full-time nurse, two part-time nurses, three physician assistants with emergency training, and a physician who visits the clinic twice a week. The clinic has a heliport in Naturita to transport patients to hospitals in Montrose or Grand Junction. According to the clinic's director, the Basin Clinic's patient-provider ratio has room for expansion (Haag, 2009).

The Uncompahgre Medical Center (UMC) in Norwood also provides primary and emergency care to area residents. UMC is one of three federally qualified community health centers on Colorado's western slope that does not deny health care based on financial limitations. UMC's medical staff includes one physician, two physician assistants, one nurse, one paramedic, and one nursing assistant. Facilities include on-site labs, x-ray and imaging services, and air service to St. Mary's Hospital in Grand Junction for emergencies.

The nearest hospitals are in Montrose and Grand Junction. Both cities are approximately 1.5 hours by road from the Site. Montrose Memorial Hospital is a full-service regional hospital with 75 beds. There are two full-service hospitals in Grand Junction. St. Mary's Hospital and Regional Medical Center has 318 beds and is a regional center for cardiovascular and orthopedic services, obstetrics, intensive care for newborns, trauma care, neurosurgery, general surgery, and women and children's services. Grand Junction's Community Hospital is an acute care facility with 78 beds.

3.10.6.3 Public Safety

The Montrose County West End Sheriff's Substation provides first-call police services in the area of the Site. The West End Sheriff's Substation is a public safety answering point that dispatches 911 calls. The substation's staff includes one sergeant, five deputies and five dispatchers. Table 3.10-20 shows the number of law enforcement calls and offenses reported to the West End Sheriff's Substation between 2006 and 2008.

Table 3.10-20
Montrose County Crime Statistics[1]

Dispatch Call	2006	2007	2008
Total law enforcement calls	5,843	5,568	5,347
Reported offenses			
Alcohol-related	28	20	38
Assault	13	19	6
Burglary	19	15	9
Death investigations	7	16	14
Disputes & disturbances	69	67	64
Drug-related	20	12	8
Motor vehicle theft	8	8	3
Property damage	3	2	4
Sex offenses	7	7	3
Theft	55	40	48
Traffic-related	589	616	826
Trespassing	20	14	23

[1] Source: Johansen, 2009.

The Nucla/Naturita Fire Protection District and Paradox Volunteer Fire Department provide fire protection services in the area of the Site. The Nucla/Naturita Fire Protection District is an all volunteer unit that provides emergency medical services, including ambulance service, and fire protection services. The Paradox Volunteer Fire Department reported that, although it has sufficient equipment to service the current population, it has had trouble attracting volunteer firefighters (Berger, 2009).

3.10.6.4 Water and Wastewater Services

The Mustang Water Authority provides potable water to the towns of Naturita and Nucla. The current water supply system, built in 2004, can supply a maximum amount of 1.2 million gallons of treated surface water per day. Average daily production is currently 300,000 gallons per day, or 25 percent of its current capacity (Carter, 2009). Individual wells provide water to several rural households in the Paradox and Bedrock areas. The Paradox Pipeline Company provides an alternative source of potable water to rural households. This member-owned cooperative currently has approximately 50 active members who typically use between 36,000 and 38,000 gallons per month per household (Oliver, 2009). Although the cooperative's supply of treated groundwater is adequate for the needs of current residents, opportunities to expand services to new households are limited by the cooperative's existing water rights.

Naturita and Nucla have lagoon system wastewater treatment plants that are currently operating below their maximum capacities. Naturita's wastewater treatment plant has a maximum treatment capacity of 200,000 gallons per day, and currently treats an average of 60,000 gallons per day (Carver, 2009). The Nucla Sanitation District's plant has a maximum treatment capacity of 300,000 gallons per day. Peak usage, which typically occurs in July, varies between 80,000 and 100,000 gallons per day (LaBondy, 2009).

In January 2009, the towns of Naturita and Nucla jointly applied to the CDPHE Water Quality Control Division's Water Pollution Control Revolving Fund for a new regional wastewater treatment plant, wastewater collection, and interceptor system to serve both towns (CDPHE, 2009b). In August 2009, the Mustang Water Authority joined the towns of Naturita and Nucla to initiate a joint feasibility study to explore options for a new regional wastewater treatment plant (Carver, 2009). Outside of Naturita and Nucla, wastewater is treated by on-site septic systems.

3.10.7 Fiscal Conditions

3.10.7.1 County Revenues

The largest sources of revenue to the Montrose County government are charges for services, federal and state revenues, property taxes, and sales and use taxes (see Table 3.10-21).

Table 3.10-21
Montrose County Budget Revenue Sources[1,2]

Revenue Source	2007	2008	2009
Property and other tax revenues	$10,782,635	$11,202,857	$11,835,053
Sales and Use taxes	$7,746	$10,154,417	$9,202,205
Licenses and permits	$529,654	$618,375	$596,675
Federal and state revenues	$15,019,291	$13,127,529	$13,554,135
Received from other governments	$1,213,546	$934,504	$1,267,876
Charges for services	$59,470,633	$63,917,641	$67,741,519
Other financing sources	$5,334,151	$3,962,253	$3,512,484
Subtotal revenues	$92,357,655	$103,917,576	$107,709,947
Internal resources	$4,829,058	$7,021,963	$5,483,768
Total resources	**$97,186,713**	**$110,939,539**	**$113,193,715**

[1] Source: Montrose County, 2009c.
[2] Non-hospital revenues.

Between 2007 and 2009, charges for services accounted for approximately 63 percent of Montrose County's revenues. These charges include clerk and recorder fees, fuel flowage charges paid to the airport by the fixed base operator, charges to inmates for personal items and telephone calls, and impact fees. In 2008, Montrose County implemented an impact fee on residential developments to fund capital improvements in the road and bridge, fairgrounds, administration, and sheriff's departments. Between 2007 and 2009, revenues from charges and fees for services increased 14 percent.

Since 2007, federal and state funds have accounted for approximately 14 percent of Montrose County's revenues. These federal and state funds are primarily grant monies used to provide Social Service and other county programs. The county's receipt of federal funds includes "payment in lieu of taxes" (PILT), which offsets a portion of property tax revenue lost from nontaxable federal lands within county boundaries. Payments are based on federal acreage in the county for all federal land agencies. Between 2007 and 2009, Montrose County PILT increased 52 percent, from $1,277,559 to $1,946,682 (USDI, 2009). Overall, federal and state revenues to Montrose County decreased 10 percent between 2007 and 2009.

Since 2007, property taxes and other tax revenues have accounted for approximately 11 percent of Montrose County's revenues. Other tax revenues include severance and cigarette taxes, which do not provide a large source of revenue to the county. Between 2007 and 2009, property taxes and other tax revenues to Montrose County government increased 10 percent (Montrose County, 2009c).

Sales and use taxes account for approximately 9 percent of Montrose County's estimated 2008 and 2009 revenues. Montrose County's original sales tax authority ended in June 2006. In November 2007 voters approved two new revenue sources: a public safety sales tax at the rate of 0.75 percent for public safety programs and a 1 percent sales and use tax for road and bridge improvements.

Additional sources of funds to Montrose County government include revenues from other governments, which primarily consist of payments from cities, other counties, and special districts as reimbursement for election costs, dispatch and law enforcement services, the housing of prisoners for other governments, and various pass-through grants. Other financing sources include terminal rents, excise tax rebates, user fee commissions, parking revenue for the airport, investment income, sale of fixed assets, and other miscellaneous sources of revenue.

3.10.7.2 Property Taxes

Mineral processing, which includes uranium milling, affects the county's fiscal status largely through the processing activity's impact on the property, or ad valorem, tax base. As shown in Table 3.10-22, Montrose County's property tax base has been increasing for the past several years. Total assessed valuation on taxable property in Montrose County grew 83 percent between 2003 and 2008; from $316.2 million to $578 million.

Table 3.10-22
Montrose County Assessed Valuation, 2003 – 2008 (million $'s)[1]

Year	2003	2004	2005	2006	2007	2008
Assessed valuation	$316.2	$330.5	$397.7	$431.2	$553.4	$578.0

[1] Source: CDOLA, 2009c.

As shown in Table 3.10-23, residential property accounts for over 40 percent of Montrose County's assessed valuation. Between 2003 and 2008, residential property accounted for 45 percent of the increase in the county's total assessed valuation. Industrial property currently accounts for less than 5 percent of the county's assessed valuation. Between 2003 and 2008, industrial activities accounted for 3 percent of the increase in Montrose County's total assessed valuation.

Table 3.10-23
Montrose County Assessed Valuation by Property Class, 2003 and 2008[1]

Class of Property	**2003**		**2008**	
	Assessed Valuation	**Percent of Total**	**Assessed Valuation**	**Percent of Total**
Vacant	$26,219,530	8.3	$69,931,840	12.1
Residential	$127,415,710	40.3	$245,623,610	42.5
Commercial	$83,784,250	26.5	$158,178,470	27.4
Industrial	$15,793,170	5.0	$24,614,920	4.3
Agricultural	$16,284,450	5.2	$17,763,480	3.1
Natural resources	$2,066,190	0.7	$6,607,160	1.1
Producing mines	$53,490	0.02	$390,160	0.1
Oil & gas	$0	0.0	$281,580	0.05
State assessed	$44,538,710	14.1	$54,655,700	9.5
Total	$316,155,500	100.0	$578,046,920	100.0

[1] Source: CDOLA, 2009c.

3.10.7.3 Town Revenues

Sales tax is the largest source of revenues to the towns of Naturita and Nucla. According to the Town Clerks, sales tax typically accounts for approximately 50 percent of each town's revenues (Lear, 2009; Smith, 2009b). Each town assesses a 4 percent sales tax. Property taxes comprise a smaller portion of town revenues. Property taxes typically comprise approximately 12 percent of Naturita's revenues (Lear, 2009) and 20 percent of Nucla's revenues (Smith, 2009b).

3.10.7.4 Severance Taxes

The State of Colorado assesses a severance tax on metallic minerals, including uranium and vanadium, of 2.25 percent of the gross income from the mining operations in excess of $19 million per year. Gross income is determined by the value of the ore immediately after its removal from the mine, and does not include any value added subsequent to mining by any treatment processes or transportation from the mine (Colorado Department of Revenue, 2009a).

Severance taxes are divided equally between CDNR and CDOLA. Half of the CDNR's portion is used to finance loans for state water projects administered by the Colorado Water Conservation Board. The other half of CDNR's portion is used to finance programs administered by the COGCC, Colorado Geological Survey - Division of Minerals and Geology, Colorado Water Conservation Board, CDOW, and the Division of Parks and Outdoor Recreation (Schrock, 2008).

CDOLA's half of severance tax revenue is distributed to local governments. Seventy percent is available through discretionary loans and grants to local governments in areas impacted by the mineral extraction industry. Local governments apply for the loans and grants, which must be used to plan, construct and maintain public facilities or to provide public services. In 2008, local governments in Montrose County received $1,835,609 in energy and mineral impact awards (see Table 3.10-24).

Table 3.10-24
Energy and Mineral Impact Awards in Montrose County, 2008[1]

Applicant	Project	Amount Awarded
Montrose County	Montrose County II35 Road Design	$55,000
Montrose County	Montrose County Master Plan Update	$190,000
Montrose County	Montrose County Septage Receiving Station	$50,000
Montrose County RE1J School District	Montrose County RE1J Support Services Bldg	$432,774
Montrose Recreation District	Montrose Recreation District Indoor Facility	$300,000
City of Montrose	Montrose Seventh Street Bridge	$360,000
West End School District RE-2	West End School District Elementary Upgrades	$350,835
West Montrose Sanitation District	West Montrose San Dist Wastewater treatment	$100,000
Montrose County Total		$1,835,609

[1] CDOLA, 2009d.

The remaining 30 percent of CDOLA severance tax revenue is distributed directly to local governments. In the past, direct local distributions were determined by the proportion of mining employment in the county. In 2008, local governments in Montrose County received $274,458 in severance tax direct distributions (see Table 3.10-25).

Table 3.10-25
Severance Tax Direct Distribution to Local Governments in Montrose County, 2008[1]

Local Government Entity	Distributed Amount
Montrose County	$144,810
City of Montrose	$44,478
Town of Naturita	$39,256
Town of Nucla	$43,486
Town of Olathe	$2,428
Montrose County total	$274,458
[1] CDOLA, 2009d.	

In 2009, the Colorado legislature passed SB08-218, which changes how CDOLA will distribute severance taxes. Beginning in the 2009 fiscal year, CDOLA's direct distributions to local governments will be based on:

- the proportion of energy industry employees within a given county to the total number of energy industry employees living in the state;
- the proportion of mine and well permits issued in a given county to the total number of such permits issued in the state; and
- the proportion of overall mineral production within the county relative to overall mineral production in the state (Schrock, 2008).

3.11 PUBLIC AND OCCUPATIONAL HEALTH

3.11.1 Background Exposure to Ionizing Radiation

Nationwide, people (non-smokers) are exposed to an average of about 310 millirems per year (mrem/yr) of natural background radiation (National Council on Radiation Protection and Measurements - NCRP, 2006). In Colorado, the average exposure rate is 400 mrem/yr (Moeller, 2006). The higher dose in Colorado is due to its higher elevation and higher terrestrial radiation, as discussed below. Table 3.11-1 presents a summary of the natural background radiation sources in the United States and in Colorado.

Table 3.11-1
U.S. Regional and Colorado Natural Background Radiation Doses

Source	U.S. Average Natural Background Radiation Dose (mrem/yr) [1]	Colorado Average Natural Background Radiation Dose (mrem/yr) [2]
Cosmic and cosmogenic radioactivity	34	50
Terrestrial radioactivity	22	49
Internal radioactivity	254	301
Inhaled radioactivity		
Rounded Total	310	400
[1] Source: National Council on Radiation Protection and Measurements, 2006. [2] Source: Moeller, 1999.		

The earth's atmosphere serves as a shield against cosmic radiation but the atmosphere provides less protection at higher elevations. In Denver, which is 5,280 feet above sea level, the

cosmic radiation dose is 50 mrem/year. Additionally flying in an airplane increases one's exposure to cosmic radiation and it is not uncommon for commercial airline crews to be exposed to 500 mrem/year.

Geography plays a major role in terrestrial radiation exposure rates. Annual exposure rates over fresh water are virtually zero because the water serves as a shield; however the dose rate over the open ocean is about 20 mrem/year because sea water contains much radioactive material of natural origin, such as radium and uranium. Soil type is also a contributor to terrestrial radiation. Above sandy soils, found along coastal plains, the terrestrial radiation levels are around 5 to15 mrem/year; for sedimentary rocks dose rates are about 30 to 55 mrem/year; and above igneous rock and soils high in uranium, such as the Colorado Plateau, doses are up to 160 mrem/year. Additionally, construction materials can factor into external radiation doses. Clay and concrete are high in radioactive substances of natural origin but, in contrast, wood does not contain radioactive substances and the dose rates inside wood structures are generally lower than those outside.

Two of the naturally occurring radionuclides that contribute to internal radiation exposure are radium and a potassium isotope found in a variety of foods. On average, the dose rate from the potassium isotope is around 15 mrem/year for women and 19 mrem/year for men. Radioactive potassium irradiates the entire body, whereas, radium is not a nutrient and the radiation is mostly absorbed by the skeleton. The amount of radium present in the body is affected primarily by what one ingests and on average is only about 1 to 2 mrem/year. Well-water consumption may increase radium intake because groundwater in some areas contains higher levels. The radium dose from eating a quarter to half-pound of Brazil nuts is more than the daily dose for workers at facilities licensed to handle radioactive materials (Moeller, 1999).

The largest natural source is inhaled radioactivity, mostly from Radon-222 and its radioactive decay products in poorly ventilated homes and buildings, which accounts for about 200 mrem/yr. Radon gas is an invisible, odorless gas that is formed from the disintegration of Radium-226. However, smoking a pack and a half of cigarettes a day will add about 1,300 mrem/year to one's effective dose.

Manmade sources such as fossil fuels, smoke detectors, glazed ceramics, fluorescent lights, luminous watches, televisions, and video display terminals are responsible for less than 3 percent of the total dose rate. The effective dose from a chest x-ray is 2 to 3 mrem. Currently, the maximum allowable dose for anyone who spends all of his or her time just outside the fence surrounding a nuclear power plant is 10 mrem/year; the equivalent of about 3 percent of the naturally occurring background-radiation dose rate (Moeller, 1999).

3.11.2 Occupational Injuries

The U.S. Department of Labor has two databases that report occupational injuries: the Census of Fatal Occupational Injuries (CFOI) and the Statistics Survey of Occupational Injuries and Illnesses (SOII). Colorado is among the few states for which the SOII does not report occupational injury data. Table 3.11-2 provides the numbers of fatal occupational injuries between 2003 and 2008 for all industries and for two subcategories – Private Industry and Mining.

Table 3.11-2
Fatal Occupational Injuries in Colorado by Selected Industries [1]

Industry	2003	2004	2005	2006	2007	2008
All industries	102	117	125	137	126	102
Private Industry	94	NA	119	124	117	93
Mining	6	7	6	3	6	6

[1] Source: U.S. Department of Labor, 2009a. More detailed information from the CFOI is available (U.S. Department of Labor, 2009b).

3.11.3 Summary of Health Effects Studies

Recent studies in the Montrose County and Colorado Plateau areas as well as the Karnes County, Texas area, the Monticello City, Utah area, and the Grants, New Mexico area have been completed specifically to investigate health status in relation to possible exposure to uranium and vanadium during mining and milling activities. Summaries are provided below:

- Researchers compared mortality rates between 1950 and 2000 in Montrose County to those in five similar counties. They concluded that there was no evidence that residents in Montrose County experienced an increased risk of dying of cancer or other diseases because of environmental exposures associated with uranium and vanadium milling and mining activities (Boice, et al., 2007).

- Researchers evaluated the mortality experiences of 1,484 men employed in seven uranium mills in the Colorado Plateau for at least 1 year after January 1, 1940 (Pinkerton, et al., 2004). The study results stated that mortality from all causes and all cancers was less than expected based on U.S. mortality rates. The study found an excess in mortality from haematopoietic and lymphatic malignancies (other than leukemia), trachea, bronchus, and lung cancer, non-malignant respiratory disease, and chronic renal disease. For workers hired prior to 1955, mortality from lung cancer and emphysema was higher, presumably because their exposure to uranium, silica, and vanadium was higher. However, mortality did not increase with employment duration. The researchers' conclusion stated that based on the study's limitations (i.e., small cohort size, inability to estimate individual exposure, lack of smoking data), that firm conclusions about the relation of increases in mortality and mill exposures were not possible.

- The same researchers that conducted the Montrose County study described above completed a mortality study for Karnes County, Texas in which they contrasted cancer rates in the county before, during, and after uranium operations (Boice, et al., 2003). The study also compared nearby counties with similar demographic characteristics. In conclusion, the study found that those cancers which might be increased following high exposures to uranium and its decay products were not elevated. The researchers qualified their conclusions with a statement that the ecological nature of the study design tempered the strength of the conclusions.

- The Utah Department of Health Office of Epidemiology completed a follow-up study for Monticello, Utah, where from 1943 to 1960 a mill processed uranium and vanadium in a location immediately adjacent to the town. The site and surrounding properties were placed on the EPA's National Priority List in 1986 and 1989 due to the chemical and radioactive contaminants associated with the mill. The initial health study in 2006 did not find conclusive evidence that the cancer rates were increasing in the Monticello area at a greater frequency than the rest of Utah. The current study found lung and bronchial

cancer significantly elevated between 1993-1997, 1998-2007, and 1973-2004 and stomach cancer between 1998 and 2004. The study's limitations included low statistical power due to Monticello's small population; lack of data prior to 1973; and the lack of adjustment or evaluation for individual factors such as smoking or family history. The study recommended further investigation and/or monitoring of the area due to the elevations of lung and bronchial cancer.

- The mortality rate of uranium mining and milling workers near Grants, New Mexico between 1955 and 1960 was analyzed (Boice, et al., 2008). The study included 2,745 men and women alive after 1978 who were employed for at least 6 months. Increased mortality due to respiratory diseases and cirrhosis of the liver was found among the underground miners, which was likely attributable to the historically high levels of radon in the uranium mines combined with the heavy use of tobacco products. There was no statistically significant elevation in any cause of death among the non-miners. The study notes that although the population was relatively small, the follow-up was long (up to 50 years) and complete.

3.11.4 Baseline Radiological Status for the Piñon Ridge Site

Energy Fuels' contractor, Environmental Restoration Group, Inc., prepared a *Baseline Radiological Investigation Report* (ERG, 2009) which provides the radiological baseline data for surface soil (0-5 and 0-15 centimeters), subsurface soils to a depth of 1 meter, vegetation, radon flux, ambient radon, and direct gamma exposure rates representative of the Site. Table 3.11-3 summarizes the scope of the radiological investigation.

Table 3.11-3
Summary of Baseline Radiological Investigation Scope

Survey Method/Endpoint	Baseline Investigation Scope	Parameters Evaluated
Gamma Survey	18-inch high bare detector gamma readings coupled with x- and y- coordinates taken every second moving along 50 to 100 m transects at ≤ 1.5ms per second. Surveys were made over the entire site along 34 transects.	Used to estimate exposure rates, surface soil Ra-226 concentrations, and to identify additional area for biased sampling
Biased Soil Sampling	Biased samples at 34 locations shown on Figures 4.1 and 4.2 (ERG, 2009). Note that PRB-33 and PRB-34 were not planned but were added during the field investigation due to elevated gamma readings in this area. Five of the 34 locations were sampled at depth (15-30 cm and 30-100 cm).	Ra-226 for most samples: Th-230, U-Nat, Pb-210, for a subset (N=5 locations, 2 at depth)
Random Soil Sampling	Random samples at 46 locations (ERG, 2009). PRR-37 and PRR-42 were not collected (replaced by addition of PRB-33 and PRB-34 noted above). All random samples were surface (0-15 cm) samples.	Ra-226 for most samples Th-230, U-Nat, Pb-210, for a subset (N=5)
Exposure and External Dose Rate of Monitoring	External dose rates were assessed using Optically Stimulated Luminescence (OSL) dosimeters at the five air monitoring stations (AMSs).	External Dose and Exposure Rates

Survey Method/Endpoint	Baseline Investigation Scope	Parameters Evaluated
Soil and Vegetation Sampling at Air Monitoring Stations	Five locations: three onsite (AMS-01, AMS-02, and AMS-03) and two located approximately 3 miles offsite (AMS-04 to the northwest and AMS-05 to the southeast). Given the diurnal nature of winds, at various times these stations would be representative of downwind and upwind locations.	Ra-226, Th-230, U-Nat, Pb-210, and Po-210
Radon Measurements	Radon flux measurements at nine locations (coinciding with biased soil samples). Ambient radon concentrations were also measured at the 5 AMSs using passive track etch detectors.	Rn-222

Following the investigation, the baseline report reached the following conclusions:

- The majority of the site exhibits exposure rates ranging between 11 and 20 micro Roentgens per hour (µR/hr), coinciding closely with the summary statistics provided in Section 3 (ERG, 2009) for non-outlier ranges. The lower range or subpopulation of readings ranging from 11 to 14 µR/hr occurs in the northern portion of the Site, coinciding with lower elevation areas.

- Readings between 14 and 20 µR/hr, corresponding to the range between the median and the non-outlier range, are found in the majority of the rest of the Site (comprising approximately 40 percent of the Site area), and appear to coincide with western and eastern drainages (see Figure 3.11-1).

- Elevated levels of radioactivity, as characterized by gamma readings greater than 20,000 cpm (counts per minute) and estimated exposure rates greater than 20 µR/hr, appear to be limited to three areas:

    1) A former drainage area in the southern portion of the Site (south of the proposed mill area), located just north of and adjacent to the offsite topsoil pile (see Figure 3.11-1);

    2) An area in the southwestern portion of the Site, near the reach of the western drainage. This area is characterized by sparse vegetation, topsoil is present at depths exceeding 1 cm, and surficial deposits of fine-grained material appear to exist.

    3) Isolated locations in the upper reaches of the eastern drainage, which were much more localized and less extensive than those noted above.

- Patterns of slightly elevated radioactivity are also apparent in the three site drainages (note darker patterns in Figure 3.11-1), where exposure rates range from approximately 15 to 17 µR/hr.

- The results based on surface soil sampling corroborate the findings discussed above regarding spatial trends of radioactivity at the Site. The majority of the Site is characterized by surface Radium-226 concentrations < 2.6 pCi/g, with a central tendency of 1 pCi/g, which is close to the national average. Areas in the southern portion of the Site exhibit higher levels of radioactivity indicative of natural and possibly historic anthropogenic influences.

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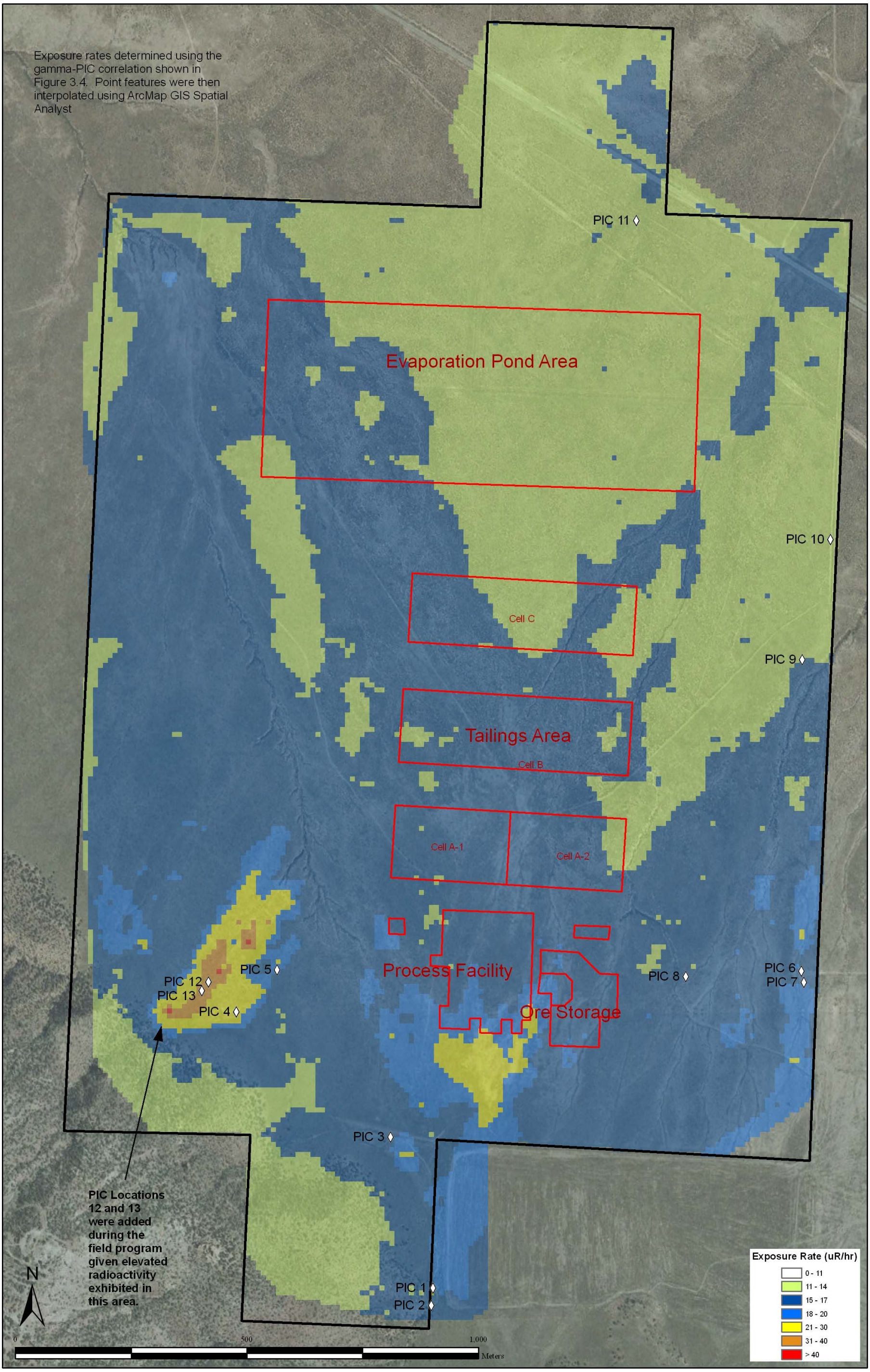
Figure 3.11-1
Exposure Rates Based on October 2007 Gamma Survey



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- Most Radium-226 concentrations at the Site range between 0.5 and approximately 1 pCi/g, close to the detection limit in some cases. However, isolated areas of elevated Radium-226 (ranging up to 24 pCi/g based on sample results) do occur, coinciding with a former drainage in the southeastern portion of the site and a sparsely vegetated area coinciding with parts of the western drainage.

- Radon-222 flux rates ranged between 0.41 and 3.78 pCi/m^2/s within the footprint of the proposed tailings area. Although Radon-222 flux rates are dependant on Radium-226 concentrations in the soil, they also vary based on soil moisture, soil type, barometric pressure, wind speed and temperature. Accordingly, flux measurements taken at the same location exhibited considerable fluctuation between monitoring events, depending on the season.

- Gamma exposure rates on the Site ranged from 101.8 mrem/yr near the highway to 127.2 mrem/yr on the south end of the Site. These dose rates represent the gamma radiation received from terrestrial and cosmic sources. The higher exposure rate at the south end of the Site is likely due to the higher Radium-226 concentrations found in the soil within this area, especially in the drainages.

- Radionuclide concentrations in vegetation are near method detection limits (MDLs) and do not correlate to radionuclide concentrations in soil for the same sample locations.

- Ambient Radon-222 concentrations ranged from 0.6 to 4.1 pCi/L and are within the expected ranges for this geographical area. The higher concentrations were recorded in the winter months when wind speeds are generally lower and there is less dispersion of radiation.

In summary, it is clear that the drainage areas within the southern quarter of the Site exhibit radiological anomalies from natural and possibly historic anthropogenic sources within the area. The natural source of the elevated radioactivity in the southern portion of the Site originates from erosion of the Salt Wash Member of the Morrison Formation, which outcrops along the flank of the mesa south of the Site. The Salt Wash Member is the uranium ore host for the nearby uranium mines. This natural source is evident by the elevated radioactivity within the drainages, especially in the extreme southern portion of the site where alluvial fans contain predominantly pebbles and cobbles of conglomeratic sandstone and sandstone with small clay galls. This detritus can be traced back to the exposed Morrison and Burro Canyon formations located further up the mesa.

Possible historic anthropogenic sources within the area include:

- Runoff and windblown dust from former ore stockpiles and existing waste rock dumps at the underground uranium mines located on the mesa south of the Site. These mining activities could have increased erosion and contributed higher levels of radioactivity (especially from the ore stockpiles) to the drainages.

- Runoff from the topsoil stockpile placed in an 80-acre parcel just south of the site in 1980 from an open pit uranium mining operation. This topsoil was removed from the area to the east where the overburden from the open pit was ultimately placed. The

topsoil was placed in a series of thin lifts and reseeded for eventual use in reclamation. The area stripped of the topsoil contained several drainages, which likely contained alluvial materials with higher radiation levels similar to those observed at the Site. The open pit was not mined down completely to the ore zone (i.e., a 20-foot layer of barren rock was left over the ore), so it is unlikely that that windblown dust from this open pit mining operation contributed to higher radioactivity levels in the area.

3.11.5 Background Air Quality Radionuclides

Energy Fuels contracted with Kleinfelder to prepare a *Meteorology, Air Quality, and Climatology, Report* for the Site (Kleinfelder, 2009i). As part of the report, Kleinfelder gathered background radionuclide data from monitors, which were installed at five locations. Data collection methods and analysis protocols are provided in that report. Table 3.11-4 presents a summary of the results of the radionuclide monitoring data.

Table 3.11-4
Radionuclide Annual Average Concentrations (µCi/mL)

Sites	Uranium	Lead-210	Radium-226	Thorium-230
Site 1	3.26×10^{-18}	2.52×10^{-15}	4.54×10^{-19}	-1.85×10^{-19} [1]
Site 2	3.36×10^{-18}	2.69×10^{-15}	6.82×10^{-18}	5.10×10^{-18}
Site 3	3.46×10^{-18}	2.36×10^{-15}	1.37×10^{-18}	4.79×10^{-18}
Site 4	3.33×10^{-18}	2.22×10^{-15}	-2.01×10^{-18} *	3.91×10^{-18}
Site 5	3.29×10^{-18}	2.54×10^{-15}	1.20×10^{-18}	2.28×10^{-18}

[1] Some radionuclides have annual averages less than zero. The negative concentrations are a result of quality control procedures by the analyzing laboratory. Occasionally, field samples have a lower radionuclide count than the laboratory blank sample used to set the "zero" point, thus, some samples have a negative concentration. Presenting negative concentrations rather than data qualifiers allows for temporal trend analysis of the data and is consistent with Section 7.5 of the NRC's Regulatory Guide 4.14. Therefore, the negative concentrations are an acceptable representation of the radionuclide concentrations collected in the Site area.

The report states, that while ambient air standards for radionuclide particulates have not been developed by the EPA, the DOE published a derived concentration guide (DCG) for inhalation doses of different radionuclides. The DCG values represent the radionuclide concentration that if inhaled, would cause a member of the public to receive an unacceptable dose of radiation. The DOE considers 100 mrem/yr an unacceptable dose of radiation. Table 3.11-5 provides the DCG values for the four radionuclides found at the Site.

Table 3.11-5
Summary of DOE-Derived Concentration Guide Values for Inhalation[1]

Radionuclide	DCGs uCi/mL
Uranium	2.0×10^{-12}
Lead-210	9.0×10^{-13}
Radium-226	1.0×10^{-12}
Thorium-230	4.0×10^{-12}

[1] Source: Kleinfelder, 2009i.

In comparison with the results in Table 3.11-4, the annual average concentrations at Sites 1, 2, 3, 4, and 5 are all at least 100 times less than the DCGs.

3.11.6 Background Radionuclides in Animal Tissue

A separate survey, *Baseline Survey of Radionuclides in Animal Tissues at the Proposed Piñon Ridge Mill Site* (Whicker, 2008), was designed to allow comparison of similar measurements during and after mill operations to assess radiological impact to animals. The report states that because uranium is radioactive, its decay leads to the formation of 17 decay products that are also radioactive (Eisenbud and Gesell, 1997). A few of these are sufficiently abundant and long-lived that they have potential biological significance. Because of the ubiquitous presence of uranium in soil and rocks, some of these radionuclides can be measured in biological tissues anywhere on earth in the complete absence of uranium mining or milling activities.

The study involved radionuclide analysis of three cottontail rabbits, three jackrabbits, and tissues from three cows. The specific tissues obtained for analysis were lung, liver, muscle, and bone. The tissues were carefully dissected, cleaned, bagged, and frozen. They were then submitted to Paragon Analytics of Fort Collins, Colorado for analysis of uranium, Th-230, Ra-226, Po-210, and Pb-210. Thirty-seven different tissue samples were submitted and a total of 106 radionuclide-specific results were obtained and reported.

The analysis reported the following results:

- In the case of the uranium measurements, of the 22 samples analyzed, only 12 exceeded the reporting limit. The other values are classified as “U”, or undetected. It is clear that the uranium contents of bone exceed those of muscle tissue, with 7 of the 12 samples containing detectable levels being bone. The error bars, representing variations among individual animals as well as laboratory uncertainties, were relatively large, with coefficients of variation (standard deviation/mean value) ranging from 0.16 to 0.62.

- All sample results from the Th-230 analyses were below the minimum detectable concentrations. This is not surprising because thorium occurs in the environment in chemical forms that are extremely insoluble, and as a result its transport through food chains is very low or negligible. Thorium isotopes are not taken up to any significant degree by plants, and when it is ingested by animals, often in the form of dust particles, the absorption fraction is very low, typically $< 10^{-4}$.

- The results for Ra-226 analyses in bone samples were much more informative and useful than for the other radionuclides. All bone samples contained Ra-226 at sub-pCi/g levels when expressed on a wet mass basis, but well above the minimum detectable concentrations, and considerably higher than measurements for human bone summarized by Eisenbud and Gesell (1997). The coefficients of variation (CV) representing differences among individual animals and laboratory uncertainties were relatively small for the jackrabbits (0.15) and cows (0.14), but higher for the cottontails (0.50). The data indicate that rabbit bone was about three-fold higher in Ra-226 than the cow bone samples.

- Measurements of Po-210 in animal tissues showed that 19 of the 27 sample analyses were below the minimum analytical detection limits, and those that exceeded the detection limits were very low (< 1 pCi/g wet tissue). Although the data reflect very low and variable levels of Po-210 in tissues, there was a tendency for the more detectable levels to occur in cow samples, particularly the liver and lung samples. The liver and kidney are known as main repositories of the small amounts of Po-210 that might be found in the body.

- Fifteen of 28 samples contained Pb-210 at levels below the minimum detectable concentration, while 13 were above. There were no apparent differences between species, but the differences between tissues were obvious. The pattern was for bone to contain the highest concentrations, lung to contain the lowest levels, while liver tissues contained intermediate amounts. Lead is well-known to be found primarily in bone, with intermediate levels in liver and kidney. Variability among individuals of the same species was relatively high, with CV values ranging from 0.34 to 1.76.

The study recommended that Ra-226 levels in bone collected from both species of rabbits be targeted as the most sensitive and useful indicator of any future changes in radiobiological conditions on the Site. The rabbits are abundant on the Site and remain on the Site over their lifetime while cattle, mule deer, and elk do not reside permanently on site. Furthermore, Ra-226 levels are readily measurable in bone with relatively small variability.

Section 4.0
Environmental Impacts, Mitigation, and Monitoring

4.1 LAND USE

4.1.1 Environmental Impacts

4.1.1.1 General Impacts

Regional and Local Land Use Patterns. As discussed in Section 3.1.1.1, public lands comprise the majority of land within the vicinity of the Site. Seventy percent of the land within a 50 mile (80 km) radius of the Site is undeveloped public land that is administered by the Bureau of Land Management (BLM) or U.S. Forest Service (Forest Service). The Proposed Action would not impact the ongoing management of these public lands for multiuse purposes. No changes in land use or conflicts with county zoning regulations are expected as a result of the Proposed Action.

The BLM manages 88 percent of the land within a 5 mile (8 km) radius of the Site. Some BLM-administered lands are used for seasonal livestock grazing, and some include DOE uranium lease tracts with currently inactive uranium mines. Private lands within 5 miles (8 km) of the Site are largely undeveloped and used for seasonal livestock grazing. Grazing lands in this area are zoned as General Agricultural Districts. There are five residences between 2.5 and 6 miles (4 and 10 km) of the Site (see Figure 3.1-2). There could be some impact from traffic to surrounding landowners who access their land from SH 90. Overall, impacts to surrounding land uses from the Proposed Action would be minimal.

Agriculture. The Proposed Action would result in the long-term loss of approximately 90 to 124 AUMs due to its displacement of 880 acres of seasonal rangeland. This loss in acreage would not adversely affect the volume of grazing forage in other grazing allotments, including the BLM's East Paradox Common Allotment, which is adjacent to the Site. No commercial crops are produced within 5 miles (8 km) of the Site, and the Proposed Action would not directly impact the use of land to grow crops elsewhere. The Mill Facility is designed as a zero discharge facility and would comply with all applicable federal and state emission standards. Therefore, the Proposed Action is not expected to affect crops. The Proposed Action would not affect the limited harvesting of trees for private use (e.g. fenceposts and firewood) that occurs on public lands within the vicinity of the Site.

Mineral Resources and Mining. The Proposed Action would stimulate uranium/vanadium ore production within the region. Existing mines, many of which have been placed on standby due to market conditions, could re-activate and have the capacity to supply the Mill Facility with feedstock ore. According to Energy Fuels, permitted mines within 180 miles (290 km) of the Site contain an estimated 4.7 million tons of uranium ore, which is sufficient to supply the Mill Facility with 500 tpd for 27 years (Filas, 2009). Therefore, no changes in land use are expected to be associated with the mining of feedstock ore for the Mill Facility. The Proposed Action would not affect other regional mining activities, including coal, natural gas, and oil production.

Recreation. The Proposed Action would result in minimal impacts to recreational activities in western Montrose County. The Site is approximately 7 miles (11 km) from the nearest launch site on the Dolores River. The Mill Facility would not impact river access or deter recreational users from floating or fishing on the river. The Mill Facility would not impact hunting on public or private lands within the vicinity of the Site.

Land Use Planning Issues. On September 30, 2009, the Montrose County Commissioners authorized use of the Site for mineral processing ("Mineral Resource Operation Facility") under a Special Use Permit (Montrose County, 2009a). The Proposed Action does not conflict with the county's updated master plan.

4.1.1.2 Construction, Operations, and Closure Impacts

4.1.1.2.1 Construction

Land use impacts during construction would include traffic-related impacts to nearby residents and recreationists and rangeland impacts. Traffic associated with construction could impact nearby landowners who use SH 90 to access their property. During the Dolores River's floating season, which typically extends between April 30 and June 15, floaters who take out at the Bedrock launch site potentially could encounter additional traffic on SH 90. Bicyclists along SH 141 could also encounter increased truck traffic. The Site would be removed from use as seasonal rangeland, which would result in the loss of approximately 90 to 124 AUMs. To the extent that hunting has been allowed on the Site in the past, construction would remove 880 acres for use by game and bird hunters.

4.1.1.2.2 Operations

Land use impacts during operations would be comparable to impacts during construction. Nearby residents and recreationists would encounter increased traffic, especially ore-hauling trucks, along SH 90 and SH 141. During the anticipated 40 year operational life of the Mill Facility, the entire 880 acre site would be unavailable for use as hunting land or seasonal rangeland. The latter would result in the on-going loss of 90 to 124 AUMs. Because existing mines within the region are capable of supplying the Mill Facility with feedstock ore throughout its operational life, no changes in land use are expected to be associated with the mining of feedstock ore for the Mill Facility, except that it would allow some of the mines currently on standby to resume production.

4.1.1.2.3 Closure

The Mill *Decommissioning Plan* (Kleinfelder, 2009b) for the Mill Facility establishes a long-term stable land configuration with a self-sustaining ecosystem that provides for environmental protection and public safety. The tailings cells, which are designed to cover approximately 90 acres, would be capped with an engineered soil cover that would satisfy relevant EPA/NRC surface stabilization requirements (i.e., 200 years and, to the extent practicable, 1,000 years without active controls). The reclaimed tailings cells and 68 acres of surrounding land would be fenced and transferred to the DOE or the State of Colorado for long-term surveillance and monitoring as described in the *Tailing Cell Closure Design Report* (Kleinfelder, 2009c). Energy Fuels would be required to provide the DOE or the State with the funds needed for the long-term surveillance and monitoring program pursuant to relevant NRC/State regulations (i.e., 10 CFR Part 40, Appendix A, Criterion 10 and 6 CCR 1007-1 Part 18 CDPHE, 2001).

Upon closure, and concurrence of NRC and State authorities on such closure, all areas of the Site, except the Restricted Tailings Cell Area, would be released for unrestricted use (i.e., returned to prior use – rangeland). Mill Facility closure would thus make 722 acres available for seasonal grazing, which, at the land's current carrying capacity, would support between 72 and 102 AUMs. Rangeland improvements during closure could increase the Site's carrying capacity and allow for the grazing of more AUMs. Mill closure would potentially return 722 acres to hunting use. The 158 acre Restricted Tailings Cell Area would be permanently removed from grazing use, resulting in the permanent loss of 16 to 22 AUMs. Mill closure would reduce traffic

impacts to surrounding landowners and recreationists. In the absence of other facilities available to mill raw uranium/vanadium ore, lands developed to supply ore to the Mill Facility could become redundant and the land reclaimed to its original use.

4.1.2 Protective/Mitigation Measures

Energy Fuels would implement the following measures to mitigate land use-related impacts resulting from the Proposed Action:

- All building and parking facility designs at the Site would conform with Montrose County development standards and would be submitted to the Montrose County Building Department for approval prior to construction.
- Upon closure, all areas of the Site except the Restricted Tailings Cell Area would be returned to rangeland.
- Upon closure, Energy Fuels would cap the tailings cells with an engineered soil cover and fence the entire Restricted Tailings Cell Area pursuant to relevant EPA/NRC/State surface stabilization requirements and guidance. Energy Fuels would provide the DOE or State of Colorado with the funds necessary to conduct long-term surveillance and monitoring of the Restricted Tailings Cell Area and funds for maintenance of fencing for 200 to 1,000 years.

4.1.3 Monitoring

Pursuant to applicable CDPHE regulations adopted in accordance with the Atomic Energy Act and NRC regulations, Energy Fuels would provide the necessary funds to the DOE or State of Colorado to conduct long-term surveillance and monitoring of the Restricted Tailings Cell Area.

4.2 TRANSPORTATION

4.2.1 Environmental Impacts

4.2.1.1 General Impacts

Traffic associated with the Proposed Action would include heavy vehicles (trucks) transporting ore, chemical reagents, and supplies to the Site, as well as light-vehicles transporting workers to the Site. Traffic would also include trucks transporting product shipments (yellowcake and vanadium oxide) from the Site. This section of the ER evaluates the potential impacts related to estimated increases in truck and light-vehicle traffic on the segments of Colorado and Utah highways that would be traversed by project-related traffic. It also evaluates the effects of project-related traffic on traffic congestion; the estimated crash rates that would result from increased traffic; the potential impacts on workers and the public from shipments of ore and chemical reagents to the Site, and shipments of yellowcake and vanadium oxide from the Site; and accidents involving the transport of materials and products to and from the Site.

CDOT Region 5 maintains federal and state highways in Montrose County, including SH 90 and SH 141. Region 4 of the Utah Department of Transportation (UDOT) maintains U.S. Highway 191 and SH 46 in San Juan County, Utah. Energy Fuels would construct and maintain the Site Access Road leading from SH 90 to the Site. The first 150 feet of this road would be paved and the remainder would be gravel. The road is designed to accommodate heavy trucks and provide good surface drainage as described in the *Site Drainage Analysis and Design Report* (Kleinfelder, 2009d). Gravel roads branching off the main access road would provide access to the ore pad and administration building. Secondary dirt or gravel roads would be constructed to provide access to all facility locations as described in the *Special Use Permit Application* (Visus, 2009). Road maintenance would include magnesium chloride or equivalent treatments and

water spray for dust suppression. Transportation impacts could result from traffic associated with the Proposed Action, especially along SH 90 and on SH 141 between Naturita and the SH 90 junction. Impacts could include vehicle crashes and potential spills or releases of ore, chemical reagents, or yellowcake from transport trucks. Impacts could also occur from vehicle/livestock collisions and increased road maintenance requirements. Other potential impacts from the projected increase in traffic, including noise levels, visual aesthetics, dust generation, and vehicle/wildlife collisions, are discussed in subsequent sections of the ER.

4.2.1.2 Construction, Operations, and Closure Impacts

4.2.1.2.1 Construction

Traffic associated with construction would include heavy-vehicles delivering materials and equipment to the Site and light-vehicles transporting workers to the Site. Approximately 2,250 truckloads of materials and equipment would be delivered during the first two quarters of construction (Golder, 2009b). Deliveries would include gravel and concrete from the local community and fencing, building steel and siding, culverts, piping, electrical, and grounding materials from regional sources. Another 4,350 truckloads of equipment and materials would be delivered between the 3rd and 7th quarters of construction. These deliveries would include gravel, fencing supplies, concrete, and petroleum products from the local area, and structural steel, plate work, and building, liner, and piping materials from all areas of the continental United States (Golder, 2009b).

Based on the anticipated materials delivery schedule, and the assumption that two construction workers would carpool to the Site in a single vehicle, Table 4.2-1 shows the average daily number of vehicles that would travel to the Site during each quarter of construction. Peak traffic would occur in the 4th quarter of construction.

Table 4.2-1
Average Daily Traffic Associated with Construction
(Number of Vehicles per Day)

Calendar Quarter	Work Qtr.	Total Construction Traffic		Traffic Originating from the East[3]		Traffic Originating from the West[3]	
		Light Vehicles[1]	Heavy Vehicles[2]	Light Vehicles	Heavy Vehicles	Light Vehicles	Heavy Vehicles
3rd Qtr 2010	1	13	13	11	12	1	1
4th Qtr 2010	2	23	13	20	12	2	1
1st Qtr 2011	3	63	9	56	8	6	1
2nd Qtr 2011	4	100	17	90	15	10	2
3rd Qtr 2011	5	100	10	90	9	10	1
4th Qtr 2011	6	75	12	68	11	8	1
1st Qtr 2012	7	5	1	5	1	1	0

[1] Light--vehicle traffic includes one vehicle for every two workers (Filas, 2009).
[2] Based on material deliveries per quarter – *Construction Plan* (Golder, 2009b).
[3] Assumes 90 percent of construction traffic comes from the east and 10 percent comes from the west (TurnKey, 2008).

Peak Trips Per Day During Construction. During construction, daily (one-way) trips to and from the Site would range from a low of 12 trips during the 7th quarter to a high of 234 trips during the 4th quarter. Table 4.2-2 shows the estimated peak number of daily trips on regional road segments during construction. The table presents additional data that are useful for evaluating the impacts of project-related traffic along affected highway segments. Such

Table 4.2-2
Peak Number of Daily Trips during Construction[1]

Highway Segment	Milepost		2008 Baseline Conditions[2]			Project Traffic		Estimated increase in traffic		
	Start	End	AADT[3]	Trucks	DHV[4]	Lt Vehicle Trips[5]	Truck Trips[6]	Total Trips	Truck Trips	Est. DHV
Colorado State Highway 90										
County Road 5.75 to Paradox	0.00	9.49	200	40	11%	20	4	12%	10%	12%
Paradox to Bedrock	9.49	14.80	NA[7]	NA	11%	20	4	--	--	11%
Bedrock to Piñon Ridge Site	14.80	23.00	530	82	11%	20	4	4.5%	4.9%	11%
Piñon Ridge Mill Site to Vancorum	23.00	33.87	530	82	11%	180	30	39.6%	36.6%	13%
Colorado State Highway 97										
SH97 (Nucla Rd) to CR EE28 in Naturita	0.00	0.32	2,000	146	11%	18	0	0.9%	0.0%	11%
Naturita to Nucla	0.32	3.93	1,600	85	11%	18	0	1.1%	0.0%	11%
Colorado State Highway 141										
US491/SH141 junction to Egnar	0.00	9.38	730	127	11%	0	16	2.2%	12.6%	11%
Egnar to K8 Road	9.38	11.27	730	173	12%	0	16	2.2%	9.2%	12%
K8 Road to SE of SH141/145 junction	11.27	44.12	480	129	12%	0	16	3.3%	12.4%	12%
SE of SH141/145 junction to NW of SH145	44.12	55.51	590	176	11%	72	16	14.9%	9.1%	12%
NW of SH145 to Naturita	55.51	60.21	1,500	222	10%	72	16	5.9%	7.2%	10%
East of SH97 to West of SH97 in Naturita	60.21	60.45	1,700	173	11%	180	16	11.5%	9.2%	12%
West of SH97 to Main Street in Naturita	60.45	60.70	2,400	228	11%	180	16	8.2%	7.0%	11%
Main Street to West 2nd Avenue in Naturita	60.70	60.80	1,200	132	11%	180	16	16.3%	12.1%	12%
Naturita to SH141/SH90 junction at Vancorum	60.80	62.44	660	121	12%	180	16	29.7%	13.2%	14%
2 miles north of SH141/SH90 junction	62.44	64.40	340	46	13%	0	16	4.7%	34.8%	13%
2 miles north of SH90 junction to Gateway	64.40	110.53	460	91	12%	0	16	3.5%	17.6%	12%
Foy Road intersection to Gateway	110.53	153.77	680	121	12%	0	16	2.4%	13.2%	12%
Gateway to Whitewater	153.77	154.11	1,400	336	12%	0	16	1.1%	4.8%	12%
U.S. Highway 491										
Junction of US491 and SH141 to County Road 6	63.27	67.95	2,400	562	11%	0	0	0.0%	0.0%	11%
County Road 6 to Utah border	67.95	69.60	2,100	573	11%	0	0	0.0%	0.0%	11%
Colorado State Highway 145										
Lone Cone Road to Market Street in Norwood	99.49	101.07	2,800	274	11%	72	0	2.6%	0.0%	11%
Market Street to Spruce Street in Norwood	101.07	101.56	2,600	200	11%	72	0	2.8%	0.0%	11%
Spruce Street to Summet Street in Norwood	101.56	102.60	2,000	194	11%	72	0	3.6%	0.0%	11%
Norwood to Redvale	102.60	110.11	1,300	126	11%	72	0	5.5%	0.0%	11%
Redvale to SH145/SH141 intersection	110.11	116.88	1,200	110	10%	72	0	6.0%	0.0%	10%
Utah State Highway 46										
Jct of SH 46 & SH 191 to La Sal Jct Post Office	0.00	9.05	600	210	NA	0	4	0.7%	1.9%	'--
La Sal Jct Post Office to Colorado state line	9.05	21.60	335	118	NA	20	4	7.2%	3.4%	'--

Highway Segment	Milepost		2008 Baseline Conditions[2]			Project Traffic		Estimated increase in traffic		
	Start	End	AADT[3]	Trucks	DHV[4]	Lt Vehicle Trips[5]	Truck Trips[6]	Total Trips	Truck Trips	Est. DHV
U.S. Highway 191										
SR95 junction to Blanding	47.26	50.41	2,760	735	NA	0	4	>0.1%	0.5%	--
800 South to 200 North in Blanding	50.41	51.66	6,915	2,187	NA	0	4	>0.1%	0.2%	--
Blanding to Verdure	51.66	65.16	2,120	744	NA	0	4	0.2%	0.5%	--
Verdure to 400 South in Monticello	65.16	71.46	2,455	946	NA	0	4	0.2%	0.4%	--
400 South to US491 in Monticello	71.46	71.86	2,610	1,039	NA	0	4	0.2%	0.4%	--
US491/US191 Jct to 600 North in Monticello	71.86	72.40	3,160	1,341	NA	0	4	0.1%	0.3%	--
600 North in Monticello to SR211	72.40	86.14	3,415	1,538	NA	0	4	0.1%	0.3%	--
SR211 to La Sal Junction (SH46)	86.14	103.45	3,735	1,703	NA	0	4	0.1%	0.2%	--
La Sal Junction to Old Airport Road	103.45	117.80	3,705	1,709	NA	0	4	0.1%	0.2%	--
Old Airport Road to La Sal Loop	117.89	123.19	5,030	2,096	NA	0	4	>0.1%	0.2%	--
La Sal Loop to 400 East Moab	123.19	124.48	9,635	3,586	NA	0	4	>0.1%	0.1%	--
400 East to Center Street in Moab	124.48	125.70	14,510	4,753	NA	0	4	>0.1%	>0.1%	--
Center Street to 500 West in Moab	125.70	126.98	9,185	2,599	NA	0	4	>0.1%	0.2%	--
500 West, Moab to SR128	126.98	128.18	9,240	2,202	NA	0	4	>0.1%	0.2%	--
SR128 to Colorado River	128.18	129.80	8,225	1,593	NA	0	4	>0.1%	0.3%	--
Colorado River to SR279	129.80	130.26	6,545	2,043	NA	0	4	>0.1%	0.2%	--
SR279 to SR313	130.26	136.73	4,835	1,958	NA	0	4	>0.1%	0.2%	--
SR313 to I-70 Crescent Junction	136.73	157.20	5,140	2,623	NA	0	4	>0.1%	0.2%	--
Interstate-70										
SR24 Hanksville Buckmaster Draw	149.20	157.94	4,085	1,601	NA	0	4	>0.1%	0.2%	--
SR6 West SR191 North	157.94	160.41	8,090	3,573	NA	0	4	>0.1%	0.1%	--
SR19 West Green River	160.41	164.55	8,870	4,359	NA	0	4	>0.1%	>0.1%	--
SR19 East Green River	164.55	175.59	8,765	4,744	NA	0	4	>0.1%	>0.1%	--
Ranch exit (Floy)	175.59	182.17	8,465	5,003	NA	0	4	>0.1%	>0.1%	--
SR191 Crescent Junction to Moab	182.17	187.42	6,800	3,882	NA	0	4	>0.1%	>0.1%	--

1 Assumes peak construction-related traffic occurs in the 4th quarter of construction (Golder, 2009b).
2 2008 traffic counts for Colorado highways from CDOT, 2009b; 2008 traffic counts for Utah highways from Butterfield, 2009.
3 AADT = average annual daily traffic.
4 DHV : the 30th highest annual hourly traffic volume reported as percent of AADT.
5 Estimated light-vehicle trips assume one vehicle for every two construction workers (Filas, 2009), 90 percent of traffic originates from the east and 10 percent originates from the west (TurnKey, 2008). Based on supply of short-term housing accommodations, the analysis assumes that 50 percent of east-bound construction worker traffic originates in Naturita, 40 percent originates in Norwood, and 10 percent originates in Nucla.
6 Estimated truck (heavy-vehicle) trips are based on material delivery schedule described in the *Mine Operations Plan* (Energy Fuels 2009d). Assumes that 90 percent of heavy-vehicle traffic originates from the east and 10 percent originates from the west. Assumes that half of heavy-vehicle traffic to the east travels north on SH 141 and half travels south on SH 141 (TurnKey, 2008).
7 NA = data not available.

information includes 2008 Average Annual Daily Traffic (AADT) for all vehicles, the number of trucks in the AADT, and current and projected Design Hour Volumes (DHV). The DHV helps assess how additional traffic would affect the existing use of a highway segment, and indicates potential areas of congestion. All road segments affected by the Proposed Action are classified as rural arterial or rural collector roads by the respective Colorado and Utah Departments of Transportation. Rural areas are expected to have a DHV between 11 and 12 percent (DOE, 2007).

Table 4.2-2 shows that nearly all affected segments of Colorado highways have DHVs within or slightly below the expected rural DHV. Currently, only the DHV for the two-mile stretch of SH 141 north of its intersection with SH 90 at Vancorum exceeds 12 percent. Although DHV data are not available for affected segments of Utah highways, the estimated increases in construction-related trips along these segments do not appear to be large enough to cause congestion.

During construction, the most heavily used public road segments would be SH 90 between the Site and Vancorum, and SH 141 between Vancorum and Naturita. Most construction-related traffic would be associated with the workforce. Based on the material delivery schedule shown in Table 4.2-1, and the assumption that there would be an average of two workers per vehicle per trip, average daily traffic on SH 90 between Vancorum and the Site would increase by 39.6 percent and the DHV would increase from 11 percent to 13 percent during the 4th quarter of construction. Average daily traffic on SH 141 between Vancorum and Naturita would increase by 29.7 percent and the DHV would increase from 12 percent to 14 percent. The greatest increases in truck traffic would occur along SH 90, between the Site and Vancorum, and on a two-mile segment of SH 141 north of Vancorum. Truck traffic would increase by 36.6 percent along this segment of SH 90, and by 34.8 percent on this segment of SH 141 during the 4th quarter of construction.

Vehicular Crashes. An estimated 21,233,869 miles would be traveled on regional public roads over the seven quarter (630 day) construction period. Based on a fatal accident rate of 0.0218 fatalities per million vehicle miles traveled on rural roads in Colorado and Utah (CDOT, 2009c; NHTSA, 2009), approximately 0.46 fatal accidents could be associated with the construction traffic. The DOE used CDOT methodology and 2004 CDOT crash data to estimate a 0.033 injury accident rate per one million miles of travel on rural state highways (DOE, 2007). Based on this, approximately 0.7 injury accidents could occur during construction.

4.2.1.2.2 Operations

During operations, trucks transporting ore to the Site would comprise a substantial portion of operational traffic. According to the *Mine Operations Plan* (Energy Fuels, 2009d), daily ore deliveries would include between 12 and 18 trucks traveling from mines in Colorado and between 8 and 12 trucks traveling from mines in Utah (see Table 4.2-3).

Table 4.2-3
Average Daily Ore Delivery Traffic
(Number of Vehicles per Day)

Ore Source	County, State	Trucks per day[1]
Green River Area	Emery County, UT	3 to 4
Monticello South Area	San Juan County, UT	2 to 3
La Sal/Lisbon Area	San Juan, UT	3 to 5
Long Park Area	Montrose, CO	0 to 1
Gateway Area	Mesa County, CO	6 to 8
Southern Area	San Miguel County, CO	3 to 4
Monogram Mesa	Montrose County, CO	3 to 5

[1] Source: *Mine Operations Plan* (Energy Fuels, 2009d).

USDOT is the primary regulatory authority for uranium ore haulage. To allow for efficient interstate commerce, the Colorado and Utah Departments of Transportation have adopted the USDOT regulations in their entirety (Energy Fuels, 2009d – *Mine Operations Plan*). USDOT regulations for transport of radioactive materials are codified in Title 49 CFR. All ore shipments would be conducted in accordance with USDOT hazardous materials shipping regulations and requirements (49 CFR Parts 171, 172, 173, 177, 178, and 179). Additionally, ore shipments would be tarped to reduce the potential for accidental spillage or fugitive dust during transportation (SENES Consultants - SENES, 2009a). *The Ore Transportation Plan* (Appendix B of the *Mine Operations Plan*) describes Energy Fuels' procedures and methods for shipping uranium ore from a mine site to an off-site mill (Energy Fuels, 2009d). The ore trucks would, in most cases, be dedicated to hauling ore from a specific mine or mines to the Mill. Prior to being released for unrestricted use, the trucks would be thoroughly washed and screened to verify that they meet regulatory standards for radiation levels.

Additional heavy-vehicle truck traffic during operations would include water trucks, tankers, and semi-trailers delivering chemical reagents and fuel. Chemical reagents, diesel fuel, and propane used to process ores would be delivered to the Site by licensed haulers in approved USDOT containers. Reagents would be transported to the Site in tankers or prepackaged totes, barrels, and bulk bags. The bulk materials are typically transported by closed tanker trucks. Bulk material transported in open trucks would be covered with tarps to reduce dusting and falling debris during transportation (SENES, 2009a). Light-vehicle traffic would include miscellaneous delivery trucks (*e.g.* UPS and FedEx), straight-day and shift workers, and visitors. With the exception of some shift worker traffic, most of this traffic would occur during daylight hours. Table 4.2-4 shows the average daily number of vehicles that would travel to the Site during operations.

Table 4.2-4
Average Daily Traffic Associated with Operations
(Number of Vehicles per Day)

Traffic Type	Days/ week	Light Vehicles		Heavy Vehicles	
		To/From East[1]	To/From West[1]	To/From East	To/From West
Ore deliveries[2]	7			12 to 17	9 to 12
Straight-day workers[3]	5	12	1		
Shift workers[4]	7	13	2		
Water trucks[5]	5			11	
Reagent and fuel deliveries[6]	5			2	6
Miscellaneous. deliveries [7]	5	3	0		
Visitor traffic[8]	5	9	1		

[1] Assumes 90 percent of light-vehicle traffic originates from the east and 10 percent originates from the west (TurnKey, 2008).
[2] Source: *Mine Operations Plan* (Energy Fuels, 2009d).
[3] Assumes 25 straight-day workers, and one light-vehicle for every two workers (Filas, 2009).
[4] Assumes three 15 man shifts working 7 days/week, and one light vehicle for every three workers (Filas, 2009).
[5] Assumes one delivery of potable water and 10 deliveries of non-potable water per day – *Water and Wastewater Plan* (Energy Fuels, 2009f).
[6] Includes six deliveries of chemical reagents from the west and two propane deliveries from the east – *Special Use Permit Application* (Visus, 2009).
[7] Includes smaller shipments of materials and parts - *Special Use Permit Application* (Visus, 2009).
[8] Source: *Special Use Permit Application* (Visus, 2009).

Additional traffic associated with operations would include product shipments from the Mill Facility. At a feedstock rate of 500 tpd, the Mill Facility would produce 2,200 pounds of yellowcake (2.5 drums) and 7,300 pounds of vanadium per day. A transport truck can carry 25 to 27 tons of cargo, or 55 to 60 drums of yellowcake. The drums would be classified by the USDOT as Type A packaging (10 CFR Part 71) and would be capped with USDOT-approved lid and clamping ring (SENES, 2009a). Approximately 50 truckloads of vanadium and 15 truckloads of yellowcake would be shipped from the Mill Facility annually (Visus, 2009). This corresponds to one truckload shipment of vanadium per week and one yellowcake truckload shipment every 3 weeks.

Most shipments of processed yellowcake and vanadium would utilize Interstate-70 or Interstate-40 for transport to their final destination. From the Mill Facility, northbound shipments would travel east on SH 90 to SH 141, north on SH 141 to U.S. Highway 50, and north on U.S. Highway 50 to Interstate-70 near Grand Junction. Yellowcake shipments to uranium hexaflouride conversion facilities in Metropolis, Illinois and Port Hope, Ontario, Canada would follow this route. Product shipments to southern parts of the country, including ports located in Texas, would travel east on SH 90 and south on SH 141 to U.S. Highway 491, then south on U.S. Highway 491 and U.S. Highway 160 to Interstate-40 near Gallup, New Mexico. With the exception of SH 90, all of these roads are designated hazardous materials routes.

Average Trips Per Day During Operation. During operations, daily trips to and from the Site would be relatively constant, consisting primarily of ore, material and water deliveries, and worker traffic. Based on the delivery and visitor schedules shown in Table 4.2-4, and the assumption that there would be an average of two straight-day workers per vehicle per trip and three shift workers per vehicle per trip, Table 4.2-5 shows the projected number of average daily trips and DHVs on affected road segments during operations.

As with the construction phase, the most heavily used public road segments would be SH 90 between the Site and Vancorum and SH 141 between Vancorum and Naturita. Total traffic would increase 24 percent along this segment of SH 90 and 18 percent along this segment of SH 141. Trucks delivering ore to the Site would represent a substantial increase in truck traffic along many road segments, including all of SH 90 and SH141 between Naturita and Gateway. On average, traffic on SH 90 would increase 20.5 percent and truck traffic would increase 80 percent. Projected increases in DHV along SH 90 due to Proposed Action traffic would exceed typical DHVs for rural roads between County Road 5.75 and Paradox (DHV increase from 11 percent to 13 percent) and the Site to Vancorum (DHV increase from 11 percent to 14 percent). Although traffic on SH 141 between Naturita and Gateway would increase by an average of only 7.7 percent, truck traffic would increase 29 percent. DHVs due to Proposed Action traffic would increase from 12 percent to 13 percent between Naturita and Vancorum, and from 13 percent to 14 percent two miles north of the SH 90/SH 141 junction. Projected increases in DHV due to Proposed Action traffic on other road segments do not exceed typical DHVs for rural roads.

Impacted Roadway Intersections. Based on anticipated ore haul routes and worker commuting patterns, the intersections that would be most affected by traffic associated with the Mill Facility would be the Site Access Road/SH 90 intersection and the SH 90/SH 141 intersection. SH 90 and SH 141 both have an “RB” access classification from CDOT, which is the basis for CDOT turn lane warrants. In 2008, Energy Fuels commissioned an independent engineering study to assess future traffic conditions and project-related traffic at these two intersections. This study reported that, according to CDOT estimates, background traffic on SH 90 would increase at an average rate of 3.40 percent per year between 2007 and 2030, and traffic on SH 141 would increase at an average annual rate of 3.85 percent (TurnKey, 2008).

Table 4.2-5
Average Number of Daily Trips during Operations[1]

Highway Segment	Milepost		2008 Baseline Conditions[2]			Project Traffic		Estimated increase in traffic		
	Start	End	AADT[3]	Trucks	DHV[4]	Lt Vehicle Trips[5]	Truck Trips[6]	Total Trips	Truck Trips	Est. DHV
Colorado State Highway 90										
County Road 5.75 to Paradox	0.00	9.49	200	40	11%	4	34	19.0%	85.0%	13%
Paradox to Bedrock	9.49	14.80	NA[7]	NA	11%	10	34	--	--	12%
Bedrock to Piñon Ridge Site	14.80	23.00	530	82	11%	10	38	9.1%	46.3%	12%
Piñon Ridge Mill Site to Vancorum	23.00	33.87	530	82	11%	70	58	24.2%	70.7%	14%
Colorado State Highway 97										
SH97 (Nucla Rd) to CR EE28 in Naturita	0.00	0.32	2,000	146	11%	26	2	1.4%	1.4%	11%
Naturita to Nucla	0.32	3.93	1,600	85	11%	26	0	1.6%	0.0%	11%
Colorado State Highway 141										
US491/SH141 junction to Egnar	0.00	9.38	730	127	11%	0	8	1.1%	6.3%	11%
Egnar to K8 Road	9.38	11.27	730	173	12%	0	8	1.1%	4.6%	12%
K8 Road to SE of SH141/145 junction	11.27	44.12	480	129	12%	0	8	1.7%	6.2%	12%
SE of SH141/145 junction to NW of SH145	44.12	55.51	590	176	11%	6	14	3.4%	8.0%	11%
NW of SH145 to Naturita	55.51	60.21	1,500	222	10%	6	14	1.3%	6.3%	11%
East of SH97 to West of SH97 in Naturita	60.21	60.45	1,700	173	11%	70	34	6,1%	19.7%	12%
West of SH97 to Main Street in Naturita	60.45	60.70	2,400	228	11%	70	50	5.0%	21.9%	12%
Main Street to West 2nd Avenue in Naturita	60.70	60.80	1,200	132	11%	70	50	10.0%	37.9%	12%
Naturita to SH141/SH90 junction at Vancorum	60.80	62.44	660	121	12%	70	50	18.2%	41.3%	13%
2 miles north of SH141/SH90 junction	62.44	64.40	340	46	13%	6	22	8.2%	47.8%	14%
2 miles north of SH90 junction to Gateway	64.40	110.53	460	91	12%	6	22	6.1%	24.2%	12%
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Gateway to Whitewater	153.77	154.11	1,400	336	12%	0	8	0.6%	2.4%	12%
U.S. Highway 491										
Junction of US491 and SH141 to County Road 6	63.27	67.95	2,400	562	11%	0	8	0.3%	1.4%	11%
County Road 6 to Utah border	67.95	69.60	2,100	573	11%	0	8	0.4%	1.4%	11%
Colorado State Highway 145										
Lone Cone Road to Market Street in Norwood	99.49	101.07	2,800	274	11%	6	0	0.2%	0.0%	11%
Market Street to Spruce Street in Norwood	101.07	101.56	2,600	200	11%	6	0	0.2%	0.0%	11%
Spruce Street to Summet Street in Norwood	101.56	102.60	2,000	194	11%	6	0	0.3%	0.0%	11%
Norwood to Redvale	102.60	110.11	1,300	126	11%	6	0	0.5%	0.0%	11%
Redvale to SH145/SH141 intersection	110.11	116.88	1,200	110	10%	6	0	0.5%	0.0%	10%
Utah State Highway 46										
Jct of SH 46 & SH 191 to La Sal Jct Post Office	0.00	9.05	600	210	NA	0	34	5.7%	16.2%	'--
La Sal Jct Post Office to Colorado state line	9.05	21.60	335	118	NA	4	34	11.3%	28.8%	'--

Highway Segment	Milepost		2008 Baseline Conditions[2]			Project Traffic		Estimated increase in traffic		
	Start	End	AADT[3]	Trucks	DHV[4]	Lt Vehicle Trips[5]	Truck Trips[6]	Total Trips	Truck Trips	Est. DHV
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Blanding to Verdure	51.66	65.16	2,120	744	NA	0	6	0.3%	0.8%	--
Verdure to 400 South in Monticello	65.16	71.46	2,455	946	NA	0	6	0.2%	0.6%	--
400 South to US491 in Monticello	71.46	71.86	2,610	1,039	NA	0	6	0.2%	0.6%	--
US491/US191 Jct to 600 North in Monticello	71.86	72.40	3,160	1,341	NA	0	6	0.2%	0.4%	--
600 North in Monticello to SR211	72.40	86.14	3,415	1,538	NA	0	6	0.2%	0.4%	--
SR211 to La Sal Junction (SH46)	86.14	103.45	3,735	1,703	NA	0	6	0.2%	0.4%	--
La Sal Junction to Old Airport Road	103.45	117.80	3,705	1,709	NA	0	20	0.5%	1.2%	--
Old Airport Road to La Sal Loop	117.89	123.19	5,030	2,096	NA	0	20	0.4%	1.0%	--
La Sal Loop to 400 East Moab	123.19	124.48	9,635	3,586	NA	0	20	0.2%	0.6%	--
400 East to Center Street in Moab	124.48	125.70	14,510	4,753	NA	0	20	0.1%	0.4%	--
Center Street to 500 West in Moab	125.70	126.98	9,185	2,599	NA	0	20	0.2%	0.8%	--
500 West, Moab to SR128	126.98	128.18	9,240	2,202	NA	0	20	0.2%	0.9%	--
SR128 to Colorado River	128.18	129.80	8,225	1,593	NA	0	20	0.2%	1.3%	--
Colorado River to SR279	129.80	130.26	6,545	2,043	NA	0	20	0.3%	1.0%	--
SR279 to SR313	130.26	136.73	4,835	1,958	NA	0	20	0.4%	1.0%	--
SR313 to I-70 Crescent Junction	136.73	157.20	5,140	2,623	NA	0	20	0.4%	0.8%	--
Interstate-70										
SR24 Hanksville Buckmaster Draw	149.20	157.94	4,085	1,601	NA	0	20	0.5%	1.2%	--
SR6 West SR191 North	157.94	160.41	8,090	3,573	NA	0	20	0.5%	0.6%	--
SR19 West Green River	160.41	164.55	8,870	4,359	NA	0	20	0.2%	0.5%	--
SR19 East Green River	164.55	175.59	8,765	4,744	NA	0	20	0.2%	0.5%	--
Ranch exit (Floy)	175.59	182.17	8,465	5,003	NA	0	20	0.2%	0.5%	--
SR191 Crescent Junction to Moab	182.17	187.42	6,800	3,882	NA	0	20	0.3%	0.5%	--

[1] Assumes daily trips remain relatively constant over operational life of Mill.
[2] 2008 traffic counts for Colorado highways from CDOT, 2009b; 2008 traffic counts for Utah highways from Butterfield, 2009.
[3] AADT = average annual daily traffic.
[4] DHV: the 30th highest annual hourly traffic volume reported as percent of AADT.
[5] Estimated light-vehicle trips are based on two straight-day workers per vehicle, three shift workers per vehicle, and 20 visitor trips. Analysis assumes 90 percent of these trips originate from the east and 10 percent originate from the west and that six miscellaneous delivery trips originate from the east.
[6] Estimated heavy-vehicle trips per day include 29 trips of ore shipments from the east and 21 trips of ore shipments from the west – *Mine Operations Plan* (Energy Fuels, 2009d), 22 trips of water deliveries from Naturita - *Water and Wastewater Plan* (Energy Fuels, 2009f), 12 delivery trips from the west, and four delivery trips from the east - *Special Use Permit Application* (Visus, 2009).
[7] NA = data not available.

Table 4.2-6 shows the estimated peak-hour volumes of background and project-related traffic at the intersection of the Site Access Road and SH 90. Based on these findings and the traffic study's recommendations, Energy Fuels plans to construct a left-turn deceleration lane for westbound traffic on SH 90 so that traffic can access the Site safely. A 10-foot wide shoulder would also be constructed on the south (eastbound) side of SH 90, east of the Site Access Road. The entire length of highway widening would be 2,175 feet. Additional warning signs may be placed along the highway on either side of the Site Access Road to warn on-coming vehicles of truck traffic entering the highway (Visus, 2009).

Table 4.2-6
2030 Afternoon Peak Hour Traffic Volume at Intersection of Site Access Road and SH 90[1]

	Eastbound			Westbound			Northbound	
Traffic Source	**Left**	**Thru**	**Right**	**Left**	**Thru**	**Right**	**Left**	**Right**
Future Background Traffic	NA[2]	41	0	0	41	NA	0	0
Project Traffic	NA	0	7	17	0	NA	8	28
Total	**NA**	**41**	**7**	**17**	**41**	**NA**	**8**	**28**

[1] Source: TurnKey, 2008.
[2] NA = Not Applicable.

Table 4.2-7 shows the estimated peak-hour volumes of background and project-related traffic at the intersection of SH 90 and SH 141. According to CDOT criteria, background traffic warrants a northbound left-turn deceleration lane on SH 141 at its intersection with SH 90. The need for this lane would exist regardless of the additional traffic associated with the Proposed Action (TurnKey, 2008).

Table 4.2-7
2030 Afternoon Peak Hour Traffic Volume at Intersection of SH 90 and SH 141[1]

	Eastbound			Westbound			Northbound		
Traffic Source	**Left**	**Thru**	**Right**	**Left**	**Thru**	**Right**	**Left**	**Thru**	**Right**
Future Background Traffic	2	NA	36	50	33	NA	NA	50	2
Project Traffic	14	NA	14	8	0	NA	NA	0	9
Total	**16**	**NA**	**50**	**58**	**33**	**NA**	**NA**	**50**	**11**

[1] Source: TurnKey, 2008.
[2] NA = Not Applicable.

Transportation Risks

Routine Transportation. No significant dust or fume emissions are expected during routine shipment of chemical reagents and other hazardous materials. Therefore, no significant nonradiological risks and/or health related impacts to the driver or members of the public are expected from the routine transportation of these materials.

Similarly, no significant dust emissions are expected during the routine transport of ore, which accounts for the majority of material shipments associated with the Mill. The ore would be covered with tarps to reduce dusting and falling debris during transportation. The ore being shipped from mines contains a substantial amount of moisture and has a lower percentage of fines than ore that has been crushed. Minor spillages of ore from trucks in transit would add little additional radioactivity to the mineralized natural environment of the Colorado Plateau. The DOE performed an analysis to estimate exposures to the public from transportation shipments containing uranium ore (DOE, 2007) and the results are provided in Section 4.11.

Transportation Emergencies. Procedures for addressing vehicular accidents (*i.e.* spillage and crashes) associated with transporting radioactive and nonradioactive materials to and from the Site are described in the *Emergency Response Plan* for the Mill Facility (Energy Fuels, 2009e). The trucking companies transporting ore, chemical reagents, and fuel to the Mill and yellowcake and vanadium oxide from the Mill to other processing facilities are required by USDOT regulations to have emergency response plans and capabilities in place to respond to accidents and cargo spills. As part of its contracting program, Energy Fuels would verify that these plans are in place.

Transportation accidents occurring off the Site would be handled by the appropriate off-site emergency responders (e.g. Colorado State Patrol, Utah Highway Patrol) and contracted emergency responders. Additionally, carriers of low-level radioactive materials, such as ore and yellowcake, and nonradioactive materials such as vanadium oxide, would have the option of incorporating Energy Fuels' emergency response teams into their emergency response plans for some transportation accidents and spills. Energy Fuels' response teams would be available to assist with radiological screening, surveying, and clean-up at off-site accident locations. Response team members would have expertise in radiation control and possess specialized monitoring equipment that that is generally not available to most law enforcement agencies, fire departments, and other first responders. For most highway transportation accidents, the hauling contractor would send a clean-up crew from a pre-qualified contractor to the accident site. In these cases the Energy Fuels emergency response team would provide assistance as requested by the incident commander on the scene (Energy Fuels, 2009e).

If involved in a severe accident, truck shipments of anhydrous ammonia to the Mill Facility could result in a significant environmental impact (SENES, 2009a). The number of shipments of anhydrous ammonia to the Mill is expected to be approximately 3 times the number of yellowcake shipments from the Mill. However, ammonia is expected to be shipped from a supplier closer to the mill (Salt Lake City) than the conversion facility in Illinois. Therefore the *Risk Assessment* estimates that the frequency of a rollover and crush of ammonia truck that could result in a catastrophic release of ammonia would be much smaller than that of a yellowcake truck. In the event of a minor release of ammonia, impacts to members of the public are expected to be small. However, the driver could be exposed to elevated ammonia concentrations before he could be evacuated from the scene of the accident. If a large amount of ammonia were released, members of the public and the driver could be exposed to high ammonia concentrations. In the event of a traffic accident resulting in an ammonia spill, UDOT and/or CDOT HazMat Teams would respond to the accident and would initiate appropriate evacuation and corrective actions, as necessary.

Vehicular Crashes. During operations, an estimated 2,801,174 miles would be traveled on regional public roads each year. Based on a fatal accident rate of 0.0218 fatalities per million vehicle miles traveled on rural roads in Colorado and Utah (CDOT, 2009c; NHTSA, 2009), this could result in 0.06 fatal highway crashes each year. Based on DOE's estimated 0.033 injury accident rate per one million miles of travel on rural state highways (DOE, 2007), approximately 0.09 injury accidents per year could occur during operations.

The *Risk Assessment* (SENES, 2009a) for the Piñon Ridge Mill Facility estimated that the frequency of transportation accidents (*i.e.* rollover and crash) involving yellowcake would be 0.00079 per year. The frequency of transportation accidents involving ore deliveries would be 000.017 per year (SENES, 2009a). These estimates are based on several assumptions, including USDOT hazardous material transportation accident statistics including the transportation route length between the Mill Facility and the conversion facility in Metropolis,

Illinois, the annual number of yellowcake shipments, the distance between mines and the Mill Facility, and the annual number of ore deliveries.

4.2.1.2.3 Closure

Traffic associated with closure would include light-vehicles transporting workers to the Site, tractor-trailer trucks delivering water and materials (*e.g.* aggregate and rock riprap) to the Site, and trucks removing decontaminated building materials and equipment from the Site. Heavy machinery required for site closure, including bulldozers, excavators, motor graders, scrapers, and compactors, would be mobilized to the Site on heavy-haul vehicles and remain there as long as needed.

Based on a 6 day per week work schedule, Energy Fuels estimates that closure activities would continue for 2 years and 9 months (855 days). Energy Fuels assumes that there would typically be about seven equipment operators per day performing reclamation work. With supervisory and radiation program personnel, approximately 10 workers would travel to the Site daily. Daily crew size could range from 2 to 15 equipment operators, depending on the scheduled work according to the *Mill Decommissioning and Reclamation Cost Estimate* (Energy Fuels, 2009h). Table 4.2.8 shows the average daily number of vehicles that would travel to the Site during each quarter of closure.

Table 4.2.8
Average Daily Traffic Associated with Closure[1]
(Number of Vehicles per Day)

Closure Quarter	Scheduled Activities[1]	Light Vehicles	Heavy Vehicles
Quarter 1	Planning and Site Monitoring	3 to 5[2]	--
Quarter 2	Planning and Site Monitoring	3 to 5[2]	--
Quarter 3	Planning and Site Monitoring	3 to 5[2]	--
Quarter 4	Planning and Site Monitoring	3 to 5[2]	--
Quarter 5	Planning and Site Monitoring	3 to 5[2]	--
Quarter 6	Facility Decommissioning and Demolition, Tailing Cell Closure	8 to 12[3]	2 to 3[4]
Quarter 7	Tailing Cell Closure	8 to 12[3]	2 to 3[4]
Quarter 8	Site Reclamation	8 to 12[3]	2 to 3[4]
Quarter 9	Site Monitoring and De-watering	3 to 5[2]	2 to 3[4]
Quarter 10	Final Closure	8 to 12[3]	1 to 2[4]
Quarter 11	Final Closure	8 to 12[3]	1 to 2[4]

[1] Source*: Emergency Response Plan* (Energy Fuels, 2009e).
[2] Assumed number of worker vehicles based on Energy Fuels' estimate of two to five workers per day (Norquist, 2009).
[3] Assumed number of worker vehicles based on Energy Fuels' estimate of 10 to 15 workers per day – *Mill Decommissioning and Reclamation Cost Estimate* (Energy Fuels, 2009h).
[4] Assumed number of tractor-trailer units hauling riprap and other materials, and water trucks - *Mill Decommissioning and Reclamation Cost Estimate* (Energy Fuels, 2009h).

Peak Trips per Day during Closure. Traffic associated with closure would be the highest between the 6th and 8th quarters of closure. During these periods, traffic could peak at 30 one-way trips to and from the Site per day. Closure-related traffic would be likely to originate in the local area. As with the construction and operational phases, SH 90 between the Site and

Vancorum, and SH 141 between Vancorum and Naturita would be the most heavily used public road segments. The peak number of daily trips associated with closure is approximately 5 to 6 percent of 2008 traffic levels on these road segments. Based on CDOT's projected traffic increases on SH 90 and SH 141 through 2030, the peak number of daily trips during closure would increase traffic on affected roadways by less than 3 percent.

Vehicular Crashes. Assuming that most closure-related traffic occurs between Naturita and the Site, between 198,760 and 339,820 miles would be traveled on regional public roads over the 11 quarter (855 day) closure period. Based on a fatal accident rate of 0.0218 fatalities per million vehicle miles traveled on rural roads in Colorado and Utah (CDOT, 2009c; NHTSA, 2009), between 0.004 and 0.007 fatal accidents could be associated with the closure traffic. Based on DOE's estimated 0.033 injury accident rate per one million miles of travel on rural state highways (DOE, 2007), between 0.007 and 0.01 injury accidents could occur during closure. Historically, vehicle accident rates have fallen over time, and future accident rates are likely to vary substantially from current ones. Nonetheless, these estimates suggest that the risks of vehicular crashes associated with closure would be low.

4.2.2 Protective/Mitigation Measures

Energy Fuels would implement the following measures to mitigate transportation-related impacts resulting from the Proposed Action:

- Energy Fuels has obtained a Site Access Permit from the CDOT that provides for safe Site access and egress (CDOT, 2008). Consistent with the terms of the access permit, Energy Fuels would widen SH 90 over a length of 2,175 feet at the Site Access intersection by constructing a left-turn deceleration lane for westbound traffic on SH 90, and a 10-foot wide shoulder on the south (eastbound) side of SH 90, east of the Site Access Road (CDOT, 2008).

- Energy Fuels would encourage its workers to carpool in order to reduce project-related traffic.

- To reduce project-related traffic during construction, Energy Fuels would encourage its contractors to provide busses or vans at central collection points in nearby towns to transport construction workers to and from the Site.

- Dust suppression measures would include magnesium chloride or equivalent treatments and water sprays on gravel roads on the Site.

- All ore shipments would be transported in dedicated ore haulage trucks, and would be conducted in accordance with USDOT hazardous materials shipping regulations and requirements.

- Energy Fuels would verify that the trucking contractors transporting ore, chemical reagents, and fuel to the Mill and yellowcake and vanadium oxide from the Mill have emergency response plans in place to respond to highway accidents and cargo spills. Guidelines for evaluating the effectiveness of ore transportation carriers' emergency response plans are provided in Appendix B to the *Mine Operations Plan* (Energy Fuels 2009d).

- Ore shipments would be tarped to reduce the potential for accidental spillage or fugitive dust during transportation.

- Chemicals reagents, diesel fuel, and propane used to process ores would be delivered to the Site by licensed haulers in USDOT-approved containers.

- Energy Fuels' emergency response teams would be available to assist with radiological screening, surveying, and clean-up at off-site accident locations and would provide verification sampling of cleanup actions.

4.2.3 Monitoring

Upon request, Energy Fuels would provide truck haulage records to Montrose County for all material and feedstock shipments delivered to the Mill Facility. The records would include the date of delivery, type and quantity of materials, place of feedstock origin, and other data the county may request.

4.3 GEOLOGY AND SOILS

4.3.1 Environmental Impacts

4.3.1.1 General Impacts

Geology

Geology-related potential impacts could occur during construction, operation, or during closure. Potential impacts could result from geologic hazards discussed in Section 3.3.1 such as slope instability, flooding and headward erosion, karst or dissolution features, faulting, seismicity, liquefaction, collapsible soils, and volcanism.

Site Selection. 6 CCR 1007-1 Part 18 Appendix A (CDPHE, 2001) gives Colorado criteria for licensing a uranium mill and deposition of tailings. Criterion 1 relates to site selection, and favors minimal potential for erosion and disturbance in the long-term. Criterion 3 favors placement below grade, or "reasonably equivalent isolation of tailings from natural erosional forces."

The Site was selected to minimize impacts from geologic hazards. Energy Fuels has conducted extensive geological and geotechnical studies to characterize the selected Site, as discussed in Section 3.3.1, to verify its suitability and establish construction requirements. The *Geologic Report* (Kleinfelder, 2009e) describes the faulting in the area and the potential magnitude of seismic events and the *Geotechnical Design Recommendations* (Kleinfelder, 2008h) discusses measures necessary for constructing foundations on the Site soils. Various other reports address specific mill area requirements, such as *Project Design Criteria* (Golder, 2008f), *Ore Stockpile Pad Design* Report (Golder, 2008g), *Tailings Cell Design Report* (Golder, 2008a), *Evaporation Pond Design* (Golder, 2008h), *Roadway Pavement Design* (Kleinfelder, 2008i) and *Phase 2 Geotechnical Field and Laboratory Test Program* (Golder, 2008b). Various other reports referred to below address erosion potential and control measures. Tailings cells would be mostly below grade, minimizing the height of disturbance and allowing for construction of very gradual, erosion-resistant embankment slopes during closure in compliance with Criterion 6 of Appendix A of 6 CCR 1007-1, Part 18 (CDPHE, 2001).

Surface Stability. The stability of the subsurface beneath the Mill and waste disposal facilities was considered in that instabilities could lead to differential settling and dissolution features could result in collapse of the overlying soils. The Site is underlain by alluvium which includes some superficial collapsible soils and the presence of the salts of the Hermosa Formation in the valley core suggests the potential for dissolution structures (such structures are called karst in limestone terrain).

Kleinfelder (2008a) summarized the alluvial valley fill as 15 to 20 feet of silty sand and clayey sand, overlying silty sand up to 80 feet thick over bedrock. Carbonate cement layers (caliche) were found in 13 of 20 geotechnical borings and uncemented gravel was found in two borings at 21 and 37 feet depth. No saturated soils were observed, either perched or at the base of the alluvium. The uppermost materials contain some poorly packed, collapsible soils, which would require removal prior to laying foundations. Kleinfelder stated that local soils, including the surficial collapsible material, could be moisture conditioned (wet to optimum moisture) and re-laid and compacted to achieve a competent base for spread foundations. For a plant with heavy loading, Kleinfelder proposed a number of alternate pier and pile designs which can transfer the load to deeper, extended competent intervals. Golder (2008b) separated and tested fine fractions from soil samples, and found limited plasticity in those fractions, and native moisture content lower than the plastic limit in all samples. The Site alluvium would therefore be a suitable foundation, provided that some loose soils were removed or replaced and re-compacted and deep foundations installed under critical plant areas.

Kleinfelder investigated a small hole at the surface north of the Site. This hole, which was suspected to be a karst feature, is underlain by the Hermosa Formation. Kleinfelder concluded that it was a local feature and to have no equivalents under the Site itself. The potential for bedrock salt dissolution undermining any portion of the Site is not significant, because the bedrock topography is not conducive to it. The salt diapir which once occupied the core of the anticline has largely been eroded and bedrock and the water table within the valley slope at low angles to the Dolores River. Groundwater discharges to the Dolores River and has no lower outlet which would allow it to tunnel below the elevation of the river, into the modern bedrock surface. The water table at the Site has a low point at approximately elevation 5,140 ft above mean sea level (amsl), while the Dolores River elevation in the Paradox Valley is between 4,930 and 4,940 ft amsl, just 200 ft lower in 7.5 miles, an average slope of 0.5 percent.

Thus, there would be no insurmountable soil stability problems in terms of bearing competence or destabilization by natural events. Appropriate foundation design would preclude any subsidence due to soil instability, or probable seismic disturbance. The alluvium is well-drained and has limited plasticity.

Slope Disturbance and Rock Falls. Construction on slopes may lead to potential instabilities. Slope disturbance is unlikely because most of the Site is flat and not susceptible to mass movement. Steeper slopes occur where the Site extends to the mesa at its southern end; however, the Mill Facility would not be constructed on the valley side where there is potential for slope disturbance.

Rock falls and slides could potentially cause damage to the Mill Facility if they were to occur; however, the valley sides to the southwest of the Site are stable. Old-growth pinyon and juniper cover these slopes, and no signs of recent mass movements (slides) or breakaway boulders having fallen from the rim of Davis Mesa in historical time are present. Faults parallel the valley side, formed by the collapse of the former anticlinal dome. The trees, however, clearly indicate that no significant movement on these faults has occurred for at least a century. Trenching over known faults in the valley floor indicated no displacement of Quaternary soils. Falls and slides therefore pose no plausible risk to the Mill Facility.

No blasting is anticipated to be required during construction. Stormwater diversionary berms at the south end of the Site would remain after decommissioning and closure, and would impede or divert rolling rock falls which might be loosened by activity on Davis Mesa above the Site.

Seismicity. The hazards of seismicity include potential damage to the Mill Facility due to ground acceleration, and destabilization of the subsurface beneath the plant (at the extreme, liquefaction of unconsolidated materials, addressed below). Criterion 4E of 6 CCR 1007-1, Part 18, Appendix A (CDPHE, 2001) states that a tailings cell "may not be located near a capable fault that could cause a maximum credible earthquake (MCE) larger than the impoundment could reasonably be expected to withstand."

The historic seismicity of the area is low, and associated with distant faults or with the Paradox Valley Unit (PVU) brine injection, which has been scaled back, with concomitant decrease in quake intensity.

The probability of natural earthquake occurrence and magnitude was assessed by Kleinfelder (2009e). The Design Earthquake (the magnitude the plant would be designed to resist with a factor of safety) has magnitude 4.8 at a distance of 10 miles from the Site, and causes a ground acceleration of 0.161 g (16 percent of the acceleration of gravity, or 5 ft/s^2). All facilities, including the plant, offices, foundations, containments, stormwater structures, and roadways would be designed in accordance with Montrose County building codes. The county currently relies on the Uniform Building Code (UBC) but is transitioning to the International Building Code (IBC), which includes a more comprehensive analysis of earthquakes. Under the IBC, the facility would be designed based on the Design Earthquake with a suitable safety factor. The final design would then checked for stability using the acceleration of gravity associated with the MCE. The MCE has a probability of occurrence of 2 percent in 50 years, corresponding to a return period of 2,475 years.

Failure of a tailings embankment because of an earthquake would be unlikely because the site is in a zone of low to moderate seismicity (Kirkham and Rogers, 1981) based on the number of sizable earthquakes that have occurred in the historical and more recent record. The three tailings cells were designed in accordance with the International Building Code (IBC) based on a Magnitude 4.8 earthquake occurring at a distance of approximately 10 miles from the site. Minimum static and pseudo-static factors of safety ranged from 2.0 to 4.9 and 1.7 to 2.7, respectively, during the life of the cells, with the highest factors of safety occurring during the post-closure period (Golder, 2008a).

Continued operation by the BOR of the PVU brine waste injection may continue to generate low magnitude movements in the deep subsurface. Since 2000, when the injection rates were substantially reduced, seismicity associated with the PVU has been less than 2.5 magnitude (not detectable by most persons). This low level activity is continual which may indicate a steady relief of stress and reduced potential of delivering a large magnitude event.

Faults beneath the Site are "non-capable" (analogous to a volcano being extinct) according to the Colorado Geological Survey (Kleinfelder, 2009e) and are believed to not have moved since the Pleistocene at the most recent (75,000 to 125,000 years). No evidence of soil displacements was found in several Site trenches overlying bedrock faults, except for one shallow dislocation between 5 and 7 feet depth, without any extension at depth in the trench or geophysical investigations (Kleinfelder, 2009e). The investigation results indicate that the Site meets the requirements of Criterion 4E of Appendix A of 6 CCR 1007-1 Part 18 (CDPHE, 2001), because there are no capable faults as defined in section III(g) of Appendix A of 10 CFR PART 100 that could cause a MCE larger than that which the tailings cells could be expected to withstand.

Liquefaction. Liquefaction of unconsolidated soils is a hazard that may occur even when a building survives the shaking of an earthquake. Modern buildings in Japan and China have

toppled, intact, when large quakes have shaken saturated alluvium and overcome intergranular friction and the material lost cohesion. Liquefaction potential depends on water saturation. The water table in bedrock beneath the Site is more than 400 feet deep and the alluvium of the Paradox Valley is essentially unsaturated throughout (maximum measured sample moisture was 13 percent). Therefore, liquefaction potential at the Site is negligible. Even if saturation were to be assumed (for conservative design purposes), the factor of safety against liquefaction of the alluvium by the MCE was estimated by Golder (2008b) to be generally in excess of 10.

Because the entire alluvial thickness appears to be unsaturated, the liquefaction potential in an earthquake is insignificant by NRC criteria (NRC, 2003a). Conservatively assuming saturation, the factor of safety of the alluvium in its native condition resisting liquefaction under the MCE seismic event is 10 or more over most of the Site, and 2.9 in one location within a single borehole (Golder, 2008b). Based on the absence of shallow groundwater, liquefaction of Site soils during an earthquake event would be highly unlikely and it would be improbable that an earthquake could cause significant damage to the Mill Facility including tailing cells, in any phase, from construction through operation and closure.

Volcanism. There would be no impact to the Mill Facility due to volcanism because it does not pose a credible hazard in the area. Igneous activity in the area is extinct, and there is no potential for a Paracutin type event (Paracutin was a surprise eruption in a cornfield in Mexico; but it lies in an active volcanic belt).

Soils

Potential impacts to soil resources within the Site would be associated with development activities from the construction, operation, and closure of the Mill Facility. Construction activities would include site clearing and grading activities required to install the project components which include the Mill, administration building, ore stockpile pad, tailing cells, evaporation ponds, and surface water control features, as well as disturbance associated with general site grading requirements, roads, soil stockpiles, and other minor ancillary facilities.

Site Selection. Site selection for permanent deposition of tailings is favored in 6 CCR 1007-1 Part 18 Appendix A (CDPHE, 2001) which has topography providing good wind protection (Criterion 4B) and is capable of sustaining a vegetative cover, or be rock-covered (Criterion 4D). Most frequent winds are light breezes from the southeast associated with nighttime valley drainage, and the location of the Site below Davis Mesa provides shelter from stronger westerly winds in the spring (Kleinfelder 2009i, *Meteorology, Air Quality and Climatology Report)*. Tailings cells would be closed with an evapotranspiration (ET) cover over a soil radon barrier. The top of the ET cover would consist of soil and rock mulch, and the tailings cell outslopes would be covered with rock blankets to prevent erosion. The embankment outslopes would have gradual slopes between 5H:1V and 10H:1V and would be seeded with a native grass mix to further stabilize the surfaces as discussed in the *Tailings Cell Closure Design Report* (Kleinfelder, 2009c). The location of the Site in the valley bottom on gentle slopes, with no proposed infringement on steeper slopes south of the Site, minimizes the potential for erosion and other soil stability impacts.

Disturbances. Impacts to soils from the Proposed Action would occur from the loss of soil production associated with the long-term disturbance and occupation of the area by the Mill Facility. Although topsoil salvaging would occur during clearing and grading, soil productivity could diminish through the loss of topsoil, or from the mixing of topsoil with less productive subsoils. Soil productivity could be degraded by soil compaction and damage or loss of soil structure from the movement of heavy construction equipment, soil mixing or displacement

during grading, and site development activities. The long-term storage of topsoil in stockpiles could decrease soil quality by the loss in organic matter or biological activity. Soil disturbance from clearing and grading could increase the potential for soil loss and sedimentation from wind and water erosion. This may occur because increased soil exposure would occur from the loss of vegetation cover, loss of biological or physical soil crusts, and from physical disturbance. Soils disturbance could increase the potential for noxious weed infestation which typically decreases soil productivity.

As indicated in Table 4.3-1, approximately 415 acres of soils would be disturbed by site development activities. Table 4.3-1 gives affected acreage of each soil mapping unit and the percentage of each.

Table 4.3-1
Acres and Percent of Total Disturbance Affected by the Proposed Action by Soil Mapping Unit

NRCS Soil Mapping Unit	Mapping Unit Name	Acres Affected by Proposed Action	Percent of Total Disturbance
15	Barx	51.2	12.3
18	Begay	76.2	18.4
56	Mikim	106.2	25.6
73	Paradox	164.1	39.6
87	Rock Outcrop	< 0.1	0.0
104	Vanada	16.9	4.1
	Total	**414.6**	**100.0**

Prime Farmland Assessment. Prime farmland is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and that is available for these uses. These soils have the combination of soil properties, growing season, and moisture supply needed to produce sustained high yields of crops in an economic manner if they are treated and managed according to acceptable farming methods. Approximately 398 acres of long-term soils disturbance or about 96 percent of the total soil disturbance would occur within soil series that are designated as prime farmland, if irrigated. However, none of these affected soils have been irrigated or farmed in the past. Therefore, no impacts to prime farmlands would occur from the Proposed Action.

Topsoil and Reclamation Suitability. Although the soils that would be affected are not considered prime farmland because they have not been irrigated or farmed, the majority of the soils that would be affected have chemical and physical characteristics which rate them as suitable topsoil and reclamation materials (see Table 3.3-3). The combination of chemical and physical properties of the affected soils should ensure successful site restoration to native vegetation communities and rangeland uses once the Mill Facility has been closed, as long as the topsoil materials are properly salvaged and stockpiled during the initial construction phase of the project. As specified in the *Technical Specifications* (Golder, 2008i), topsoil would be stripped to depths of 6 to 12 inches and stockpiled for later use during reclamation and closure. Topsoil salvaging procedures in the *Technical Specifications* (Golder, 2008i) stipulated that topsoil salvaging would occur in a manner to minimize contamination with other soil horizons, and to ensure topsoil removal does not result in erosion or excessive sedimentation. Further, topsoil stockpiles would not be disturbed and would be protected from wind and water erosion, compaction, and contamination. Topsoil stockpiles would be graded to prevent erosion and an effective cover of non-noxious, quick-growing, annual and perennial plants would be established to stabilize the stockpiles and to ensure long-term viability of the topsoil. The topsoil stockpiles

would be seeded and mulched during the first appropriate growing season after topsoil stripping and stockpiling.

The *Specifications for Closure and Reclamation of Mill Facilities* (Golder, 2009c) which describes: topsoil redistribution, soil preparation, fertilization, seed mix, seeding methods, seeding timing, and mulching that would be implemented to restore the Site. These standard reclamation specifications would allow for successful revegetation of the Site. The reclamation objectives are to establish a long-term self-sustaining ecosystem that stabilizes the Site, provides environmental protection and public safety, and returns the majority of the Site to rangeland use. The NRCS recommended a reclamation seed mix (see Table 4.3-2) that was developed for the ecological site conditions of the Site and which is suitable for all of the soils that would be affected by the Proposed Action.

Table 4.3-2
NRCS Recommended Seed Mixture

Common name (Scientific Name – Kartesz)	Variety	Seeding Rate (LBS/Acre – PLS)[1]
Needle and Thread *(Stipa comate)*		1.8
Indian Ricegrass *(Oryzopsis hymenoides)*		1.8
Thickspike Wheatgrass *(Elymus lanceolatus)*	Critana	1.8
Sandberg Bluegrass *(Poa Secunda)*	Sandberg	0.9
Bottlebrush Squirreltail *(Elymus elmoides)*		0.9
Blue Grama *(Bouteloua graceilis)*	Alma	0.9
Galleta *(Hilaria jamesii)*	Viva	0.9
	Total	**9.0 lbs/Ac**

[1] Double rate if broadcast seeded.

To enhance the diversity of some of the reclaimed areas, shrubs and forbs could also be included in the seed mixture. Potential shrubs species that could be included in the seed mix include four-wing saltbush, gardner saltbush, and winterfat. Forbs species that could be included in the seed mixture include blue flax, penstemon and lupine, among other forb species adapted to site conditions. Shrub and forb species should not be included in the seed mix on or in the vicinity of the tailing cells where deeper rooted shrub species might penetrate into the engineered caps or could attract wildlife to this area.

As soon as feasible after construction, interim reclamation of disturbed areas that are not required for operations should be reseeded with the recommended seed mixture for erosion control and stabilization purposes and to minimize the area of surface disturbance.

Water and Wind Erosion. None of soils that would be affected by development activities have a high wind or water erosion hazard. Although a large area of disturbance would occur during clearing and grading, the Mill Facility has been designed to occupy or disturb the minimum area necessary for construction and operations. The area is generally flat which minimizes the

potential for slope wash erosion. Prior to clearing and grading, the Site would be surveyed and staked to minimize disturbance to surrounding areas outside of the construction footprint as outlined in the *Technical Specifications* (Golder, 2008i).

As outlined in the *Site Drainage Analysis and Design Report* (Kleinfelder, 2009d), the potential for erosion would be minimized by diverting un-impacted or undisturbed surface water drainage around the Mill Facility through designed diversion berms and channels that are directed into natural drainage channels east and west of the Site. Diverting runoff around the facilities would minimize potential sedimentation by minimizing runoff volumes over disturbed areas of the Site. Diversionary berms would be armored with DOT liners and riprap; channels would be lined with grouted riprap and would have rock energy dissipation aprons where channels discharge to arroyos. Culverts would have rock outlet protection and sand bag baffles and/or settling basins at the upstream end to retain sediments.

During construction, grading of the Site would be managed to control runoff, erosion, and sediment transport by utilizing a variety of sediment control measures including hay bales, silt fences, and temporary detention basins. The purpose of these controls would be to minimize the amount of sediment runoff from the Property Boundary to levels that approximate conditions prior to initiating construction. The mill, ore pad, tailings cells, and evaporation ponds have been designed as “zero discharge” facilities where there would be no offsite stormwater discharge. Precipitation and stormwater runoff that contacts these areas would be contained on-site in lined ponds or cells and recycled for use in the mill and/or evaporated. Stormwater runoff from the administration facility and other structures not within the footprint of the zero-discharge area (e.g. monitoring stations, water supply well field, secondary roads, soil stockpiles) would be controlled using best management practices (BMPs) for stormwater and erosion control. These measures may include surface water diversion channels, energy dissipating structures, slope projection and sediment catchment basins.

Facility decommissioning would entail demolition of the mill and removal of the ore pad, mill pad, and evaporation ponds. These materials would be placed in the final tailings cell. Erosion, sediment and dust control measures used in the operational phase would remain in place during decommissioning. Temporary controls would be substituted for permanent controls at such time the permanent controls are removed as part of closure and reclamation.

Hydric Soils. As noted in Table 4.3-1 and in Section 4.3.2.2 approximately 4.23 acres of the Vananda silty clay soil series (Va) would be disturbed by the Proposed Action. According to the NRCS (2008) this soil is designated as being partially hydric, however field investigations (Kleinfelder, 2008c and 2009f) did not encounter any hydric soils within the Site.

Soil Engineering Properties. The *Geotechnical Design Recommendations* (Kleinfelder, 2008h) characterizes the engineering properties of the native soil and overburden materials at the Site for engineering design purposes. This work consisted of subsurface exploration, laboratory testing, design meetings, and engineering analysis to provide geotechnical design recommendations that would be incorporated into the facility designs. The report concluded that the native overburden soils may be used as engineered fill anywhere on the Site provided they are processed and moisture conditioned as specified in the report. *The Technical Specifications* (Golder, 2008i) for construction provide detailed specifications and procedures for construction of soil foundations.

As the tailings cells are regraded and covered in a phased manner according to the *Tailings Cell Closure Design Report* (Kleinfelder, 2009c), survey monuments would be installed to enable

monitoring of settlement as the tailings gradually dewater. The *Tailings Cell Closure Design Report* details placement of the interim cover, dewatering, and regrading of fill cap construction, and placement of low-maintenance rock armor in accordance with the criteria listed in Criterion 6 of Appendix A 6 CCR 1007-1, Part 18 (CDPHE, 2001). The survey monuments would be monitored from the time interim cover is placed until each cell is closed through facility closure, and thereafter on a decreasing frequency schedule, to verify that there is no unacceptable differential settling which could threaten the integrity of the cells' covers in the post-closure period.

4.3.1.2 Construction, Operations, and Closure Impacts

4.3.1.2.1 Construction

Geology. Potential geologic impacts during construction include seismic destabilization, inadequate foundation preparation, erosion of disturbed areas, and stormwater disruption. Volcanism and rock slides are counted above as having vanishingly small potential.

There is little potential of seismicity disrupting or compromising construction through geologic phenomena. Trenched soils show no evidence of dislocations since at least the Pleistocene (75,000 to 125,000 years) (Kleinfelder, 2009e), and all facilities are or would be designed to meet IBC requirements as described above. Because of the absence of saturated material in the alluvium beneath the Site, seismic liquefaction of the soils would be highly unlikely (Golder, 2008b).

Subgrade soils would be compacted in place or excavated and replaced with compacted material to the compaction level required for each component of the Mill Facility. Foundations would generally consist of spread foundations on removed, replaced, and moisture-conditioned compacted soils. Deep foundations would be utilized for critical locations within the mill with larger load bearing requirements. These measures are described below in Section 4.3.1.2, Soils.

Surface water control structures would be constructed at the start of construction activities, so that full erosion and sedimentation control would be in place before most surface disturbance would occur (Golder, 2009b). BMP temporary erosion and surface water control measures would be used during construction of the Site Access Road and permanent surface water control structures (Golder, 2009a). Disturbed soils and constructed berms would be stabilized as soon as is practicable, using DOT liner and riprap on stormwater diversionary dikes, grouted riprap in runoff diversion channels, and vegetation on low to moderate slopes.

Soils. In construction, the Site would be disturbed and modified, surficial soils stripped and stockpiled, subsoils excavated and/or compacted, foundations (deep and shallow) installed for the plant, and an access road constructed. Foundation requirements are addressed in this section, because geotechnical measures would be implemented during that phase. The Site would be vulnerable to substantial erosion, if not properly managed during the construction phase.

The Site Access Road and surface water control structures would be the first items constructed at the Site under the *Construction Plan* (Golder 2009b), so that complete runoff and sedimentation controls would be in place prior to facility construction. During the construction of the Site Access Road and surface water control structures, temporary erosion and sediment control measures would be installed (Golder, 2009a). These include the use of silt fences and straw bale filters where appropriate, water sprays to control dust, and stabilization of disturbed

areas and embankments as soon as is practicable. While the facility is being constructed, permanent surface water controls would be in place, and mobilized sediment would be contained to the extent practicable.

The primary access that would be constructed to the Site consists of 150 feet of paved road off SH 90 and then a gravel road over a prepared subbase. This design minimizes the possibility of tracking sediment onto the highway. Smaller, temporary gravel tracking pads would be utilized during construction to minimize tracking from wet or muddy areas of the Site.

Stockpiled topsoil and subsoil would be graded and seeded to prevent erosion of piles. Diversion channels would be constructed around each pile to minimize stormwater run-on.

Foundation work would be critical. Energy Fuels has gathered geotechnical data to support design of foundation subbase soils for each component of the Mill Facility and load bearing piers for plant areas.

The Site Access Road and ore haulage roads would be built according to American Association of State Highway and Transportation Officials (AASHTO), U.S. Department of the Interior (DOI) and CDOT specifications and design manuals for mine haulage roads. Roadway design and references are given in the *Roadway Pavement Design Recommendations* (Kleinfelder, 2008i). Main roadways would be two-lane, 22-ft wide with 2-ft shoulders. Subgrade materials were assessed from the *Geotechnical Design Recommendations* (Kleinfelder, 2008h), the *Phase 2 Geotechnical Field and Laboratory Test Program Report* (Golder, 2008b), and the *Geologic Report* (Kleinfelder, 2009e). Loose surficial materials would be removed, and the road bed subgrade scarified and moisture-conditioned to within 2 percent of optimum moisture content, and compacted to 95 percent standard Proctor density, measured in place by ASTM D698. Optimum moisture and Proctor density were determined in a soil mechanics laboratory from tests of density and compaction energy at varying moisture content. The compacted surface would be proof-rolled with a heavy vehicle, and any areas that deformed would be removed and replaced to achieve stable subgrade. Aggregate specifications in the road bed also follow DOI and CDOT specifications.

The ore pad design is described the Ore *Stockpile Pad Design Report* (Golder, 2008g). Borehole and soil testing data from three holes in the ore pad area were used to assess soil characteristics. Surficial soils include collapsible loess and loose alluvium. As with the road subgrade, loose materials would be removed, the remaining soil scarified, moisture-conditioned and compacted to 95 percent standard Proctor prior to installing liners. The 1 acre ore pad would have a concrete liner and the 5-acre pad would have a reinforced geosynthetic liner of very low permeability under protective fill layers.

Design of the tailings cells is described in the *Tailings Cell Design Report* (Golder, 2008a). There were 26 boreholes drilled in the tailings cell area to furnish geotechnical data. Cells would be excavated up to approximately 100 ft below grade with perimeter embankments above grade. Embankment foundations would have loose surficial material removed and the subgrade moisture-conditioned and compacted. Moisture conditioning and compaction of the excavated sidewalls and floor of the tailings cells would be required prior to installing multi-layer cell liners and leak collection and recovery systems, which are described elsewhere.

Mill foundation design has not been finalized but would generally consist of spread foundations on soils that have been removed, moisture conditioned, replaced, and compacted in accordance with the technical specifications. Deep foundations would be limited to critical locations within

the mill with higher loading levels. In general, surficial soils would be stripped and stockpiled for later reclamation. Excavated and compacted subgrade would be placed in lifts totaling at least 5 feet thick to support building floor slabs. Alternate load bearing structures discussed in *Geotechnical Design Recommendations* (Kleinfelder, 2008h) for critical areas were drilled piers penetrating to at least 35 feet, on a spacing no more than 30 pile diameters, with reinforcing steel and concrete fill. Piles would be load tested at 200 percent of design load plus downdrag.

Preliminary design has outlined geotechnical considerations and measures and alternatives to obtain foundations that would withstand the MCE and prevent differential settling. Final design would optimize factors of safety of foundation work for those potential impacts, and cost effectiveness. Surface water control measures including diversion structures and an elevated pad area for the mill would protect mill foundations against surface water infiltration and erosion.

4.3.1.2.2 Operations

Geology. Impacts of a geologic nature that might occur during operations include seismic activity, settlement and erosion. Volcanism and rock slides are counted above as having vanishingly small potential. Geotechnical stability of soils beneath the Site is addressed below in Section 4.3.1.2, Soils.

Impacts of seismicity might include damage to the plant and structures, and destabilization of foundation subgrade. All components would be designed to withstand the MCE, determined from historic seismicity records and assessment of the energetic capability of capable faults within 100 miles of the Site (USGS referenced in Kleinfelder, 2009e). The MCE has a lateral acceleration of 0.161g.

As discussed above, the three tailings cells were designed in accordance with the IBC based on a Magnitude 4.8 earthquake occurring at a distance of approximately 10 miles from the site. Minimum static and pseudo-static factors of safety ranged from 2.0 to 4.9 and 1.7 to 2.7, respectively, during the life of the cells, with the highest factors of safety occurring during the post-closure period (Golder, 2008a).

In early operations, disturbed soil areas would have been stabilized and “permanent” (life of project) stormwater, erosion and sediment control structures would be in place. Regular monitoring and maintenance of the Mill Facility would include inspection and repair of these control structures. Erosion controls would include seeding and mulching disturbed areas with low to moderate slopes and soil stockpiles; if this vegetation is set back by unfavorable weather, such areas would be re-seeded.

Soils. During operations, surface disturbances outside of the Mill and ancillary facilities would have been stabilized with vegetation and other methods. Potential impacts during construction might consist of seismic disturbance, erosion of surface water control structures, or settling caused by incompetent foundation materials.

There is little potential of seismicity disrupting or compromising operations through soil (geotechnical) destabilization. Trenched soils show no evidence of dislocations since at least the Pleistocene (75,000 to 125,000 years) (Kleinfelder, 2009e). The Mill Facility including tailings cells would be designed to meet IBC requirements for earthquake protection. Because of the absence of saturated material in the alluvium beneath the Site, the factor of safety against any seismic liquefaction in the alluvium under the MCE event is generally greater than 10, even if saturation is conservatively assumed (Golder, 2008b).

A Stormwater Management Plan (SWMP) has been prepared for the Site (Golder, 2009a) that details the inspection and maintenance requirements for stormwater control facilities, which are designed to keep these structures functioning properly and minimize erosion and sedimentation on the Site. Seeded areas could fail to grow due to unfavorable weather and leave some disturbances susceptible to erosion. Inspection of reclaimed areas would be a routine part of stormwater monitoring, and action would be taken to correct such possible impacts by regrading and re-seeding at the first appropriate opportunity. Although the soils within the Site are only moderately susceptible to wind erosion, air emissions would be monitored on- and off-site to ensure compliance with state regulations for fugitive dust (i.e., PM_{10}).

Foundation pretreatment is addressed above in Construction, because that is when it would be implemented. Excessive differential settling would represent a failure of construction. Sufficient geotechnical data has been gathered to support foundation design according to accepted criteria, to give high factors of safety for all components during the life of the project.

4.3.1.2.3 Closure

Geology. Closure of the Mill Facility would entail demolition of the Mill and most of the ancillary facilities with disposal in the tailings vault, followed by reclamation of newly disturbed areas in accordance with the *Mill Decommissioning Plan* (Kleinfelder, 2009b). Impacts of a geological nature that might occur during closure include erosion of newly exposed foundation subgrade. Fugitive contaminants that might have been released during operations might also be found to have contaminated soils outside the facility. After closure, the main concern would be the long term integrity of the closed tailings cells and its potential compromise by seismicity or erosion.

Operational surface water control structures (e.g., stormwater ponds), evaporation ponds, and a truck wash station, would be the last components to be removed during closure, so that erosion and contaminant control measures would be maintained during the demolition period. As these control structures are closed and reclaimed, BMP temporary measures would be used to control erosion and sediment. Diversionary dikes at the south end of the Site and channels to the natural drainages would remain as permanent protection for the closed tailings cells.

A radiological survey of the facility and vicinity would be conducted to identify soil contamination that may have occurred during operations. Soils discovered to be contaminated above regulatory thresholds outlined in Criterion 6(6) of Appendix A of 6 CCR 1007-1, Part 18 (CDPHE, 2001), would be excavated and placed in the final tailings cell as described in the *Mill Decommissioning Plan* (Kleinfelder 2009b).

With the exception of the tailing cells, the surface would be restored by regrading to approximately the original (pre-construction) configuration. The primary earthwork involved in this restoration would be removal of the ore pad and mill pad, with redistribution of contaminated soils in the final tailings cell and clean soil in cut areas that require backfilling to achieve original grades. Regraded surfaces would be disked, harrowed and reseeded using the procedures and seed mixes described in the *Specifications for Closure and Reclamation of Mill Facilities* (Golder, 2009c).

The main road would be slightly realigned around the northeast toe of Tailing Cell C to provide space for the final 10H:1V outslope of that cell. Otherwise, the main access road would be left in place for the subsequent user of the land surface outside of the Restricted Tailings Cell Area as well as for access to monitoring wells and air monitoring stations.

The tailings cell and closure cover have been designed to meet CDPHE requirements for long-term stability including resistance to pluvial erosion (i.e., 1,000-year storm event) and the MCE. Minimum static and pseudo-static factors of safety ranged from 2.0 to 4.9 and 1.7 to 2.7, respectively, during the life of the cells, with the highest factors of safety occurring during the post-closure period (Golder, 2008a). Stormwater diversionary structures at the south end of the facility would remain in place to divert the 1,000-year, 24-hour storm event flow around the cells and into the surrounding drainages. To resist erosion, the top of the reclaimed tailings cells would be covered with a rock mulch and vegetation, and the gentle 5H:1V to 10H:1V side slopes would be covered with rock. Drainages would also be constructed between the tailings cells and armored with large, durable rock to convey surface water runoff from the toe of the tailings cells to the surrounding natural drainages.

Soils. Demolition activities would resemble construction activities in that large areas of disturbed soils would be exposed to possible erosion. Long term differential settling could also disrupt the integrity of the tailings cells.

Surface water controls would be left in place for the entire Site until dismantling and removal of the plant is complete, to maintain control of sediment mobilization. Only when demolition is complete and contaminated soils are placed in the last tailings cell would surface water control structures, including stormwater and evaporation ponds, be closed and reclaimed (Golder 2009c). The stormwater diversionary dikes at the south end of the Site and channels carrying runoff to the surrounding natural drainages would be left in perpetuity to divert surface water from the tailings cells, the only facility component to remain post-closure.

Radiological surveys to identify areas of soil contamination in the vicinity of the Site are discussed in the *Mill Decommissioning Plan* (Kleinfelder 2009b). Soils found to be contaminated above regulatory thresholds would be removed and placed in the final tailings cell prior to closing it.

During the post-closure period, reclaimed areas would be monitored for soil stability and potential invasive plant species, and appropriate measures taken to correct soil or vegetation deficiencies.

Tailings cells have been designed consistent with 6 CCR 1007-1 Part 18 Appendix A to be mostly below grade and founded in compacted silts and fine-grained sands, while above-grade embankments around the cells and runoff diversionary structures at the south end of the property would limit runoff to direct precipitation received on the tailings cells. Survey markers set in cell caps would be monitored regularly from the time the interim cover was placed on each cell until the final cover settlement reached near-steady state conditions. Placement of cover materials would be done in a phased manner to allow for incremental consolidation and dewatering of the encapsulated tailings material.

4.3.2 Protective/Mitigation Measures

Energy Fuels would implement the following measures to mitigate geology and soil-related impacts resulting from the Proposed Action:

- The Site was selected in part for its isolation from geologic hazards such as slope instabilities, significant seismicity, and erosion potential. Extensive geotechnical and geophysical studies (Kleinfelder, 2009e) showed no subsurface cavities (karst) or insurmountable soil stability issues. The research and investigations showed that the risk of geologic hazards is low.

- All facilities (Mill, tailings cells, evaporation ponds, and ancillary facilities) would be designed to withstand the maximum credible earthquake's ground acceleration in accordance with IBC requirements.

- In areas where collapsible soils have been identified at the surface within the Mill Facility footprint, soils would be removed and a competent compacted soil base would be created.

- Engineering control of surface water runoff including diversion, soil stabilization, rip rap, etc. as described in the *Stormwater Management Plan* (Golder, 2009a) would be incorporated into the design of the Mill Facility.

- Timing of construction and removal of surface water control structures (first built, last dismantled) would maintain erosion and sediment control during construction, operations, and closure.

- BMPs for erosion control, as outlined in the *Stormwater Management Plan* (Golder, 2009a), would be implemented during construction of the access road and surface water structures.

- Post-closure monitoring and maintenance of the reclaimed facilities would be conducted to verify long-term stability prior to transfer of the reclaimed tailings cells to the State of Colorado or the DOE for long-term surveillance and monitoring.

4.3.3 Monitoring

During construction, Energy Fuels would monitor all BMPs in accordance with the *Stormwater Management Plan* (Golder, 2009a). During topsoil salvaging efforts, Energy Fuels would ensure that a qualified representative would observe these operations to verify and confirm suitable topsoil salvaging depths are being utilized to prevent potential loss of this resource.

During operation, soil sampling would be conducted as described in detail in the *Operational Monitoring Plan* (Visus and Energy Fuels, 2009b). Soils would be sampled at 1) four locations, randomly collocated with the 2007 baseline soil sample locations, which are representative of the site and outside of the windblown sample areas; 2) five locations at each of the air monitoring stations; and 3) four locations collocated with the surface water samplers. Samples would be analyzed for RA-226, U-nat, Pb-210, Th-230, and Th-232. Every 5 years surface sampling of windblown soils would be conducted at locations downwind of the tailings cells, evaporation ponds, and ore pad. Following spill cleanup activities, soil sampling would be conducted around the Mill Facility and tailings pipelines on a per occurrence basis in order to confirm that contaminated soils within the spill area is remediated.

Post-closure monitoring and maintenance of the site would include inspections and assessments of facility reclamation efforts to ensure successful reestablishment of vegetation, erosion control and site stability and the integrity of soil covers. Corrective measures would be implemented as necessary to control erosion, allow for establishment of vegetation or to control any potential noxious weed infestations and to meet other post-closure requirements established by the CDPHE. The soil sampling protocol following closure of the Mill Facility is described in Section 4.11.

4.4 WATER RESOURCES

4.4.1 Environmental Impacts

NRC guidance - NUREG 1748 (NRC, 2003a) Section 6.4.4, Water Resources Impacts, lists a number of potential impacts which might be applicable at any facility, including discharges, impacts to water quality, hydrologic alterations and impacts, water withdrawals and impacts to other users, protective measures and cumulative impacts.

4.4.1.1 General Impacts

Surface Water

Surface Water Hydrology. Potential impacts to surface water hydrology are principally alteration of runoff patterns and reduction of flow, whether it reaches the Dolores River as surface flow or infiltrates to groundwater. If groundwater (i.e., water supply wells) is not capable of supplying all of the Mill Facility water demand, water would be obtained from the City of Naturita or other off-site sources to make up the deficiency. This would impact the San Miguel River as a withdrawal of water tributary to that stream, under water rights held by the Town of Naturita and/or others.

The Site was selected according to the precepts of Criterion 1 of Appendix A of 6 CCR 1007-1, Part 18 (CDPHE, 2001a), namely to favor remoteness from populated areas, and minimal potential for hydrologic and erosion impacts.

The Mill Facility is designed as a zero-discharge facility; that is, no industrial wastewater would be released to the environment, either as a surface discharge or infiltration to groundwater. There would be sewage adsorption fields for domestic wastewater (septic systems) for the Mill and administrative facilities. Water management systems are described in the *Water and Wastewater Plan* (Energy Fuels, 2009f) and *Facility Operating Plan* (Visus and Energy Fuels, 2009a).The *Facility Operating Plan* is a comprehensive narrative of the facility design, operations, and controls for 10 process area subdivisions, written as a component of the Mill License Application but intended to be a continually updated working document. Standard Operating Procedures would be developed for each process area, including water supply, septic systems, tailings cells, and evaporation ponds, in consultation with operators and approved by the Plant Manager and the RSO.

Stormwater runoff would be managed as three streams, as documented in the *Stormwater Management Plan* (Golder 2009a).

- Off-site runoff would be diverted around the Mill Facility by diversionary dikes and channels to natural watercourses (arroyos).
- Precipitation and runoff from most of the Mill Facility would be captured and routed to stormwater ponds (east and west). Stormwater and supernatant water from tailings cells would be subject to re-use to ensure no discharge from the facility and to reduce water demand. Stormwater ponds are designed to contain the 100-year, 24-hour storm event runoff.
- Stormwater pond overflow, from an event exceeding the 100-year design event, would overflow to evaporation ponds. These ponds are designed principally to contain and evaporate raffinate solution, the process fluid from which uranium and vanadium have been extracted. Although some of the raffinate is recycled, a portion of this solution would not be reusable due to elevated dissolved solid concentrations. Evaporation

ponds have the capacity to contain working raffinate solution, accumulated salts, and direct precipitation and overflow from the stormwater ponds up to the 1,000-year, 24-hour storm event. The 100-year storm event is calculated to yield 3 inches of rain, and the 1,000-year event could yield 4.4 inches, as reported in the *Site Drainage Analysis and Design Report* (Kleinfelder, 2009d).

A water right is being obtained for capture of runoff from the facility, which is a taking of waters of the State because it would be contained to prevent any off-site migration, and subjected to beneficial use as industrial water. This water right claim is for the maximum annual precipitation recorded for the Site vicinity (21 inches) over the area of capture (245 acres), in the amount of 428 acre-feet/year This would cover 143 acres to a depth of 3 feet, and equal the irrigation requirement given by the USDA for alfalfa in Montrose County (Colorado Department of Agriculture, 1999). The *average* annual precipitation, however, would yield just 252 acre-feet.

Septic adsorption fields would constitute the only near surface water discharge from the Mill Facility. There would be separate septic adsorption fields for office and mill restrooms, 50 x 12 feet and 100 x 40 ft in area, respectively (Kleinfelder, 2008j). Water from sinks, spigots, and showers would be collected separately and routed for re-use in the Mill, to minimize water consumption and disposal. The flow of septic and gray water systems would be no more than the 3 gpm potable water supply.

The proposed diversion and channeling of stormwater runoff around the facility would concentrate the runoff which might otherwise fan over the slope at the base of the valley side, slightly modifying where infiltration occurs. In runoff events, which cause flow in East Paradox Creek, impacts to the hydrology of the Mill Facility should have small significance to discharge to the Dolores River, the receiving stream. The 240 acres that would comprise the zero-discharge portion of the Site represents only 0.7 percent of the approximately 50-square mile drainage basin from which the creek receives runoff.

Surface Water Quality. The facility would have minimal surface water discharge potential to impact water quality in the Dolores River, the receiving stream for the catchment area in which the Site is located. Fugitive particulates might escape the confines of the plant and accumulate on the surface and then impact surface runoff quality. Fugitive emissions of dusts and vapors would be tightly controlled under emissions controls in the *Facility Operating Plan* (Visus and Energy Fuels, 2009a) and *Air Quality Permit Application* (Kleinfelder, 2009a). These controls would include: water sprays on ore stockpiles, tailings beaches, and any dry portions of the evaporation ponds; baghouses for dust generating areas such as the feed hopper, and scrubbers for emissions from processing equipment and tanks. A small amount of windblown material would likely accumulate on the downwind side of the ore pad and tailings cells. There could also be minor tracking of contaminated soils into those portions of the Site that would not be included in the zero-discharge area. However, the soil monitoring program described in the *Operational Monitoring Plan* (Visus and Energy Fuels, 2009b) and summarized in Section 4.4.3 below, would allow for detection and cleanup of contamination during operations.

As described in the *Material Containment Plan* (Energy Fuels, 2009c), the *SPCC Plan* (Energy Fuels, 2009b), and *Facility Operating Plan* (Visus and Energy Fuels, 2009a), chemical reagents, fuels and oils, process solutions, mineral concentrates, raffinate, and tailings solutions would all be enclosed within containment systems compatible with the materials being stored or transferred. All containment systems would also have engineered secondary containment and in some cases tertiary containment. Leak detection and leak monitoring would also be

incorporated into these containment systems as described in Section 4.4.3. The containment systems would minimize the potential for runoff contacting materials that could contaminate the surface water.

Discharge from domestic wastewater septic adsorption fields would be less than 3 gpm (the potable water supply), and would flow into thick alluvium located on broad and relatively flat portions of the Site. It would be highly unlikely for this discharge to find surface expression downgradient of the Site. Furthermore, the wastewater would be treated through adsorption and microbial degradation processes in the septic systems and adsorption fields.

Surface water runoff from the portion of the Site outside of the zero-discharge area would not typically reach the Dolores River. With the exception of large storm events and rapid snowmelt events, the surface water runoff would infiltrate into the soils on-site before reaching East Paradox Creek. Similarly, much of the runoff entering East Paradox Creek would also likely infiltrate into the creek bottom before reaching the Dolores River. Therefore, runoff from the Site would have little potential to impact river water quality by discharge. Stormwater diversion channels at the south end of the site would tend to concentrate flows around the facility; however, these flows would not be in contact with milling or waste disposal activities.

Groundwater in the southeast portion of Paradox Valley also discharges to the Dolores River. The water that flows in the base of the alluvium and the groundwater flowing in the bedrock aquifer system within the valley all contacts the Hermosa Formation or mixes with groundwater that does, before discharging to the Dolores River via the river alluvium, which contains high salinity brines. The BOR's PVU pumps the brines from the Dolores River alluvium to reduce salinity loading of the Colorado River. Groundwater withdrawals from the bedrock aquifer and interception of a small amount of runoff from the facility would decrease combined groundwater discharge from the southeast portion of Paradox Valley to the river. This could cause a slight decrease in groundwater flow to the river during operations, but it is unlikely this would be measurable.

Groundwater

Groundwater Hydrology. Potential impacts related to groundwater hydrology include aquifer depletion and alteration of flow directions. A secondary potential impact of aquifer depletion is damage to other groundwater users, as loss of yield in existing wells. In some environments, inelastic compaction and irreversible loss of storage in the aquifer may occur due to depletion.

The water demand for the 500 tpd operation is 141 gpm of process water, and 3 gpm of potable water (CH2MHill, 2009). The intent is to purchase the potable water from the City of Naturita as well as any shortcomings in process water the aquifer cannot supply up to the 141 gpm. It is not clear what yield the aquifer can sustain, because it is fractured and drawdown is spatially too complicated to interpret from a short-term pumping test. For reference, the 141 gpm is equal to 0.31 cubic feet per second (cfs), 0.61 acre-feet/d, 227 acre-feet/yr, or the irrigation requirement of 75 acres of alfalfa. Energy Fuels has applied for a groundwater right for 175 gpm.

The water demand (224 acre-feet/yr) is less than the annual average capture of rainwater by the Mill Facility zero-discharge area (252 acre-feet/yr). Evaporation from stormwater ponds (which cover about 1 acre) can be expected to be approximately 4 acre-feet/yr. Evaporation from the evaporation ponds, which cover 40 acres but would contain saline water, could be as much as 160 acre-feet/yr).

Because the bedrock aquifer is fractured by faults and jointing parallel to the Paradox Valley and the anticline, the drawdown would likely be strongly elliptical (anisotropic), with highly heterogeneous storage. The cone of depression may extend quite far to the north, but be interrupted to the south. The configuration of the bedrock aquifer and its connection to other Mesozoic strata under Davis Mesa are not well known, and therefore, prediction of the drawdown is speculative until operations could begin, and pumping is sustained. Early in operations, a longer term data collection and analysis of aquifer performance would be undertaken to gauge the long term sustainability of the aquifer, and to monitor for potential impacts to other well users. In the short term, a 3-day pumping test has indicated the aquifer may be capable of producing up to 175 gpm (Golder, 2008e).

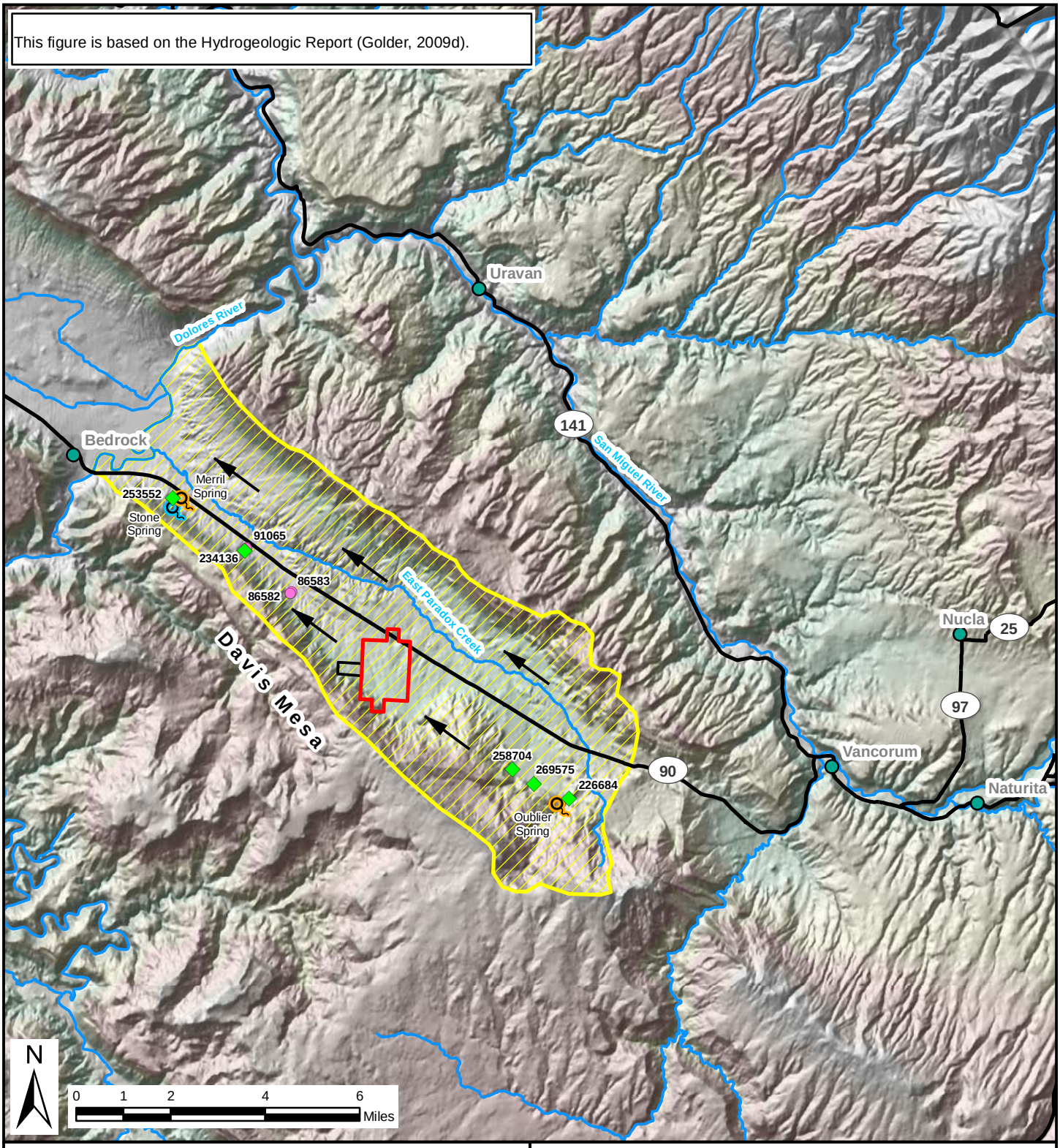
Figure 4.4-1 shows locations of proposed water supply wells PW-1 through PW-5, and existing off-site water wells. PW-1, PW-2 and PW-3 were subjected to pumping tests reported in the *Water Supply Evaluation* (Golder, 2008e). During operational startup, observation wells would measure potentiometric levels to monitor aquifer performance during sustained pumping, using dataloggers to record water levels automatically over several weeks. Monitoring of the observation wells would also continue through the life of the project, but at less frequent intervals. As discussed in Section 4.3.3, off-site wells and springs would also be monitored to determine if operation of the supply wells were affecting the water production or water quality of these water supplies.

Water withdrawals to supply the Site would change the groundwater flow patterns. Drawdown propagating outward from pumping wells would reverse the flow direction east of the wells, from northeasterly to southwesterly. This would alter what is upgradient and downgradient with respect to the Mill Facility to some degree during operations. Some groundwater may be drawn back from the contact between the bedrock aquifer and the Hermosa Formation, until the northeast edge of the aquifer is depleted. Aquifer consolidation is not a concern for the Triassic bedrock. This is a phenomenon which occurs in unlithified clayey silts, in such places as the Gulf Coast. The Triassic strata are competent. Following operations, recharge on the valley side would return the groundwater regime to its original condition. The current groundwater flow pattern and the projected modification of flows due to groundwater pumping are shown schematically in Figure 4.4-2.

The capture and containment of runoff from parts of the Mill Facility would marginally decrease recharge of the alluvium. Use of water from runoff capture in the Mill would help to offset the amount of groundwater that would need to be pumped from the bedrock aquifer for supply. Energy Fuels has applied for a water right to capture and use this surface water for industrial purposes.

Groundwater Quality. Leaks and spills of chemical reagents in the Mill Facility constitute a potential impact to groundwater quality. Measures to minimize the potential for leaks and spills, and to contain such occurrences as might occur, are detailed in the *Facility Operating Plan* (Visus and Energy Fuels 2009a), *SPCC Plan* (Energy Fuels, 2009b), and *Material Containment Plan* (Energy Fuels 2009c). The SPCC Plan focuses on storage and spill response for petroleum products such as diesel fuel and oils. The *Material Containment Plan* addresses the storage and spill response procedures for ore feedstocks, chemical reagents, processing streams, tailings, and raffinate. Measures are also described in the BMPs in the *Stormwater Management Plan* (Golder, 2009a). Structural spill prevention measures would include:

- Installation of secondary containment for all tanks, processing equipment, pipes, storage areas, and floor sumps (floor sumps would also be equipped with monitoring systems to detect leaks in primary containment);



Property Boundary
Well Field Boundary
Surface Drainage Area
Off-site Well Not Proposed for Monitoring
Off-site Well Proposed for Monitoring
Off-site Spring Proposed for Monitoring
Off-site Spring Not Proposed for Monitoring
Direction of Drainage

Figure 4.4-1

Location of Water Supply Wells and Off-Site Wells

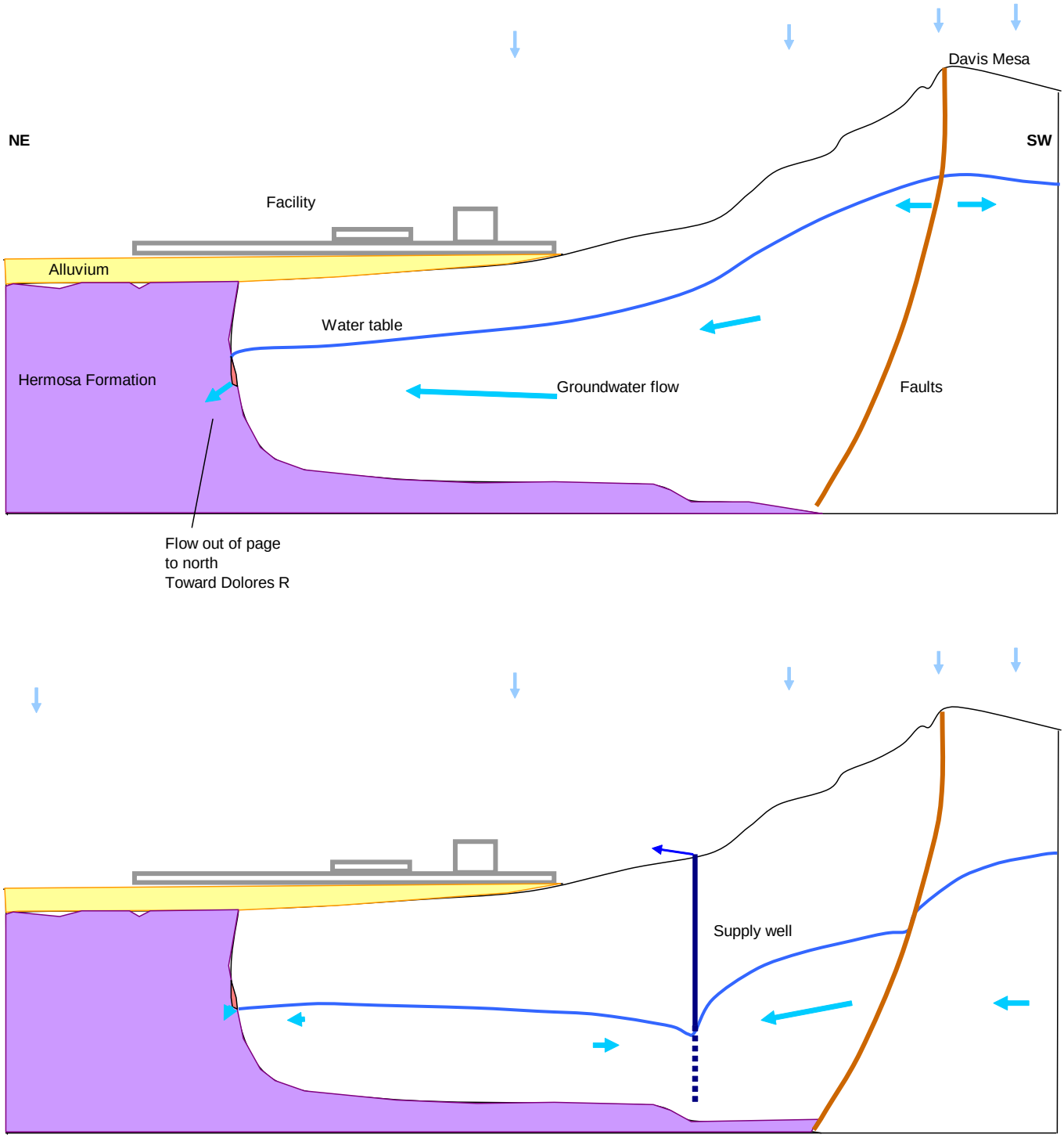


Figure 4.4-2

Schematic Cross Section Showing Groundwater Flow, Before and After Pumping

- Storage of chemical reagents and other materials in enclosed buildings, bins, and tanks to prevent contact with precipitation and surface water runoff;
- Installation of multiple liner systems with leak collection and recovery systems between the primary and secondary liners in the tailings cells and evaporation ponds; and
- Installation of synthetic liners in the stormwater ponds and below the ore pad.

Non-structural components of the various plans emphasize comprehensive employee training, covering but not limited to material management practices, good housekeeping, stormwater management, spill response and safety training, as appropriate to the employee's tasks. Training would be conducted by qualified professionals, with periodic refresher training, and would be fully documented. Non-routine maintenance tasks would require Radiation Work Permits and job safety analysis, as described in the *Facility Operating Plan* (Visus and Energy Fuels, 2009a). Any spills or leaks that might occur would be dealt with and reported according to the *SPCC Plan* and the *Material Containment Plan* (Energy Fuels, 2009b and 2009c).

Implementation of the measures outlined in the *Stormwater Management Plan*, *SPCC Plan*, and the *Material Containment Plan* and installation of the various structural components listed above would protect groundwater against impacts to the aquifer and water quality. Groundwater monitoring outlined in the *Operational Monitoring Plan* (Visus and Energy Fuels, 2009b) would allow for detection of impacts should they occur or verification of the absence of impacts (see Section 4.4.3).

Tailings cells are designed for permanent encapsulation of wastes and would remain on the Site after closure. The cells would be subject to specific regulation to prevent any foreseeable leakage of solutions from tailings impoundments to groundwater, namely Criteria 5, 6, 7 and 10 of 6CCR 1007-1 Part 18 Appendix A (CDPHE, 2001). Criteria 5 and 10 incorporate basic groundwater protection standards from 40 CFR Part 192, D and E (EPA, 1983) and 10 CFR Part 40 Appendix A.

Criterion 5A states that the primary groundwater protection standard is the design of impoundments for byproduct material, to prevent migration of wastes to water or subsurface at any time during operation or through closure. It specifies that a liner left in place must be mechanically sound, on a sound foundation and cover all soil that might otherwise contact the waste. Criterion 5E specifies there be leakage detection systems between liner layers, and requires dewatering of tailings prior to closing of the cell to reduce head in the cells as much as possible. Criterion 6 specifies a final cover effective for 200 years, and to the extent practicable, 1,000 years, limiting radiation and radon escape, and protecting against erosion. Criterion 7 sets requirements for the leak detection. Other criteria of 6 CCR 1007-1 Part 18 Appendix A relate to site selection and design, airborne releases, and terms of licenses.

The tailings cells design, which meets the criteria listed in 6 CCR 1007-1, is presented in the *Tailings Cell Design Report* (Golder, 2008a). Cells are designed for long term stability and containment under static and seismic loading (up to the MCE), through a 13-year active life and for a 1,000-year post-closure period. The cells would be mostly below grade with primary and secondary liners with intervening leak collection and recovery systems. A tailings dewatering underdrain would also be present on top of the primary liner to dewater the tailings and limit hydraulic head on the primary liner. The evaporation ponds would have the same liner design and leak collection and recovery systems as the tailings cells; however, they would not have or need an underdrain for dewatering purposes. The design of the evaporation ponds is included in the *Evaporation Pond Design Report* (Golder, 2008h).

The primary and secondary liners of the tailings cells would both be 60 mil HDPE (high density polyethylene) geomembranes. The lower liner would be underlain by a geosynthetic clay liner (GCL) consisting of bentonite between geotextile layers, with a reported hydraulic conductivity less that 10^{-9} cm/s, and that laid on a compacted soil foundation. The upper liner would be light reflective to resist long-term ultraviolet light damage. The leak collection layer also follows specification in 40 CFR 264.221 by reference from 6 CCR 1701-1 Part 18 (CDPHE, 2001); it consists of a geonet sandwiched between unwoven geotextile layers connecting to a sump where fluid may be measured and, if necessary, recovered. Testing of the GCL material with a solution of similar composition to the tailings and raffinate solution but with lower pH (i.e., more acidic) did not significantly increase the permeability of the GCL (Golder, 2008a). The underdrain above the primary liner consists of perforated HDPE piping in trenches backfilled with gravel, connected to a sump built over the leak collection sump.

4.4.1.2 Construction, Operations, and Closure Impacts

4.4.1.2.1 Construction

Surface Water. During construction there is the potential for damage to partially constructed runoff control structures. Access roads and stormwater control structures would be completed before any other facility construction begins (Kleinfelder, 2009d and Golder, 2009b) and so would be in place to manage runoff and sediment through the construction of all other facilities. During construction of the permanent runoff control structures, temporary erosion control measures would be used following BMPs described in the *Stormwater Management Plan* (Golder, 2009a), and consisting of silt fences, straw bale filters, and such measures. A detailed *Construction Stormwater Management Plan* would also be developed either during final design of the facility or by the general construction contractor prior to site construction. Implementation of the stormwater management plans would minimize the potential for erosion and sediment-laden runoff.

As soon as stormwater control structures are in place, and thereafter for the life of the Mill Facility, direct precipitation runoff (what falls on the Mill Facility) would be captured. A water right has been applied for this surface water in the amount of 428 acre-feet/yr, calculated from the maximum recorded annual precipitation in the Site vicinity. Water that is captured in stormwater and evaporation ponds during the construction phase may be used for dust control. The water right claims this water for industrial use, including mineral processing, truck and equipment washing and fire protection which would apply in the operations phase, and for dust suppression.

During construction of the stormwater control structures, there is the potential of stormwater eroding disturbed areas and contributing sediments to East Paradox Creek. Energy Fuels would implement temporary sediment control measures, such as erosion control matting, silt fences, straw bale wattles, and swales outlined in the BMPs to control erosion during construction, and temporarily halt construction that would create muddy and rutted conditions until the soil dries out sufficiently to support the appropriate equipment. Disturbed areas outside of the facility footprint would be vegetated as soon as is practical. BMP control measures would continue to be used in those areas until soils are fully stabilized.

Groundwater. Water supply wells would be installed prior to any other construction and water would be available from the wells as required through the life of project. Impacts to the bedrock aquifer (dewatering) may therefore begin during construction. Spills of equipment fuel could occur and enter the subsurface. Once installed, stormwater control structures would intercept

water that would otherwise have infiltrated or run off. This reduction of surface infiltration to groundwater has been claimed by Energy Fuels as a water right for industrial use.

Water for dust suppression would be a small and intermittent demand compared to plant use and is not expected to make measurable impacts to the water table. A *Stormwater Management Plan* and a *SPCC Plan* specific to construction activities would be developed and implemented on site at the start of construction. On-site fuel tanks would be in secondary containment and BMPs would be in effect to prevent or mitigate any spills or leaks.

4.4.1.2.2 Operations

Surface Water. Potential hydrological impacts during the 40 years of anticipated operations could include flooding of the facility and spreading of contamination, erosion or breaching of stormwater control channels, and reduction of flow to the Dolores River due to precipitation captured in the zero-discharge area of the Site.

In the life of the project, the probability of a 100-year storm event occurring approaches 50 percent. Because full stormwater containment and facility integrity are essential, critical elements of the stormwater control structures have been designed to manage the 1,000-year, 24-hour storm event. Those elements, described in the *Stormwater Management Plan* (Golder, 2009a) consist of:

- Stormwater ponds with capacity to hold the 100-year storm runoff from the Mill Facility, with overflow to evaporation ponds which can readily hold the difference between 100 and 1,000 year events. Tailings cells would always have sufficient freeboard to contain direct precipitation of the 1,000-year storm event.
- Diversionary dikes at the south end of the facility and channels, suitably armored against erosion, to carry runoff from Davis Mesa around the Mill Facility to natural drainages.
- Elevated ore pad and Mill with perimeter berms and channels to prevent run-on. Tailings cells and evaporation ponds would also be protected by berms and/or embankments from run-on.

The process fluid remaining after uranium and vanadium have been extracted (raffinate solution) would be directed to evaporation ponds. Although some of this solution would be recyclable, the high dissolved solids content of the raffinate solution would make it necessary to dispose of the remaining fluids by evaporation. Fountains or sprinklers would be used to enhance evaporation during the warmer months. The evaporation ponds would have sufficient capacity to contain the raffinate solution, accumulated precipitated salts, and the direct precipitation and stormwater pond overflow from the 1,000-year 24-hour storm event.

During operations, all areas of soil disturbance would be stabilized by permanent structural controls, including riprap, rock mulch and vegetation to minimize soil erosion. A ditch along the side of the main access road would flow through a water quality swale to settle sediments and buffer the flow leaving the site through the culvert under SH 90. These protective measures would constitute hydrologic alteration of the Site, but they would have small (no measurable) significance to surface water quantity outside the perimeter of those protective measures.

During operations, water in stormwater ponds may be used in the Mill to both maintain stormwater capture capacity and to reduce water supply requirements. The stormwater control structures would contain runoff resulting from precipitation up to the 1,000-year 24-hour storm event. Implementation of the *Stormwater Management Plan* (Golder, 2009a) with routine

inspections and maintenance of stormwater control structures would minimize the potential for these structures to fail during a storm event. A large storm could possibly cause runoff erosion in diversionary channels, and add to turbidity in East Paradox Creek. Grouted riprap armoring of the channels and energy dissipation structures where the channels empty into the arroyos are designed to prevent runoff erosion, and to carry the 100-year storm runoff. The facility is designed to contain runoff and withstand run-on from a 1,000-year storm, but if a large storm were to affect the Site or Site vicinity, Energy Fuels would assess impacts and report to CDPHE.

Structural stormwater management components and BMPs would be inspected on a monthly basis. Inspections may be conducted after storm events when weaknesses might be more apparent. Inspectors would observe sediments or pollutants in the drainage system, stockpile stability, and the condition of culverts. Inspections would be documented and files held on site. Semi-annual comprehensive site compliance inspections would duplicate monthly stormwater inspections, but also assess the stormwater control's adequacy, and proper implementation. The *Stormwater Management Plan* (Golder, 2009a) would be revised if appropriate.

Maintenance concerns identified during inspections would be addressed by mill operations personnel. Maintenance could include repairing and cleaning ditches and channels, regrading and stabilizing eroded areas, unplugging culverts, replenishing gravel on roads and pads, installing temporary or permanent erosion or surface water controls, and repairing or replacing damaged surface water samplers.

Stormwater monitoring is described in the *Stormwater Management Plan* (Golder, 2009a).and in the *Operational Monitoring Plan* (Visus and Energy Fuels, 2009b). When flowing, stormwater samples would be collected on a quarterly basis from three samplers located in the three primary drainages crossing the Site near the Property Boundary and one sampler located in a drainage upgradient of the Site.

Energy Fuels would prepare an annual report summarizing stormwater compliance, to be submitted to CDPHE. It would report:

- Performance of the stormwater management system;
- Water quality monitoring results;
- Changes to BMPs or stormwater management plan;
- Employee training;
- Spills; and
- Summaries of semi-annual comprehensive facility inspections and any actions taken.

Groundwater. The principal potential impact to groundwater during operations would be depletion of the bedrock aquifer by the supply wells. This could possibly impact other groundwater users, in terms of lowering the water levels in their wells, or drying up springs. It could also deplete discharge to the Dolores River. Other potential impacts to groundwater include leaks and spills affecting water quality. Capture of incident precipitation by the stormwater control structures would continue to intercept water that would either have infiltrated the alluvium or run off to the Dolores River.

Energy Fuels has negotiated an agreement to purchase water from the City of Naturita in the event that groundwater supply wells should not meet all of the Mill's demand in the long term. The city water is held as water rights in wells connected to the San Miguel River. This supply

would suffice for the life of the project, or until Energy Fuels develops an alternative supply. The Naturita Town Council has approved supplying up to 150,000 gallons of water per 24-hour period for up to 40 years (*Water and Wastewater Plan* – Energy Fuels, 2009f), which would represent 75 percent of the water needed to operate the Mill.

There are other groundwater wells and springs in the southeast Paradox Valley, which are completed in or flow from the same valley margin Triassic aquifer. Those wells and springs located northwest of the Site may experience some drawdown due to groundwater withdrawals at the Site, if the drawdown is highly elliptical. However, those wells to the northwest should also continue to get most of their recharge from the valley side. Impacts are therefore possible, though not quantifiable until groundwater withdrawals begin at the Site.

Water wells southeast of the Site should be unaffected by Site groundwater withdrawals. The slump block of Morrison Formation just southeast of the Site rests on the Hermosa Formation and the valley margin Triassic aquifer is interrupted or limited. Limited hydraulic connection means that impacts are unlikely to be transmitted from the Site to those wells. In the event that impacts to other users due to Energy Fuels' water withdrawals do occur, Energy Fuels would adjust water withdrawals at its supply wells and negotiate mitigating measures with those users per Condition 14 of its Special Use Permit with Montrose County (Montrose County, 2009a). Groundwater monitoring of potential aquifer depletion is discussed in the *Operational Monitoring Plan* (Visus and Energy Fuels, 2009b) and summarized in Section 4.4.3 below.

One other "user" of groundwater is the BOR's PVU, which extracts saline groundwater from the alluvium next to the Dolores River crossing of the Paradox Valley, filters it by reverse osmosis, and returns the treated water to the river. The extracted concentrated brine is disposed of by pumping it into the deep Leadville Formation. The project was developed, to reduce the salt load carried by the Colorado River. Any diminishment of groundwater flow toward the river and in contact with the Paradox Member, either by interception of runoff in the vicinity of the Site or by reducing the flow in bedrock, would augment this salt reduction, if it were indeed measurable.

There would be a very low probably of impacting the groundwater quality from leaks or releases during operations because:

- The multiple liner systems below waste disposal facilities and the secondary containment measures in the mill are designed to minimize the potential for a release to the environment. Spill response measures and monitoring of soils and groundwater are designed to limit the impact of a spill or release should it occur.
- Groundwater is absent below most of the tailings cells (i.e., Tailing Cells B and C) and all of the evaporation ponds. Where water is present below the M and Tailings Cell A, it is of poor quality, limited in extent, and more than 450 feet deep. Low permeable formations between the surface and the groundwater would also prevent seepage from reaching the groundwater.

4.4.1.2.3 Closure

Surface Water. During closure, decommissioning would potentially expose some soils to possible erosion. The *Mill Decommissioning Plan* (Kleinfelder 2009b) specifies that stormwater control structures, along with a truck wash station, would be the last components dismantled, so that controls would be intact through the facility decommissioning. When the stormwater control structures (unit isolating berms, stormwater ponds, evaporation ponds) are dismantled, temporary erosion and sediment control measures as described in the BMPs would be applied (erosion matting, straw bales, etc). Stormwater diversion structures at the south end of the Site and channels directing runoff away from closed tailings cells would be permanent, and monitored for integrity through the post-closure monitoring period.

Potential impacts to surface water quality during closure would consist of erosion of disturbed soils and transport of added sediment to East Paradox Creek. This would be minimized to some extent by conducting the closure in a phased manner. Tailings Cells A and B would already have been reclaimed prior to closure. Phased closure would then consist of construction of the interim tailings cover, demolition of the mill, removal of the ore pads and evaporation ponds, cleanup of contaminated soils, and placement of the engineered cap over the final tailings cell. Because contaminated material from the Mill, ore pad, and evaporation ponds would be transported to, and placed in, the final tailings cell, there would also be potential for residual amounts of radioactive material to be spilled or blown as dust during closure activities. Travel ways would be scanned, cleaned up, and sampled as specified in the *Mill Decommissioning Plan* (Kleinfelder, 2009b).

As discussed above, potential impacts would be controlled with both permanent and temporary stormwater and erosion BMPs. The reclamation and closure plans (Golder, 2009c and Kleinfelder, 2009b) are designed to restore the majority of the Site and drainage patterns to the pre-construction configuration. The tailings cells and permanent surface water controls associated with tailings reclamation would be the exception, as the reclaimed cells would be above the original grade and drainage would be directed around and off the tailings areas.

In post-closure, only the diversionary dike at the south end of the Site and channels bypassing the sealed tailings cells would remain, which should not measurably alter the natural hydrology. All disturbed areas would have been stabilized. Those areas returned to their approximate original contours would be revegetated. The slightly elevated tailings cell caps would be armored with rock on the gradual outslopes of the embankments and rock mulch on top, as well as sown with grasses. The spaces between tailings cells would be armored with large rock to safely pass the 1,000-year storm event.

Groundwater. Potential impacts in closure include protracted depletion of the aquifer after withdrawals cease, shifts in groundwater quality as the aquifer does recover, and the return of groundwater flow rates toward the Dolores River to baseline conditions. There is every reason to expect that the bedrock aquifer would gradually recover its pre-construction water storage through recharge when pumping ceases. As the dewatering rate of the aquifer cannot yet be predicted, neither can the recovery rate.

In closure, the stormwater control structures, except for diversionary dikes and channels, would be removed, and the approximately 240 acre-feet/yr of average precipitation on that area would return to evapotranspiration, infiltration, and runoff. Precipitation on the tailings cells would not infiltrate below grass roots over the cell liners, but would either be consumed by evapotranspiration or seep across the surface soil layer of cell cover to the rock blanket on cell flanks, and into the alluvium (Kleinfelder, 2009c). Infiltration previously intercepted by the zero-discharge area would resume flow at the base of the alluvium or in the bedrock aquifer, to eventually discharge to the Dolores River.

Any water supply replacement measures implemented by Energy Fuels to mitigate impacts to other users would be maintained until such times as the impacts recover to an effective approximation of the baseline condition.

When pumping ceases, recovery of the aquifer would return flow to the northeasterly flow path of baseline. This change of directions would cause shifts in monitoring well chemistry, approximately reversing shifts that would occur when pumping began. Water supply wells would be either abandoned or transferred to the landowner.

There would be a very low probably of impacting the groundwater quality during and after closure. The tailings and other materials disposed in the tailings cells (i.e., mill demolition debris,

evaporation pond salts, liner materials, and contaminated would all be dewatered and protected from surface water infiltration by the tailings cell cover. The cover would also provide protection against erosion and emanation of radiation (i.e., direct gamma or radon emission).

4.4.2 Protective/Mitigation Measures

The following protective/mitigation measures would be implemented to mitigate potential impacts to surface water and groundwater:

- The Mill Facility is designed to be a zero-discharge site. This means no industrial wastewater would leave the milling and waste disposal areas of the Site. Septic adsorption fields would treat the only water released to the environment.

- Stormwater containment structures would be constructed to contain direct precipitation on the zero-discharge area of 240 acres including the Mill, ore pad, tailings cells, and evaporation ponds to prevent any runoff, sediment transport or solute migration from the facility. Stormwater control structures would be completed prior to facility construction so as to minimize erosion and impacts to drainages during construction. The stormwater structures would be removed only after facility decommissioning.

- Permanent diversionary dikes at the south end of the Site would prevent run-on during the life of the Mill Facility, and divert runoff from the closed tailings cells. Diversion channels would carry intercepted runoff to existing drainages.

- The Mill Facility and its stormwater control structures are designed to withstand and fully contain the 1,000-year, 24-hour storm event.

- Regular inspections and maintenance of stormwater structures, as required in the *Stormwater Management Plan*, would keep the stormwater management system operating as designed.

- The *Material Containment Plan* and the *SPCC Plan* detail extensive structural (physical containment) and non-structural (institutional practices, training, reporting) measures to prevent spills of chemicals, reagents or products. Quarterly stormwater inspections, semi-annual facility inspections, and Standard Operating Procedures in the *Facility Operating Plan* for each process area also are independently protective of the environment and water quality in particular.

- Aquifer depletion by water supply wells would be closely monitored at startup and during the project's life to project long-term performance and develop a water supply strategy that is protective of the resource and other groundwater users.

- The groundwater monitoring program would include off-site wells and springs, to detect and manage any aquifer depletion impacts. The on-site and vicinity groundwater monitoring program would detect contamination of groundwater by the Mill Facility.

- The surface water monitoring program would allow for evaluating water quality of the Site's runoff over time and provide early detection of potential surface water impacts.

- Tailings cells and evaporation ponds would be constructed with leak collection and recovery systems between the primary and secondary liners. An engineered cover,

constructed at closure, would limit percolation into the dewatered tailings and provide long-term erosion protection.

- Operation of the LCRS in the tailings cells and evaporation ponds would result in little to no hydraulic head on the secondary and tertiary liners; therefore, the driving force behind any seepage from these facilities would be minimal.

4.4.3 Monitoring

Surface Water

Surface water monitoring would consist of monitoring the surface water samplers and stormwater monitoring in accordance with the *Operational Monitoring Plan* (Visus and Energy Fuels, 2009b). Sampling of water from impoundments (the east and west stormwater ponds) is not required. There are no on-site or off-site streams or rivers that would be subject to drainage from potentially contaminated areas; therefore, monthly sampling of these types of surface water is also not required.

The surface water sampling program has been developed to collect surface water on an event basis rather than a fixed calendar schedule, given the intermittent nature of runoff events in the area. Quarterly surface water samples are scheduled, although the actual number of sampling events each year is dependent on precipitation during the sampling period. The type of runoff event, rain gauge recording, and presence or lack of runoff at each sampling location would be documented for each event.

In accordance with the *Stormwater Management Plan* (Golder, 2009a), Energy Fuels would inspect and monitor the stormwater facilities and discharges on a monthly, quarterly, and semi-annual basis as follows:

- Monthly – inspections of structural stormwater management measures, erosion and sediment controls, and other structural BMPs;
- Quarterly – sampling of stormwater runoff according to the general surface water monitoring program; and
- Semiannually – comprehensive site compliance evaluations.

Surface water monitoring data would be submitted on an annual basis to the CDPHE. The reports would include a summary of the monitoring activities, sampling data sheets and analytical reports as well as an evaluation of data trends.

Groundwater

Groundwater monitoring would be conducted as described in detail in the *Operational Monitoring Plan* (Visus and Energy Fuels, 2009b). Baseline sampling locations include five on-site monitoring wells three production wells (two on-site and one off-site), seven exploratory holes (four on-site and three off-site), and four domestic wells and one spring location within approximately 5 miles of the Site.

This operational monitoring program is designed to detect potential impacts of operations on groundwater through quarterly monitoring, as Energy Fuels continues to monitor groundwater throughout pre-operational, operational, and post-operational phases of the Mill. Samples would be collected monthly through the first year of operation and quarterly thereafter. The effect

caused by pumping the production wells would be assessed by monitoring water levels in the observation piezometers near the production wells and by monitoring water quality and flow at off-site wells and an off-site spring in the vicinity of the Site. Energy Fuels would monitor the off-site wells and spring to evaluate if their water productivity and/or quality are impacted by operation of the production wells.

The monitoring efforts are grouped into four categories:

- Monitoring groundwater presence and quality in wells located hydraulically upgradient and downgradient of the project.
- Monitoring perched water and groundwater, if present, for potential leakage of the process water and raffinate in close proximity to the mill and tailings disposal cells;
- Monitoring groundwater observation piezometers to observe the water level response to pumping the production wells; and
- Monitoring pre-existing Chinle formation water wells and springs located within five miles of the site.

The locations the monitoring wells, observation piezometers, vicinity wells and springs, and off-site water wells and the spring are provided in the *Operational Monitoring Plan* (Visus and Energy Fuels, 2009b). The final locations and number of wells may be adjusted based on operational constraints and future findings regarding groundwater presence and quality.

Upgradient and Downgradient Wells. The upgradient portion of the aquifer, relative to the Mill Facility, is situated between the edge of Davis Mesa and the southern boundary of the Site and the aquifer terminates north of the location of Tailings Cell A (Golder, 2009d). Therefore, the downgradient part of the aquifer is west/northwest of the Site.

The upgradient monitoring wells, progressing from the south; include MW-7, MW-6, MW-5 and MW-8B. Well MW-1 (which is dry) is designated to monitor for leakage downgradient of the evaporation ponds. Upon completion of construction of Tailings Cell A and prior to commencement of mill operations, a downgradient monitoring well (MW-10) would be installed at the western edge of the tailings cell. Monitoring of proposed wells at four additional locations downgradient of the Mill, tailings cells, and evaporation ponds would be conducted to provide warning of raffinate or process water leakage. Proposed wells MW-11S and MW-11D would be sited downgradient of the Mill and proposed wells MW-12S, MW-12D, MW-13S, MW-13D, and MW-14S would be sited downgradient of the three tailings cells. Energy Fuels would use these wells to monitor the presence and quality of water perched at the bottom of the alluvium (shallow S-designated wells and MW-1) and at the bottom of the Chinle/Moenkopi formations or first groundwater (deep D-designated wells), where present.

Additionally, wells installed north of the aquifer limit would be monitored quarterly to provide continued documentation of the absence of groundwater at these locations. These wells, which include MW-1, MW-2, MW-3, and MW-4, would be monitored for water levels and would be sampled if water levels and production are sufficient for sample collection.

For upgradient and downgradient monitoring wells (MW-5, MW-6, MW-7, MW-8B, MW-10, MW-11S/D, MW-12S/D, MW-13S/D, and MW-14S) samples would be collected monthly during the first year of operations and quarterly thereafter (if an adequate volume of water exists for sample collection). These monitoring wells are not used for drinking water or watering of livestock or crops. Groundwater samples would be analyzed for a monthly/quarterly suite of parameters described in the *Operational Monitoring Plan* (Visus and Energy Fuels, 2009b). The

parameters include U-nat, Ra-226, Ra-228, Th-230, and Pb-210. Once each year, the sampling suite would be expanded to include the annual suite of parameters shown in the table.

Potential Leakage of Process Wells. Three well pairs and one single well are planned at the western side (downgradient) of the Mill and tailings cells to monitor potential leakage of process water and raffinate. Four wells (one of each well pair and the single well) would be designated as shallow (S) completions and would be screened at the bottom of the alluvium, near the contact with the underlying formation (either the Chinle or the Hermosa). The remaining three wells would be designated as deep (D) completions and would be screened at the first groundwater occurrence, or if groundwater is not present, at the contact between the Chinle/Moenkopi Formation and the Hermosa Formation. These monitoring well locations are summarized below:

- Well MW-11S and MW-11D: located at the western side of the Mill;
- Wells MW-12S and MW-12D: located at the western edge of Tailings Cell A;
- Wells MW-13S and MW-13D: located at the western edge of Tailings Cell B; and
- Well MW-14S: located at the western edge of Tailings Cell C (only shallow completion of monitoring well MW-14 is planned for this location due to anticipated absence of the Chinle and Moenkopi formations).

These wells would be installed upon completion of the Mill and neighboring tailings cells to avoid interference with construction activities. Wells would be located outside the reclamation footprint of the Mill and tailings facilities and would remain operational during the post-operational phase of the project.

Monitoring well MW-1 (currently installed) is designated to monitor potential leakage from the evaporation pond area. The well is located near the northwestern side of the evaporation pond area and is screened in the alluvium, near the contact with the Hermosa Formation. The well is similar in completion to the wells designated as shallow (S) completions for monitoring water perched at the bottom of the alluvium. To date, no water has been observed at well MW-1.

The wells close to the Mill Facility (MW-11 through MW-14) are downgradient wells and are part of the upgradient/downgradient well system described above.

Observation Piezometers and Production Wells. Throughout operations, groundwater levels would be monitored to assess the response of the aquifer to groundwater withdrawal from pumping the production wells. Water levels would be monitored in six piezometers, to be installed in the vicinity of the production wells similar to those installed (and subsequently abandoned) as part of the long-term aquifer tests (Golder, 2008c and 2008e). Monitoring of the piezometers would be initiated prior to the start of operations to establish baseline conditions and would continue during the life of the project unless operation of the production well field is terminated or Montrose County approves otherwise. The existing groundwater observation piezometers include:

- PW-1 OB-A;
- PW-1 OB-B;
- PW-2 OB-A;
- PW-2 OB-B;

- PW-3 OB-A; and
- PW-3 OB-B.

Additional production wells (including, but not limited to PW-4 and PW-5) would be installed prior to commencement of operations. Each of the future production wells would be tested for aquifer properties using two observation piezometers at each production well. Following aquifer testing at the production wells, the piezometers would continue to function as water level monitoring systems.

While production wells are operating, water levels in the observation piezometers would be monitored twice each month during the aquifer's transient state induced by pumping. If the aquifer attains steady state (recharge balances the pumping rate(s)) as indicated by stable water levels in the observation piezometers, the frequency of monitoring would be reduced to monthly readings. Should the saturated thickness of the aquifer at the location of the observation piezometers for a production well be reduced by pumping to 50 percent of its original thickness, the pumping rate at that production well would be adjusted (reduced) to prevent further groundwater drawdown. If adjusting the pumping rate proves ineffective, the production well would be shut down until the aquifer recovers sufficiently to resume pumping.

Water quality samples would not be collected from the observation piezometers; however, samples would be collected from each of the production wells on a quarterly basis during the first year of operation and annually thereafter. The samples would be analyzed for the monthly/quarterly suite of parameters provided in the *Operational Monitoring Plan* (Visus and Energy Fuels, 2009b) and include: U-nat, Ra-226, Ra-228, Th-230, and Pb-210. Once each year, the sampling suite would be expanded to include an annual suite of parameters. With the exception of well PW-3, the production wells are not used for drinking water or watering of livestock or crops. Production well PW-3, which is located within 1.25 miles (2 km) of the tailings cells, is used for watering of livestock in addition to providing a raw water supply to the Mill. Therefore, this well would be analyzed for both dissolved and suspended radionuclides.

Pre-existing Off-Site Water Wells and Spring. To assess the response of the aquifer to groundwater withdrawal from pumping the production wells, off-site wells and an off-site spring in the vicinity of the site would be monitored. Monitoring of the off-site wells and spring was initiated prior to the start of operations to establish baseline conditions and would continue during the life of the project unless operation of the production well field is terminated. Appendix A of the *Hydrogeologic Report* (Golder 2009d) provides a description of the wells and springs identified in the vicinity of the site through database searches and field investigations. Appendix B provides the measures that Energy Fuels would implement if any of the off-site water sources owned by others (i.e., five wells and one spring) exhibit a significant decrease in productivity or deterioration in water quality.

<u>Off-Site Wells</u> With permission of the owners, five functional wells would be monitored prior to and during operations to determine whether water productivity and/or quality are impacted by operation of the production wells.

Monitoring of the wells includes pumping each well at full capacity of the pump/valve system for approximately 20 minutes, and measuring and recording the pumping rate every 5 minutes. Water quality field parameters (pH, specific conductivity, temperature, oxidation reduction potential and dissolved oxygen) would also be recorded on 5-minute intervals. Should pumping cause the water level to drop to or below the pump intake level, the rate is adjusted to continue

pumping without running the well dry. If accessible, static water levels would be taken prior to the start of the pumping test and after the test is completed. The off-site wells would be monitored for productivity and water levels on a quarterly basis during the pre-operational period and during the first two years of mill operations. Thereafter, the wells would be monitored annually for productivity and water levels.

Water sampling and analysis would be conducted on an annual basis during both the pre-operational and operational periods. The water sample would be collected during the second half of the flow test. Samples would be analyzed for the annual suite of parameters provided in the *Operational Monitoring Plan* (Visus and Energy Fuels, 2009b), which is the same parameter suite analyzed for the groundwater samples collected from monitoring wells at the Site. Although these off-site wells are used for domestic and livestock watering purposes, they are located greater than 1.25 miles (2 km) from the Property Boundary. Sampling frequency may be increased at a well if water production or quality exhibits a significant change over time. A water sample would also be collected any time that a water quality field parameter (other than temperature) changes by 20 percent or more between monitoring events.

Off-Site Springs Three springs have been identified within the drainage basin. These springs include Stone Spring, Merrill Spring, and Oublier Spring. Stone Spring is located approximately 5 miles northwest of the Site on public land administered by the BLM. The spring flows from a 120-foot long tunnel in the Chinle Formation and is piped approximately 1,000 feet to two residences. When inspected in June 2009, it was flowing at approximately 10 gpm; however, the flow varies seasonally and the spring reportedly stopped flowing for a 3-month period in 2003. Merrill Spring is located just east of Stone Spring on public land administered by the BLM. The spring also emanates from the Chinle Formation, but was not flowing when inspected in June 2009. Oublier Spring is located approximately 5 miles southeast of the Site on BLM-administered land. This spring flows from near the base of the Salt Wash Member of the Morrison Formation, which is stratigraphically considerably higher than the Chinle Formation.

Merrill Spring would not be monitored given that it was not flowing in June 2009, a time when springs and seeps have typically exhibited higher flows. Oublier Spring also would not be monitored given that it is completed above the production wells in a different formation. Stone Spring, located 5 miles downgradient (northwest) from the Site, would be monitored quarterly for flow rate during the pre-operational period and during the first two years of operations. Thereafter, flow monitoring would continue on a semi-annual basis (late spring and early fall) during operations. Sampling and analysis would be performed on a semi-annual basis both prior to operations and during operations. Sampling would take place in the late spring, when flow is expected to be highest, and in late fall during the low-flow season. Water samples would be analyzed for the parameters provided in the *Operational Monitoring Plan* (Visus and Energy Fuels, 2009b). Flow measurements would be taken after any stored hydraulic head is first dissipated. The flow rate and water quality field parameters would be measured and, if scheduled, the water sampled.

Reporting. Groundwater monitoring data would be submitted on an annual basis to the CDPHE. Annual reports compile data for the entire period and include a summary of the monitoring activities, sampling data sheets and analytical reports, and contain an evaluation of data trends.

4.5 ECOLOGICAL RESOURCES

4.5.1 Environmental Impacts

4.5.1.1 General Impacts

Vegetation

Three dominant vegetation communities located within the Site include 1) pinyon-juniper vegetation along the bluffs in the southwest portion of the Site, 2) big sagebrush habitat located in a narrow strip adjacent to the pinyon-juniper habitat and on the northeast half of the Site, and 3) a mixed grassland habitat located in the central portion of the Site between both big sagebrush habitats (see Figure 3.5-2 in Section 3.5.1.2, Vegetation).

Wetlands

Only one non-jurisdictional wetland feature, a retention pond, is located within the Site (Kleinfelder, 2008c). It is situated upslope from the proposed Mill Facility and is further separated from the Mill Facility by an earthen berm. Water runoff at the Site would be naturally diverted prior to reaching the retention pond. No disturbance is proposed for this area. No direct or indirect impacts to this wetland feature and associated vegetation are expected during construction, operation, or closure of the Mill Facility. Wetlands are not discussed further in this ER.

Invasive, Non-Native Species

Table 3.5-6 (Section 3.5.1.4, Invasive, Non-Native Species) provides a list of 21 noxious weeds that require management and control within the State of Colorado and are known or suspected to occur within Montrose County, of which two (redstem filaree and cheatgrass (downy brome)) have been observed within the Site (Kleinfelder, 2009g; WestWater, 2009) and an additional eight within the project vicinity (Lyon and Sovell, 2000). In addition to noxious weeds identified by the State of Colorado and Montrose County for management and control, areas of the Site have been invaded by other non-native species including, Russian thistle, broom snakeweed, and herb sophia. Infestations of invasive, non-native species can adversely alter ecological communities by out-competing native species, especially if soil surfaces are disturbed (Whitson et al., 2004). Once noxious weeds become established, their distribution expands without natural controls including native competitors, predators, and pathogens (Lyon and Sovell, 2000).

Federally Listed Threatened and Endangered Species

Canada Lynx. Direct and indirect effects to lynx by the Proposed Action may occur as a result of increased vehicular traffic. Lynx that have been reintroduced to Colorado suffer mortality as they move through and/or into new areas (CDOW, 2009b). Human-induced deaths are the primary causes of lynx mortality in Colorado with 30.4 percent of deaths attributable to either gunshot (known or probable deaths; 18.3 percent) or vehicular collision (12.1 percent of all mortality sources). Mortality by vehicle is a significant source of mortality for lynx in other parts of their range as well (Aubry et al., 2000; Ruediger et al., 2000). CDOT determined locations of potential lynx road crossing events in western Colorado (Crooks et al., 2008). Although radio-collared lynx selectively avoid highways, evidence suggests they crossed several roads in Montrose County and San Miguel County including SH 145. Similar to bobcats (McCord and Cardoza, 1982), lynx are generally active during crepuscular periods in summer and most active during afternoon and evening in winter (Kolbe and Squires, 2007). Restriction of most traffic to daylight hours would reduce but not eliminate risks of collisions of project-related vehicles with lynx.

Black-Footed Ferret. Black-footed ferrets were reintroduced to Rio Blanco and Moffat counties in northwest Colorado in 1999 at one site (Coyote Basin) on the Colorado-Utah border west of Rangely and in 2001 at a second site (Wolf Creek) south of Dinosaur National Monument. The Coyote Basin site is approximately 128 miles north and the Wolf Creek site is 135 miles north of the Site. No black-footed ferrets introduced at either location in Colorado would be affected by construction, operation, or closure of the Mill Facility. Therefore, ferrets are not addressed further in this ER.

Mexican Spotted Owl. At the time they were listed, there were only 20 historic records (13 records accepted) of Mexican spotted owls in Colorado, mostly from the San Juan Mountains in southwestern Colorado. USFWS (1995) identified the following potential threats to the species: catastrophic fire, recreation, urbanization, timber harvest, and road construction. The USFWS identified less severe threats including land exchange, oil and gas leasing, mineral development, and grazing while noting that individual actions may generate low impact to the species but in combination, they may generate high cumulative impact because of synergistic interactions (USFWS, 1995).

If Mexican spotted owls occur within the Site or vicinity, available information indicates they would most likely be in the pinyon-juniper vegetation south of the Site. No removal of pinyon-juniper vegetation is proposed, therefore no direct impact to potential spotted owl habitat is expected. However, noise generated during construction and operation could directly impact Mexican spotted owls. The USFWS established 92 dBA as the sound-only injury threshold for northern spotted owls in the Pacific Northwest (USFWS, 2003b). In the analysis, the USFWS noted that noise levels of 44 dBA would be detected, 57 dBA would be the threshold for alert behavior, and noise ≥70 dBA would cause a disturbance to northern spotted owls (USFWS, 2003b). It can be expected that Mexican spotted owls may react similarly to noise levels as northern spotted owls.

Endangered Colorado River Fish (Bonytail Chub, Humpback Chub, Colorado Pikeminnow and Razorback Sucker). No critical habitat for the bonytail or humpback chub has been designated in the Dolores River and it is unlikely that they occur in the Dolores or San Miguel rivers. Likewise, none of the ephemeral streams within the Site is suitable habitat for Colorado pikeminnows or razorback suckers. The pikeminnow occurs within the Colorado River and they occur within the Dolores River approximately 1.2 miles upstream from the confluence with the Colorado River (USFWS, 2002b). The primary threats to endangered Colorado River fish species are streamflow regulation, habitat modification, predation by non-native fish species, hybridization, and pesticides and pollutants (USFWS, 2002a). There is no critical habitat for any of the species near the Site.

The accidental spill of uranium/vanadium ore into the Dolores River or San Miguel River would potentially pose a localized short-term impact on the aquatic environment and endangered Colorado River fish. Part of the released load could be washed away by the stream and carried a long distance from the accident site. The frequency of a rollover and/or crash of an ore truck at water crossings is calculated at 8.4×10^{-5} per year (once every 12,000 years) (SENES, 2009a). The accidental spill of yellowcake into the water could also potentially pose a localized short-term impact on the aquatic environment and endangered Colorado River fish as discussed above. The frequency of a rollover and crash of a truck carrying yellowcake is estimated to be 4×10^{-6} (once every 250,000 years).

The number of shipments of anhydrous ammonia to the Mill Facility is expected to be approximately 3 times more frequent than yellowcake shipments from the Mill. However,

ammonia is expected to be shipped from a supplier closer to the Mill than the yellowcake conversion facility in Illinois. Therefore, it is expected that the frequency of a rollover and crush of an ammonia truck, which could result in catastrophic release of ammonia, would be much smaller than that of a yellowcake truck (SENES, 2009a). Petroleum products would be transported to the Site over much shorter distance; however, the number of deliveries would be greater than that of ammonia, resulting in greater risk of accidental spills.

Uranium/vanadium ore can also contain aluminum, arsenic, barium, copper, iron, lead, manganese, selenium, vanadium, and zinc, all of which are potentially toxic to aquatic species (DOE, 2007). Ore solids, however, have high specific gravity and most would be expected to settle to the riverbed within a short distance from the accident site (SENES, 2009a). DOE (2007) also concluded that it is unlikely that any adverse impacts to biota would occur because of the relatively low toxicity and low concentrations of the potentially hazardous constituents of uranium/vanadium ore. Alternatively, the uranyl form of yellowcake is more highly soluble and would persist farther downstream than ore; spills of yellowcake could adversely affect streams with elevated water concentrations (SENES, 2009a). The probabilities associated with either an ore spill or a yellowcake spill in a river are negligible. Further, expected expedient and comprehensive clean up actions would be required under USDOT regulations. An Emergency Response Plan would be in place for responding to accidents and cargo spills. This, coupled with low or moderate impacts to fish, would result in a small risk of adverse affects to endangered Colorado River fish (SENES, 2009a).

Petroleum products can be toxic to algae, invertebrates, and fish. During 96-hour tests of acute toxicity, the LC50 (lethal concentration for 50 percent of the subjects) for juvenile coho salmon exposed to diesel fuel ranged between 2,186 and 3,017 mg/l (World Health Organization, 1996). Effects of such contamination, if an accidental release occurred, are unlikely to affect any of the four fish species because potentially occupied habitats in the Colorado River are approximately 65 miles downstream from the Site. Petroleum products in the water column would dissipate and not be present in toxic concentrations at the confluence with the Colorado River.

Colorado Hookless Cactus. An intensive survey of potential Colorado hookless cactus habitat present within the Site (pinyon-juniper woodland) was performed on August 24, 2009 but no hookless cactus was found (WestWater, 2009). Colorado hookless cactus has not been found in the Paradox Valley area in previous survey efforts (USFWS, 1990b; Lyon and Sovell, 2000; Ferguson, 2009). Construction, operation, and closure of the Mill Facility would have no effect on Colorado hookless cactus, and, therefore it is not discussed further in this ER.

Clay-Loving Buckwheat. The clay-loving buckwheat is endemic to the adobe hills and flats immediately adjacent to Delta and Montrose counties, Colorado. Occupied habitat and designated critical habitat are approximately 60 miles northeast of the Site. Botanical surveys conducted by Kleinfelder (2009g) and WestWater (2009) did not document this species. The clay-loving buckwheat is highly unlikely to occur within the Site and vicinity, and, therefore, construction, operation, and closure of the Mill Facility would have no effect on the species or critical habitat and it is not discussed further in this ER.

Candidate Species

Western Yellow-billed Cuckoo. According to the USFWS (2007c), the threats currently facing the western DPS of yellow-billed cuckoo include habitat modification and destruction, and pesticides. Cuckoo breeding habitats have also been reduced by groundwater pumping and tamarisk. The overuse of riparian habitat by livestock grazing, especially on plants like willows and cottonwood saplings, also plays a factor (USFWS, 2007c). However, there is no occupied

habitat within or near the Site or within Montrose County. Wildlife surveys conducted by Kleinfelder (2009h) and WestWater (2009) did not document this species. Western yellow-billed cuckoos are highly unlikely to occur within the Site and vicinity. Construction, operation, and closure of the Mill Facility would have no effect on the species or potentially suitable habitat. Therefore, it is not discussed further in this ER.

Gunnison's Prairie Dog. Only Gunnison's prairie dogs that inhabit montane habitats (higher elevation, cooler and moister plateaus, benches, and intermountain valleys) found in the northeastern portion of the species' range in central and southcentral Colorado and north-central New Mexico have been identified as candidate species for listing under the ESA. Populations of Gunnison's prairie dogs within the Paradox Valley are not included in the USFWS' recent finding and would not be considered as candidate species (USFWS, 2008b).

Gunnison's prairie dogs have inhabited the Site in the past; abandoned burrows (not occupied during the current year) were adjacent to the Site in Section 7, Township 46 North, Range 17 West. Gunnison's prairie dogs inhabit the Paradox Valley and were observed at two locations, east and west of Site during surveys conducted in August, 2009 (WestWater, 2009). Similar to other species of prairie dogs, Gunnison's prairie dog construct burrow systems with entrances usually on slopes or small rises rather than in depressions, a strategy to protect burrows from flooding (Pizzimenti and Hoffmann, 1973). Similar to other species of prairie dogs, Gunnison's prairie dogs have been adversely affected by converting native habitats to agricultural land (Knowles, 2002). Prairie dog control through intentional poisoning and recreational shooting has reduced their abundance and outbreaks of sylvatic plague have been especially devastating to Gunnison's prairie dog (USFWS, 2008b).

Prairie dogs will often burrow in previously disturbed areas (Koford, 1958; Knowles, 1982). Soil disturbances including pipelines, range ripping and furrowing, and past cultivation, as well as heavily grazed sites where livestock concentrate often provide suitable prairie dog habitat and may be potential sites likely to be colonized by prairie dogs (U.S. Forest Service, 2001).

Gunnison Sage Grouse. Gunnison Sage-grouse is a former candidate species and potentially, a future candidate species for listing under ESA because USFWS is obligated under a District Court settlement to reconsider removing it from the list of candidates and publish a new finding on or before June 30, 2010. Gunnison Sage-grouse has remained a Species of Special Concern in Colorado where it has declined because of habitat loss due to housing and human development, livestock grazing, water diversion projects, and increased deer and elk populations; the Colorado Wildlife Commission eliminated hunting in areas occupied by Gunnison Sage-grouse in 2000 (CDOW, 2009b).

Of the threats to Gunnison Sage-grouse, by far the greatest is the permanent loss and associated fragmentation and degradation of sagebrush habitat associated with urban development and/or conversion (Gunnison Sage-grouse Rangewide Steering Committee, 2005). In the San Miguel Basin Gunnison Sage-Grouse Conservation Area which includes the Site, habitat occupied by Gunnison Sage-grouse is only 45 percent of all habitat that could potentially be occupied, including former habitat that is vacant. There are 41,360 acres of presumably suitable habitat in the San Miguel Basin that is classified as vacant or of unknown use. Less than 7 percent of identified vacant habitat is dominated by sagebrush (Gunnison Sage-grouse Rangewide Steering Committee, 2005). An additional 62,000 acres in the San Miguel Basin Gunnison Sage-Grouse Conservation Area was identified as potential sage grouse habitat but only 34 percent of that is currently dominated by big sagebrush (Gunnison Sage-grouse Rangewide Steering Committee, 2005). Consequently the sagebrush vegetation in

Paradox Valley has high potential value to Gunnison Sage-grouse. Construction and operation of the Mill Facility would impact 247.6 acres of big sagebrush, which would reduce the amount of available sagebrush within Paradox Valley.

The Site and vicinity is not within currently occupied Gunnison Sage-grouse habitat, but the big sagebrush shrubland at the Site and within the Paradox Valley is potential habitat (San Miguel Basin Sage Grouse Working Group, 1998). The Site is within a corridor, partially vegetated by pinyon-juniper woodlands that separates occupied Gunnsion Sage-grouse habitat in Dry Creek Basin from potential habitat in the East Paradox Valley (CDOW, 2008). Overall range for Gunnison Sage-grouse is approximately 1.5 miles south of the Site within the Dry Creek Basin, although the closest lek is farther than 11 miles south and wintering habitat is 12 miles south of the Site.

BLM Sensitive Species and State of Colorado Species of Special Concern

Mammals. Four of the six species of bats that are included in Table 3.5-2 could occur within the Site and vicinity. The Proposed Action could impact bats by adversely affecting summer and/or winter roosts, hibernacula, and foraging habitats, contaminating surface water, generating noise that could interfere with echolocation, and through night lighting that may alter their behavior. Noise from traffic and other sources is believed to interfere with bats' echolocation of insect prey (Jones, 2008).

There is suitable habitat for Botta's pocket gopher and northern pocket gopher within the Site, including foraging habitat that consists of forbs (thistles), succulent grasses (bromes), prickly pear, and saltbush (CDOW, 2009d and 2009e), but neither species of pocket gopher was observed during surveys conducted in 2007 and 2008 (Kleinfelder, 2009h). Both species are Colorado Species of Special Concern (see Table 3.5-2). The Proposed Action could impact pocket gophers by direct mortality during ground clearing and excavating actions and by vehicles in general.

Northern river otters have been reintroduced from diverse geographic locations in North America since 1976 and have become established in the Dolores River and San Miguel River (Boyle, 2006), but they are not expected to occur within the Site. Water pollution, control of streamflows, and human-caused mortality (trapping, shooting, predation by dogs) have adversely affected otters in Colorado (Boyle, 2006).

Birds. Only four of the bird species that have been identified as sensitive species by the BLM and/or are a protected species in Colorado and included in Table 3.5-2 are believed to possibly occur within the Site: Gunnison's Sage-grouse, bald eagle, American peregrine falcon, and western burrowing owl. Gunnison's Sage-grouse was discussed above as a candidate species for listing under the ESA.

Bald eagles have been killed by vehicles during winter and at other times as they feed on roadside carrion (USFWS, 1999) and increased vehicular traffic associated with the Mill Facility may increase the risk, especially because the Site and wider area vicinity is identified as bald eagle winter range (CDOW, 2009b). Bald eagle winter range is an area where bald eagles have been observed between November 15 and April 1.

Bald eagles would be likely to feed on any deer carrion if present along that portion of SH 90 or other segments of SH 90 and other routes connecting from the west through La Sal, Utah and from the east through Vancorum, Colorado.

American peregrine falcons are a species of concern in Colorado and are a BLM-sensitive species. Disturbance of the adults could lead to egg or chick abandonment, leaving them vulnerable to predators and the elements. In extreme cases of disturbance, for example the sudden appearance of a human or machinery very close to a nest, the adult may leave so quickly as to knock eggs or chicks out of the nest (White et al., 2002). There are nine active peregrine falcon eyries within an approximate 20-mile radius of the Site, but the closest is 4 miles away near the confluence of East Paradox Creek and the Dolores River. Noise associated with the Mill Facility is not expected to affect peregrine falcons. They are not discussed further in this ER.

Threats to the burrowing owl include loss of habitat through prairie dog eradication programs, agricultural and urban conversion, the absence of grazing that keeps vegetation low, insecticides and pesticides, and collisions with moving and stationary structures (USFWS, 2003c; McDonald et al., 2004). Impacts to burrowing owls could occur directly, through mortality, if nests and nestlings are destroyed (Marks and Ball, 1983). During surveys conducted in spring 2008 and summer 2009, western burrowing owls were documented adjacent to and in the vicinity (approximately 0.8 to 1.5 miles away) of the Site (Kleinfelder, 2009h; WestWater, 2009); however, burrowing owls were not documented within the Site. Potential suitable habitat (e.g., abandoned Gunnison's prairie dog burrows, other small mammal burrows) was identified along the western portion of the Site within the mixed grasslands habitat, although no sign of owls inhabiting the abandoned burrows was found (WestWater, 2009). No disturbance is proposed at these burrows; therefore, no direct or potentially direct impact to this species is expected.

Reptiles. The midget faded rattlesnake is the only sensitive species of reptiles likely to be present within the Site, based on known distributions and habitat affinities. Surveys conducted in 2007 and 2008 (Kleinfelder, 2009b) and 2009 (WestWater, 2009) did not observe this species within the Site. They are not discussed further in this ER.

Amphibians. Although five amphibian species are included in Table 3.5-2 as BLM-sensitive species and species of special concern in Colorado, only canyon tree frogs and northern leopard frogs potentially occur within or adjacent to the Site. The canyon tree frog occurs along intermittently flowing streams in deep, rocky canyons (CDOW, 2009f). Threats to the canyon tree frog are habitat related (Lyon and Sovell, 2000), and include reduction in water quality often from uranium mill tailings (Center for Native Ecosystems, 2009). The mill process areas, ore pad, tailings cells, and evaporation ponds are designed as "zero discharge" facilities. Precipitation and runoff that contacts these areas would be contained on site in lined ponds and cells and recycled for use in the Mill Facility. The system is designed to withstand a 1,000-year storm event. Therefore, contamination from the Mill Facility is not expected within drainages that may provide habitat for the canyon tree frog. None of the ephemeral drainages on-site provide habitat for any of the species. The groundwater table is either absent or greater than 400 feet below ground surface at the proposed locations of the mill, tailings cells, and evaporation ponds (Golder, 2009a); therefore, water quality within waterbodies potentially connected to groundwater sources should not be affected. Tree frogs were not documented during surveys conducted in 2007 and 2008 (Kleinfelder, 2009h) or 2009 (WestWater, 2009). The Proposed Action is not expected to affect canyon tree frogs or potentially suitable habitat and therefore, they are not discussed further in this ER.

Northern leopard frogs inhabit wet meadows, and the banks and shallows of marshes, ponds, streams, and irrigation ditches (CDOW, 2009f). Threats to this species include habitat loss, degradation, and fragmentation caused by construction within pristine areas, urbanization and

growth of suburbs, logging, building of roads and trails, and grazing within riparian vegetation (Smith and Keinath, 2007; Lyon and Sovell, 2000). Other threats to this species include negative interactions with non-native species (i.e., bullfrogs), bacterial infection, mortality from roads, or impacts from sedimentation and toxic runoff from roads that may negatively affect amphibians in nearby ponds (Smith and Keinath, 2007). Recently, USFWS (2009e) announced initiation of a status review for the leopard frog in western states to determine if listing under the ESA may be warranted. Northern leopard frogs could occur within the small stock pond on the Site or East Paradox Creek located north of the Site, although leopard frogs were not observed in the vicinity of the stock pond during survey efforts in 2007 and 2008 (Kleinfelder, 2009h) or 2009 (WestWater, 2009). Effects to potential northern leopard frog habitat at the stock pond are not expected. No permanent connection to East Paradox Creek occurs; therefore, no effects to potential habitat in the creek from the Proposed Action are expected. It is expected that there would be no impact to Northern leopard frogs due to the Proposed Action and they are not discussed further in this ER.

Fish. None of the four fish species that are of special concern in Colorado and BLM-sensitive species occur within the Site; there are no rivers or perennial streams near the Site, and none of the ephemeral drainages on-site provide habitat for any of the species. Fish could be adversely affected by accidental spills and releases of ore, yellowcake, chemical reagents, and petroleum products during transport to or from the Mill Site as discussed above for Colorado River endangered fish species.

Invertebrates. One invertebrate species identified as sensitive by the BLM, the Great Basin silverspot butterfly (also called the Nokomis fritillary butterfly), occurs within Montrose County and has been recorded at least 7 miles west of the Site. It is possible that introduced thistles documented within the Site and its vicinity could serve as nectar sources during adult flight, based on the known proximity of this species to the Site. Elimination of grazing and/or increase of non-native, invasive species could change the vegetation composition present within the Site and eliminate potential nectar sources used by this species during adult flight. It is expected that there would be no impact to the Great Basin silverspot butterfly and they are not discussed further in this ER.

Vascular Plants. Of the 24 sensitive vascular plants included in Table 3.5-2, only five possibly occur within the Site in pinyon-juniper woodlands and/or big sagebrush shrublands: Grand Junction milkvetch, Naturita milkvetch, sandstone milkvetch, Paradox lupine (Payson lupine), and Paradox breadroot. However, none of the five species were observed during on-site surveys conducted in 2007 and 2008 (Kleinfelder, 2009h), or in 2009 (WestWater, 2009).

No sensitive vascular plants have been identified within the Site and therefore, no impacts are expected to these species. Sensitive plants associated with pinyon-juniper woodland should not be affected by the Proposed Action disturbance is not proposed within the pinyon-juniper woodlands. They are not discussed further in this ER.

Terrestrial Wildlife

Big Game. The Proposed Action could potentially result in direct mortality or injury to various wildlife species. For example, wildlife-vehicle collisions are documented for mule deer; mule deer mortality increases with traffic volume during winter (Arnold, 1978; Reed, 1981; Romin and Bissonette, 1996). The Site is entirely within mule deer overall range, mule deer winter range, and mule deer severe winter range. In addition, routes to be used for transporting ore from various mines in Utah and Colorado to the Mill Facility pass through resident mule deer population areas, mule deer winter ranges, severe winter ranges, and winter concentration

ranges in Colorado, and crucial or substantial winter ranges in Utah. In some of the seasonal ranges in Colorado, CDOW has defined mule deer highway crossing zones, which are areas where mule deer traditionally cross roads, presenting potential conflicts between mule deer and motorists. CDOT has documented vehicle-related mortality of mule deer and elk during winter within the crossing zones and at other locations on SH 90 proximate to the Site (Znamenacek, 2009).

Similarly, the Site is entirely within elk overall range, elk winter range, elk severe winter range, and an elk winter concentration area. In addition, routes to be used for transporting ore from various mines in Utah and Colorado to the Mill Facility pass through resident elk populations, elk winter ranges, severe winter ranges, and winter concentration ranges in Colorado, and elk crucial ranges in Utah. Transportation routes also cross pronghorn crucial yearlong range and winter range in Utah and Colorado. Elk and pronghorn could also be directly impacted by vehicular collisions.

Mule deer, elk, and pronghorn mortalities occur when they attempt to jump fences and their legs become ensnared between the top two fence wires (Harrington and Conover, 2006). Mule deer fence-related mortality is generally higher than elk mortality because deer cross fences more frequently, particularly highway rights-of-way fences, and juvenile ungulates (including pronghorn) were most susceptible to fence mortality (Harrington and Conover, 2006). More deaths were caused by woven-wire fence with single strand barbed-wire top than woven-wire with two top barbed-wire strands or four-strand barbed wire fences (Harrington and Conover, 2006).

Most indirect effects to mule deer are associated with degradation and/or alterations to habitats (habitat loss). The Proposed Action could potentially impact mule deer and elk by reducing the amount of habitat available and/or causing diminished use of habitats adjacent to human activities. Increased presence of humans in wildlife habitats also contributes to indirect (sometimes called “secondary”) impact. Examples typically include increased recreation demand (including off-highway vehicle use), increased habitat conversion, habitat degradation by human encroachment, and increased illegal harvest (Comer, 1982).

The Proposed Action could potentially alter mule deer and elk distributions on winter ranges some distance away from the Property Boundary similar to effects associated with construction of new roads and/or oil and gas activities within winter ranges because mule deer generally avoid roads (Rost and Bailey, 1979; Easterly et al., 1991). Elk also avoid roads and traffic (Rost and Bailey, 1979: Lyon, 1983; Witmer and DeCalesta, 1985; Rowland et al., 2000). Animals could be displaced to surrounding habitats, already supporting other animals, and local densities would increase in those areas. Such increased densities could lead to density-dependent effects including overcrowding and overutilization of habitats, increased intraspecific competition, and increased prevalence of disease, predation, and physiological stress. Density-dependent demographic responses (e.g., decreased survivorship, decreased fecundity) are possible, though unlikely to be documented, and could potentially contribute to declining local populations.

The Site coincides with habitats utilized by black bears (black bear overall range). CDOW recognizes potential conflicts between humans and black bears and has developed recommendations for bear-proofing homes that would also be applicable to work places. In particular, garbage attracts bears and such attractants can draw bears into situations where they destroy property and/or become a threat to human safety, possibly leading to their destruction. A resource list of bear resistant containers is available from CDOW (2009h). Use of

bear-proof containers and frequent refuse collection would minimize potential for conflicts on construction sites.

Poaching wildlife, the illegal taking or possession of any game, fish, or non-game wildlife, is a possible consequence of additional human populations in the vicinity of wildlife habitats (Comer, 1982). CDOW (2009i) has estimated that poachers may kill as many animals as licensed hunters and has developed a program, “Operation Game Thief,” to inform the public about poaching, to encourage the public to report poaching incidents.

Small Game. Increased traffic associated with the Proposed Action could potentially increase vehicle-related mortality of small game species, primarily mammals (Table 3.24-2 in Section 3). Desert cottontails, black-tailed jackrabbits, coyotes, bobcats, and mourning doves are small game species that are known to occur on the Site. Indirect effects would occur as a result of long-term loss of habitats from construction and operation of the Proposed Action: 247.6 acres of big sagebrush shrubland and 167.0 acres of mixed grassland habitats would be removed. Loss of 414.6 acres of big sagebrush shrubland and mixed grassland habitats, combined, is not expected to result in a significant impact to any of the small game species because each species is more of a habitat-generalist than a habitat-specialist. That is, each species is adaptable and capable of utilizing multiple habitat types in the area surrounding the Site rather than being restricted to one particular habitat or set of conditions (for example, Colwell and Futuyma, 1971).

Waterfowl and Turkeys. No waterfowl habitats (i.e., retention pond) within the Site would be affected by construction or operation of the Proposed Action. The raffinate solution present within the evaporation ponds and ponded tailings solution within the tailings cells may attract waterfowl, including snow geese. However, use of bird netting over the evaporation ponds should exclude waterfowl from entering the ponds, and bird balls used in the tailings cells should camouflage the ponded tailings solution present and discourage landing in the toxic solution. The Proposed Action is not expected to affect the waterfowl and they are not discussed further in this ER.

There is no habitat within the Site currently utilized by Merriam’s turkey although access to the Site by SH 90 to the west and on SH 141 along the Dolores Canyon between Gateway and Vancorum passes through turkey overall range. Increased project-related traffic could result in turkey mortalities but the extent to which that would occur is impossible to estimate. The Proposed Action is not expected to affect turkeys and they are not discussed further in this ER.

Migratory Birds. There are 18 species of migratory birds in the area surrounding the Site that have significantly declining population trends based on BBS route data. Brewer’s sparrow is dependent on big sagebrush and the local population has been significantly declining ($P<0.01$) during the past 15 years. Other species with declining trends that may nest in sagebrush and/or grasslands on the Site include killdeer, Say’s phoebe, vesper sparrow, black-throated sparrow, blue grosbeak, western meadowlark, Brewer’s blackbird, brown-headed cowbird. Removal of vegetation during nesting would risk mortality of birds, eggs, and/or nestlings. Direct mortality coupled with loss of nesting habitat could contribute to the species’ observed decline in the area surrounding the Site. Project effects could include direct mortality of birds and eggs during the nesting period as well, removal of nesting habitat, and degradation of nesting habitat due to noise and human activities.

Non-Game Wildlife. Increased project-related traffic during construction, operation, and closure could result in non-game wildlife mortalities, especially for mammals and reptiles Individuals of

some wildlife species may be directly impacted by the Proposed Action if they are killed by vehicles traveling to and from the Site. Species most susceptible to vehicle-related mortality include those that are inconspicuous (lizards, snakes, small mammals), those with limited mobility, burrowing species (mice and voles), wildlife with behavioral activity patterns (crepuscular activity) making them vulnerable, and wildlife that may scavenge roadside carrion (Leedy, 1975; Bennett, 1991; Forman and Alexander, 1998; Trombulak and Frissel, 2000).

Direct removal of 247.6 acres of sagebrush shrubland could potentially affect 30 species of non-game vertebrates and removal of 167.0 acres of mixed grassland could potentially affect 22 species if all (potentially-occurring species actually inhabit the Site. Observations made during on-site surveys conducted in 2007 and 2008 (Kleinfelder, 2009h) and in August 2009 (WestWater, 2009) indicate that not all species that inhabit sagebrush shrubland and/or mixed grassland would be present. Non-game wildlife species are would potentially be displaced from habitats that are cleared of vegetation. Displacement from adjacent habitats would most likely be a long-term effect once construction ends and operation begins. If adjacent habitats are at carrying capacity for the species, displaced individuals could adversely be affected by competition for resources, increased susceptibility to predation, or disease that may be facilitated by crowding. The Proposed Action could decrease individuals' reproductive success by increasing neonate or nest abandonment and possibly by interfering with breeding behaviors, sustenance, and growth of fetuses and/or young, conception rates, and fetal survival. These direct impacts may negatively affect population growth through diminished rates of survivorship and fecundity. Populations may also be negatively affected if individuals emigrate from habitats affected by project-related disturbances.

Aquatic Species

None of the fish species that occur in the Dolores River and tributaries occur within the Site; there are no rivers or perennial streams near the Site, and none of the ephemeral drainages on-site provide habitat for any of the species. Fish could be adversely affected by accidental spills and releases of ore, yellowcake, chemical reagents, and petroleum products during transport to or from the Mill Site as discussed above for Colorado River endangered fish species.

4.5.1.2 Construction, Operations, and Closure Impacts

4.5.1.2.1 Construction

Vegetation

Construction of the Proposed Action would directly impact vegetation, primarily by removal. Direct impact within the Mill License Boundary is expected to be long-term (for the life of the project). Although the entire Mill License Boundary would not be void of vegetation, the entire area is being considered for direct impact (307.8 acres). The majority of the development within the Mill License Boundary would affect big sagebrush shrublands, removing approximately 236.5 acres. Approximately 71.3 acres of mixed grasslands would be affected. No pinyon-juniper would be removed; therefore no direct impact to this dominant vegetation type is expected. Long-term disturbance (for the life of the project) outside the Mill License Boundary would be approximately 46.1 acres and would include 8.8 acres of big shagebrush habitat and 37.3 acres of mixed grassland habitat. Disturbance that would be revegetated during the life of the project (soil stockpile and pipelines) would be approximately 60.7 acres and would include 2.3 acres of big sagebrush and 58.4 acres of mixed grasslands (Table 4.5-1).

Table 4.5-1 provides the acres of habitat removed within the Mill License Boundary and outside the Mill License Boundary (both long-term and temporary disturbance) for each dominant

vegetation type within the Property Boundary (see Table 3.5-1 in Section 3.5.1.2, Vegetation). The amounts of impacted big sagebrush and mixed grasslands are minor compared to the extent of each vegetation type within the region surrounding the Site. For example, there are 70,396 acres dominated by big sagebrush vegetation and 29,119 acres of grass/forb rangeland (corresponding to mixed grasslands) that have been identified with the San Miguel Basin Gunnison Sage-Grouse Conservation Area (Gunnison Sage-Grouse Rangewide Steering Committee, 2005), within which the Site is located. Consequently, the Proposed Action would impact 0.4 percent of sagebrush and 0.6 percent of grasslands in this portion of the San Miguel Basin Gunnison Sage-Grouse Conservation Area.

Table 4.5-1
Acreage and Percent of Site Total Impacted

Dominant Vegetation Community	Disturbance within Mill License Boundary [1] (acres)	Disturbance Outside Mill License Boundary – Long-Term [2] (acres)	Disturbance Outside Mill License Boundary – Short-Term [3] (acres)	Total Disturbance within Property Boundary (acres)	Total Type within the San Miguel Basin (acres)	Percentage of Vegetation Type Disturbance by Proposed Action
Pinyon-Juniper Woodland	0.0	0.0	0.0	0.0	6,050	0.0
Big Sagebrush	236.5	8.8	2.3	247.6	70,396	0.4
Mixed Grasslands	71.3	37.3	58.4	167.0	29,119	0.6
Total	**307.8**	**46.1**	**60.7**	**414.6**	**--**	**--**

[1] Includes Mill, three tailings cells, 10 to 20 evaporation ponds, an ore pad, and ancillary facilities such as roads and parking lots.
[2] Includes ancillary facilities such as roads, parking lots, guard house, and administrative buildings outside the Mill License Boundary.
[3] Includes soil stockpiles and pipelines outside the Mill License Boundary that would be revegetated after disturbance and at least throughout the life of the project.

Invasive, Non-Native Species

Because noxious weeds are often able to establish in cleared, disturbed areas following surface disturbance, primarily along roads and areas of development, construction of the Proposed Action could increase the presence of these weed species and/or introduce them into areas that are not currently infested with non-native species through increased vehicle traffic, equipment placement and operation, foot traffic, and other surface-disturbing activities associated with the Proposed Action. Establishment of noxious weeds could alter the native plant communities, which may out-compete native, more desirable plant species and be less palatable than native vegetation, indirectly impacting wildlife (CDOW, 2008).

Federally Listed Threatened and Endangered Species

Canada Lynx. Construction-related traffic would increase daily traffic on SH 90 and other access routes which would increase the potential for lynx mortality. Estimated existing traffic and estimated increases in traffic due to construction of the Mill Facility are discussed Section 4.2, Transportation. The increased traffic due to construction of the Mill Facility could potentially contribute to mortality of Canada lynx if dispersing animals are in the region; however, the extent of that contribution is impossible to predict.

Mexican Spotted Owls. The closest construction area to pinyon-juniper habitat where noise would be generated is the subsoil stockpile (480 feet away). Noise produced by some construction equipment (jackhammers, mounted impact hammer, graders) could generate noise ≥70 dBA which would be sufficient to disturb northern spotted owls (USFWS, 2003b). In most of

the pinyon-juniper habitat, noise would range between 57 dBA (threshold causing alert behavior in northern spotted owls) and 70 dBA during construction. Based on responses to noise by northern spotted owls, Mexican spotted owls, if they were present in the pinyon-juniper woodlands, could be affected by noise produced during construction. However, their presence within the Site is highly unlikely and adverse effects to Mexican spotted owls due to construction noise would be minimal and discountable.

Endangered Colorado River Fish. Impacts to the four endangered Colorado River fish due to construction are not anticipated unless there was an accidental release of petroleum products into the Dolores River or San Miguel River while en route to the Site. Potential effects are discussed above in Section 4.5.1.1, General Impacts.

Candidate Species

Gunnison's Prairie Dog. Soil disturbance during construction of the Mill Site could provide habitat suitable for colonization by prairie dogs during or following construction. If they did colonize the Site, they could be susceptible to direct mortality by construction equipment.

Gunnison Sage-Grouse. Construction of the Mill Facility would impact 247.6 acres of big sagebrush, which would reduce the amount of available sagebrush within Paradox Valley. Construction could potentially interfere with attempted movements by Gunnison Sage-grouse between occupied habitat in Dry Creek Basin and potentially suitable habitat in the East Paradox Valley. Consequently, the Mill Facility could potentially affect efforts to re-establish Gunnison Sage-grouse populations in East Paradox Valley (CDOW, 2008).

BLM Sensitive Species and State of Colorado Species of Special Concern

Mammals. Construction of the Mill Facility would generate noise. Night lighting would likely occur at during construction and could act as barriers to bat movements (Kuijper et al., 2008), reduce bat activity in the immediate vicinity (Stone et al., 2009), or have an opposite effect (mercury vapor lamps) by attracting nocturnal insects (Svensson and Rydell, 1998; Rydell and Racey, 1993). Alternatively, monochromatic orange sodium lamps neither attract insects nor bats (Rydell and Baagoe, 1996) and use of these lamps might minimize potential effects of night lighting on bats. Loss of foraging habitat can adversely affect bats (Adams, 2003) and potential use by foraging bats of the retention pond on the southern end of the Site may be limited by noise and other disturbances associated with construction. Construction of the Proposed Action would impact 247.6 acres of big sagebrush and 167.0 acres of mixed grasslands that provide feeding habitats for these species (CDOW, 2009b).

Removal of foraging habitat, or alteration in vegetation cover and vegetation composition from introduced, invasive species may negatively affect the pocket gophers, if present.

An accidental release of petroleum products into the Dolores River or San Miguel while en route to the Mill Site could potentially be harmful to river otters. Otters could be affected by oiling fur with loss of insulating properties, ingestion with accumulation of petroleum residues in tissues, and changes in habitat use (Boyle, 2006). Risk of accidental spills and releases is described above for Colorado River endangered fish in Section 4.5.1.1, General Impacts.

Birds. Increased traffic resulting from with construction of the Mill Facility would increase the potential for vehicular collisions with wildlife and potential mortality for bald eagles scavenging along roadsides.

Although western burrowing owls are relatively tolerant of passive human disturbance, such as increased traffic or construction noise (Martin, 1973; Marks and Ball, 1983), the owls could be indirectly impacted during their breeding season from noise and vibration associated with construction and increased human presence, habitat loss including destruction or degradation of foraging habitat adjacent to occupied or potentially occupied burrows, and decrease in prey species (California Burrowing Owl Consortium, 1993; Marks and Ball, 1983). Such disturbance may displace individuals to surrounding habitat, possibly resulting in overcrowding and increased competition for food resources and nesting sites. Colorado Partners in Flight (2000a) recommend a disturbance buffer of 100 to 300 meters (328 to 984 feet) to minimize disturbance to nesting or foraging western burrowing owls, especially during the breeding season (February 1 through August 31); therefore, any activity or project component within 300 meters may indirectly impact this species.

Fish. Impacts to fish species during construction are not anticipated unless there is an accidental release of petroleum products into the Dolores River or San Miguel River while en route to the Site. Potential effects are discussed above for the Colorado River endangered fish species in Section 4.5.1.1, General Impacts.

Terrestrial Wildlife

Big Game. Increased traffic due to construction of the Mill Facility could potentially contribute to mortality of mule deer, elk, and possibly pronghorn.

The distances across mule deer ranges that are crossed by all existing transportation routes to and from the Site are provided in Table 4.5-2. In addition, the distances of known mule deer highway crossing zones that are crossed within those ranges are provided, but only for Colorado highways because similar information is not provided in Utah (Utah Division of Wildlife Resources, 2009). Known mule deer crossing zones are areas where increased mortality due to project-related traffic is assumed to be most likely, especially in those areas where the number of construction-related vehicles would result in an increase above the 2008 average annual daily traffic volumes by a relatively high amount. With these assumptions, mule deer mortality would could potentially increase on several routes during construction including 1) SH 90, east and west of the Site in Colorado where it passes through a resident population of mule deer, severe winter ranges and/or winter concentration areas, 2) on SH 141 in San Miguel County and Montrose County where the highway passes through mule deer winter range, severe winter range, and winter concentration range, and 3) on SH 46 in Utah, which connects U.S. Highway 191 to SH 90 while passing through mule deer crucial range defined by Utah Division of Wildlife Resources (2009).

The Site is entirely within elk overall range, elk winter range, elk severe winter range, and an elk winter concentration area. In addition, routes to be used during construction would pass through resident elk populations, elk winter ranges, severe winter ranges, and winter concentration ranges in Colorado, and elk crucial ranges in Utah. The distances across these elk ranges that are crossed by existing transportation routes to the Mill Facility are provided in Table 4.5-3. Based on similar assumptions to those discussed for mule deer, elk vehicle-related mortality would most likely increase during construction 1) on SH 90, east and west of the Piñon Ridge Mill in Colorado where it passes through a resident population of elk, as well as through elk severe winter range, 2) on SH 141 in Montrose County where the highway coincides with elk winter range and severe winter range, and 3) on SH 46 in Utah, which connects U.S. Highway 191 to SH 90 while passing through elk crucial winter range.

Table 4.5-2
Highways Used During Construction and Operation of the Mill Facility that Coincide with Mule Deer Residential Populations and Winter Ranges in Colorado and Utah, Including Estimates of Existing (2008) Traffic Volumes and Additional Traffic Expected from Project-Related Vehicles

County – State	Highway (direction from Site)	Distance (miles) of Intersecting Highway		2008 Average Daily Traffic Volume	Average Construction Traffic		Average Operation Traffic	
		Mule Deer Range	Range with Highway Crossing Zone		Number of Vehicle trips per day	Percent Increase from 2008	Number of Vehicle trips per day	Percent Increase from 2008
Mule Deer Resident Population[1]:								
Dolores – CO	SH 491(s)	6.1	2.2	2,250	0	0	8	0.4
Dolores – CO	SH 141(s)	15.0	2.7	605	16	2.5	8	1.2
Montrose – CO	SH 141(s)	7.4	6.5	400	195	29.7	120	18.2
San Miguel – CO	SH 145(s)	4.1	4.1	2,175	72	3.3	6	0.3
Montrose – CO	SH 145(s)	9.9	9.9	1,250	72	5.8	6	0.5
Montrose – CO	SH 97(s)	3.9	0	1,800	18	1.0	28	1.6
Montrose – CO	SH 90(w)	1.7	1.7	200	24	12.0	38	19.0
Range Totals		**48.1**	**27.1**					
Mule Deer Winter Range[1]:								
San Miguel – CO	SH 141(s)	39.2	18.3	535	88	16.4	8	1.5
Montrose – CO	SH 141(s)	11.3	8.9	1,865	196	10.5	120	6.4
San Miguel – CO	SH 145(s)	4.1	4.1	2,175	72	3.3	6	0.4
Montrose – CO	SH 145(s)	13.3	13.3	1,250	72	5.8	6	0.5
Montrose – CO	SH 97(s)	3.9	0	1800	18	1.0	28	1.6
Montrose – CO	SH 90(w)	23.0	5.7	365	24	6.6	48	13.2
Montrose – CO	SH 90(e)	10.9	4.4	530	210	39.6	128	24.2
Montrose – CO	SH 141(n)	33.4	20.7	400	16	4.0	28	7.0
Mesa – CO	SH 141(n)	57.8	23.4	680	16	2.4	28	4.9
Range Totals		**196.9**	**98.8**					
Mule Deer Severe Winter Range[1]:								
San Miguel – CO	SH 141(s)	30.0	18.3	535	16	3.0	8	1.5
Montrose – CO	SH 141(s)	11.3	8.9	1,865	210	11.3	120	6.4
Montrose – CO	SH 145(s)	10.2	10.2	1,250	72	5.8	6	0.5
Montrose – CO	SH 97(s)	3.9	0	1,800	18	1.0	28	1.6
Montrose – CO	SH 90(w)	15.2	5.7	365	24	6.6	48	13.2
Montrose – CO	SH 90(e)	10.9	4.4	530	210	39.6	128	24.2
Montrose – CO	SH 141(n)	28.0	20.6	400	16	4.0	28	7.0
Mesa – CO	SH 141(n)	57.8	23.4	680	16	2.4	28	4.9
Range Totals		**167.3**	**91.5**					
Mule Deer Winter Concentration Range[1]:								
San Miguel – CO	SH 141(s)	12.6	12.6	535	16	3.0	8	1.5
Montrose – CO	SH 141(s)	11.3	8.9	1,865	210	11.3	120	6.4
Montrose – CO	SH 145(s)	12.1	12.1	1,250	72	5.8	28	2.2
Montrose – CO	SH 97(s)	3.9	0	1,800	18	1.0	26	1.4
Montrose – CO	SH 90(e)	8.6	4.4	530	210	39.6	128	24.2
Mesa – CO	SH 141(n)	5.0	4.9	680	16	2.4	8	1.2
Range Totals		**53.5**	**42.9**					
Mule Deer Crucial Winter Range[2]:								
San Juan – UT	US 191(s)	11.4	N/A	3,575	4	0.1	6	0.2
San Juan – UT	SH 46(w)	16.6	N/A	468	24	7.2	38	8.1
San Juan – UT	US 191(n)	10.2	N/A	3,705	4	0.1	20	0.5
Range Totals		**38.2**	**N/A**					
Mule Deer Substantial Winter Range[2]:								
San Juan – UT	US 191(n)	1.9	N/A	3,575	4	0.1	6	0.2

[1] CDOW, NDIS (CDOW, 2009b):

- Resident Population - year-round range for a population of animal. The residents use all of the area all year; it

County – State	Highway (direction from Site)	Distance (miles) of Intersecting Highway		2008 Average Daily Traffic Volume	Average Construction Traffic		Average Operation Traffic	
		Mule Deer Range	Range with Highway Crossing Zone		Number of Vehicle trips per day	Percent Increase from 2008	Number of Vehicle trips per day	Percent Increase from 2008

cannot be subdivided into seasonal ranges although it may be included within the overall range of the larger population.

- Winter Range - that part of the overall range where 90 percent of the individuals are located during the average five winters out of ten from the first heavy snowfall to spring green-up, or during a site specific period of winter as defined for each DAU.
- Severe Winter Range - that part of the overall range where 90 percent of the individuals are located when the annual snowpack is at its maximum and/or temperatures are at a minimum in the two worst winters out of ten.
- Winter Concentration Area – that part of the winter range where densities are at least 200 percent greater than the surrounding winter range density during the same period used to define winter range in the average five winters out of ten.
- Mule Deer Highway Crossing Zones - Those areas where mule deer movements traditionally cross roads, presenting potential conflicts between mule deer and motorists.
- Critical (Crucial) Value Habitat - an area that provides for "sensitive" biological and/or behavioral requisites necessary to sustain the existence and/or perpetuation of a wildlife species.
- Substantial Value Habitat - an area that provides for "frequent" use by a wildlife species.

[2] Utah Gap Analysis, 1997.

Table 4.5-3
Highways Used During Construction and Operation of the Mill Facility that Coincide with Elk Residential Populations and Winter Ranges in Colorado and Utah, Including Estimates of Existing (2008) Traffic Volumes and Additional Traffic Expected from Project-Related Vehicles

County – State	Highway (direction from Site)	Distance (miles) of Intersecting Highway with Elk Range	2008 Average Daily Traffic Volume	Average Construction Traffic		Average Operation Traffic	
				Number of Vehicle trips per day	Percent Increase from 2008	Number of Vehicle trips per day	Percent Increase from 2008
Elk Resident Population Range[1]:							
Montrose – CO	SH 90(w)	4.2	365	24	6.6	48	13.2
Elk Winter Range[1]:							
Dolores – CO	SH 141(s)	1.8	730	16	2.2	9	1.1
San Miguel - CO	SH 141(s)	31.6	535	16	3.0	8	1.5
Montrose – CO	SH 141(s)	11.3	1,865	196	10.5	120	6.4
San Miguel - CO	SH 145(s)	4.1	2,175	72	3.3	6	0.3
Montrose – CO	SH 145(s)	13.3	1,250	72	5.8	6	0.5
Montrose – CO	SH 97(s)	3.9	1,800	18	1.0	28	1.6
Montrose – CO	SH 90(w)	23.0	365	24	6.6	48	13.2
Montrose – CO	SH 90(e)	10.9	530	210	39.6	128	24.2
Montrose – CO	SH 141(n)	33.4	400	16	4.0	28	7.0
Mesa – CO	SH 141(n)	57.8	680	16	2.4	8	1.2
	Range Totals						
Elk Severe Winter Range[1]:							
San Miguel - CO	SH 141(s)	29.4	535	16	3.0	8	1.5
Montrose – CO	SH 141(s)	11.3	1,865	196	10.5	120	6.4
Montrose – CO	SH 145(s)	1.3	1,200	72	6.0	6	0.5
Montrose – CO	SH 97(s)	3.9	1,800	18	1.0	28	1.6
Montrose – CO	SH 90(w)	15.2	365	24	6.6	48	13.2
Montrose – CO	SH 90(e)	10.9	530	210	39.6	128	24.2
Montrose – CO	SH 141(n)	28.0	400	16	4.0	28	7.0

County – State	Highway (direction from Site)	Distance (miles) of Intersecting Highway with Elk Range	2008 Average Daily Traffic Volume	Average Construction Traffic		Average Operation Traffic	
				Number of Vehicle trips per day	Percent Increase from 2008	Number of Vehicle trips per day	Percent Increase from 2008
Mesa – CO	SH 141(n)	16.6	680	16	2.4	8	1.2
Range Totals							
Elk Winter Concentration Range[1]:							
San Miguel - CO	SH 141(s)	1.4	480	16	3.3	8	1.7
Elk Crucial Yearlong Range[1]:							
San Juan – UT	US 191(s)	4.8	3,415	4	0.1	6	0.2
Elk Crucial Winter Range[2]:							
San Juan – UT	US 191(s)	11.8	2,120	4	0.2	6	0.3
San Juan – UT	SH 46(w)	11.6	335	24	7.2	38	11.3

[1] CDOW, NDIS (CDOW, 2009b):

- Resident Population - year-round range for a population of animal. The residents use all of the area all year; it cannot be subdivided into seasonal ranges although it may be included within the overall range of the larger population.
- Winter Range - that part of the overall range where 90 percent of the individuals are located during the average five winters out of ten from the first heavy snowfall to spring green-up, or during a site specific period of winter as defined for each DAU.
- Severe Winter Range- that part of the overall range where 90 percent of the individuals are located when the annual snowpack is at its maximum and/or temperatures are at a minimum in the two worst winters out of ten.
- Winter Concentration Area – that part of the winter range where densities are at least 200 percent greater than the surrounding winter range density during the same period used to define winter range in the average five winters out of ten.
- Critical (Crucial) Value Habitat - an area that provides for "sensitive" biological and/or behavioral requisites necessary to sustain the existence and/or perpetuation of a wildlife species.

[2] Utah Gap Analysis, 1997.

U.S. Highway 191 in San Juan County, Utah and SH 141 in San Miguel County, Colorado also pass through pronghorn crucial yearlong range and winter range, respectively (Table 4.5-4). However, given the existing (2008) traffic levels and relatively few project-related trips per day through those ranges, increased pronghorn mortality due to traffic associated with construction of the Proposed Action is expected to be minimal.

Table 4.5-4
Highways Used During Construction and Operation of the Mill Facility that Coincide with Pronghorn Residential Populations and Winter Ranges in Colorado and Utah, Including Estimates of Existing (2008) Traffic Volumes and Additional Traffic Expected from Project-Related Vehicles

County - State	Highway (direction from Site)	Distance (miles) of Intersecting Highway with Elk Range	2008 Average Daily Traffic Volume	Average Construction Traffic		Average Operation Traffic	
				Number of Vehicle trips per day	Percent Increase from 2008	Number of Vehicle trips per day	Percent Increase from 2008
Pronghorn Resident Population and Winter Range[1]:							
San Miguel - CO	SH 141(s)	14.0	480	16	3.3	8	1.7
Pronghorn Crucial Yearlong Range[2]:							
San Juan - UT	US 191(s)	19.0	3,575	4	0.1	6	0.2

[1] CDOW, NDIS (CDOW, 2009b):

- Resident Population - year-round range for a population of animal. The residents use all of the area all year; it cannot be subdivided into seasonal ranges although it may be included within the overall range of the larger population.
- Winter Range - that part of the overall range where 90 percent of the individuals are located during the average five winters out of ten from the first heavy snowfall to spring green-up, or during a site specific period of winter as defined for each DAU.

[2] Utah Gap Analysis, 1997.

- Critical (Crucial) Value Habitat - an area that provides for "sensitive" biological and/or behavioral requisites necessary to sustain the existence and/or perpetuation of a wildlife species.

Construction of the Mill Facility would take nearly two years to complete and would possibly coincide with two consecutive winters. Mule deer and elk wintering on or in the vicinity of the Site would potentially be displaced by construction activity. A barbed-wire fence would be constructed to extend from the existing highway right-of-way fence along the south side of SH 90 to surround the Property Boundary within Section 8, including the southern upslope portion extending to Davis Mesa and vegetated with pinyon-juniper woodland. Mule deer, elk, and pronghorn mortalities occur when they attempt to jump fences and their legs become ensnared between the top two fence wires (Harrington and Conover, 2006). Additional mortality can also occur if the Property Boundary fence would cause mule deer and elk to cross SH 90 more often than they would in its absence. Increased crossing rates are assumed to increase animals' risk of collision with vehicles. Increased mortality could potentially occur for fawns that are unable to cross fences (usually woven wire fence) and die next to the fence. Ninety percent of ungulate carcasses found adjacent to fences were fawns lying in a curled position, probably after being separated from their mothers (Harrington and Conover, 2006).

Most indirect effects to mule deer and other wildlife are associated with degradation and/or alterations to habitats (habitat loss). The Proposed Action could potentially impact mule deer and elk by reducing the amount of habitat available and/or causing diminished use of habitats adjacent to human activities. Increased presence of humans in wildlife habitats induced by the action also contributes to indirect (sometimes called "secondary") impact. Examples typically include increased recreation demand (including off-highway vehicle use), increased habitat conversion, habitat degradation by human encroachment, and increased illegal harvest (Comer, 1982).

Analysis of potential effects by direct loss of habitat on mule deer and elk by construction of the Proposed Action is based on 1) total exclusion of ungulates from within the barbed-wire fenced Property Boundary that would result in loss of functional habitat, 2) CDOW's estimates of mule

deer and elk populations in 2008 within respective DAUs, 3) mapped extents of winter range, severe winter range, and winter concentration areas within each DAU, 4) CDOW's definitions for population use of various wintering ranges by mule deer and elk (see footnote 4 in Table 4.5-5), and 5) assumed random distribution of each population within ranges according to CDOW's definitions in item number 4.

As defined, winter range supports 90 percent of the population during the average five winters out of ten while severe winter ranges are smaller areas within winter range that support 90 percent of the population during the worst, most severe two out of ten winters. Winter concentration areas are also smaller areas within winter range on which animal densities are (at least) 200 percent greater than the surrounding winter range density during average five of ten winters. Consequently, densities of animals on winter concentration areas, a, and densities on remaining non-concentration areas, b, must equal the overall animal density on the winter range, w, relative to the proportion of winter concentration area, p, within the winter range and the proportion of the winter non-concentration area, q, (where $q = 1 - p$). Thus, $w = a \times p + b \times q$. Because the animal density on winter concentration areas, a, is 3 times greater (equivalent to 200 percent greater) than densities on winter non-concentration areas, b, $a = 3b$. Solving for b: $b = (w / (3p + q))$.

These assumptions, definitions, and computations were used to estimate densities of mule deer and elk within winter ranges, severe winter range, winter concentration areas, and winter non-concentration areas and then, based on the area within each range that would be directly removed by construction of the Proposed Action, an estimate of how many animals (mule deer and elk) would have been supported by the affected winter ranges was computed and is provided in Table 4.5-5. The amount of mule deer winter range that would be excluded by the Proposed Action (854.16 acres of the Site surrounded by a boundary fence) would support approximately 22 mule deer during average five out of ten winters, based on 2008 population estimates for deer in DAU 24. No mule deer winter concentration areas would be directly affected by the project. The project would affect the non-concentration portion of the winter range so that, if mule deer became distributed on winter concentration areas (where densities are at least 200 percent greater than the surrounding winter range) during average five out of ten winters, then habitat on the non-concentration area affected by the Proposed Action would have supported 14 mule deer. However, the direct loss of severe winter range due to construction of the Proposed Action would have otherwise supported 48 mule deer on the Site during the worst two out of ten winters (Table Terrestrial-4.5-5).

The effects of construction, however, could alter mule deer and elk distributions on winter ranges some distance away from the Property Boundary. A study of mule deer response to natural gas wellfield development in Wyoming revealed that wintering mule deer avoided roads with high traffic volumes (263 to 350 vehicles per day) by an average distance of 4 miles. Mule deer avoided roads with moderate traffic volumes (19 to 30 vehicles per day) by an average of 1 mile, but their avoidance of roads with low volumes (up to 12 vehicles per day) averaged 0.5 mile (Sawyer et al., 2006). Wintering elk also are affected by roads and were found to reduce their use of habitats by distances up to 0.75 mile from roads, less than their avoidance of roads during summer, which was up to 1.7 miles from roads. Greater avoidance of roads by summering elk was likely due to higher traffic volume and recreational use in summer than in winter (Sawyer et al., 2007).

Table 4.5-5
Areas of Mule Deer and Elk Winter Ranges that Would Be Potentially Affected by Construction and Operation of the Mill Facility with Estimated Densities of Animals on Each Range and Numbers of Animals Supported by Each Affected Winter Range

Winter Range Type	Total Area (acres) of Habitat In DAU	Density of Animals in Winter Range (animals per acre)	Area (acres) of Range Directly Affected by Project	Estimated Number of Animals Supported by Affected Winter Range
Mule Deer - DAU Population in 2008 = 27,160 deer				
Winter Range [1]	943,119	0.026	854.16	22.1
Severe Winter Range [2]	430,942	0.057	854.16	48.4
Winter Concentration Area [3]	264,796	0.050	0	0
Winter Non-Concentration Area [4]	678,323	0.017	854.16	14.2
Elk - DAU Population in 2008= 19,530 elk				
Winter Range [1]	1,291,978	0.014	854.16	11.6
Severe Winter Range [2]	654,724	0.027	854.16	22.9
Winter Concentration Area [3]	281,113	0.028	792.99	22.6
Winter Non-Concentration Area [4]	1,010,865	0.009	61.17	0.6

[1] Winter Range - that part of the overall range where 90 percent of the individuals are located during the average 5 winters out of 10 from the first heavy snowfall to spring green-up, or during a site specific period of winter as defined for each DAU.
[2] Severe Winter Range- that part of the overall range where 90 percent of the individuals are located when the annual snowpack is at its maximum and/or temperatures are at a minimum in the two worst winters out of ten.
[3] Winter Concentration Area – that part of the winter range where densities are at least 200 percent greater than the surrounding winter range density during the same period used to define winter range in the average five winters out of ten.
[4] Winter Non-Concentration Area – that portion of the winter range that is not a winter concentration area and supports densities at least 200 percent lower than winter concentration areas in the average five winters out of ten.

Small Game. Impacts to small game species during construction would be similar to those described above in Section 4.5.1.1, General Impacts.

Migratory Birds. The Migratory Bird Treaty Act prohibits “taking” migratory birds, parts, nests and eggs of trust species covered by the Act. Most migratory birds nest between May 15 and July 15 and based on the based the possibility for a “take,” BLM has adopted Best Management Practices (BLM, 2007) that include imposing a timing limitation on use authorizations to mitigate vegetative disturbing activities during the primary portion of the nesting season between May 15 and July 15. Construction of the project would require removing 247.6 acres of big sagebrush shrubland and 167.0 acres of mixed grassland (see Table 4.5-1). Numerous species of migratory birds nest in both vegetation types including Brewer’s sparrow (a Bird of Conservation Concern) and others that were observed on-site.

The Proposed Action would require construction of an additional overhead electrical power line. San Miguel Power Association, Inc. (SMPA) plans to supply electric power to the facility via an existing 69 kilovolt overhead distribution line paralleling SH 90. The new electrical power line would extend from SH 90 to the Site for approximately 1.03 miles. Some migratory birds, especially raptors, are susceptible to electrocution on power lines, which can occur whenever a bird touches a conductor while perched on a grounded crossarm, or touches two phase conductors or a conductor and groundwire simultaneously while in flight (Janss and Ferrer, 1999; Bevanger, 1994). Bird species susceptible to electrocution use powerlines and power poles as hunting and resting perches and/or nesting structures, as well as have large wingspans to connect two sources of electricity (Avian Power Line Interaction Committee - APLIC, 1996). Species found within the Site that may be affected by electrocution belong to the following orders: Falconiformes (eagles, hawks, kites, falcons, and osprey), Strigiformes (owls), and Passeriformes (perching birds; Janss, 2000; Bevanger, 1998; Roig-Soles and Navazo-Lopez,

1997). Electrocution of some species may increase temporally during juvenile dispersal, as observed for owls (Sergio et al., 2004) and eagles (Harmatta et al., 1999).

Power lines built prior to the 1970s may put birds at a higher risk for electrocution, because older power lines often have conductors and groundwires close together, and/or conductors placed on top of the cross bars as opposed to below the cross bars, which create more potential to electrocute birds (APLIC, 1996). Another feature that may increase the number of birds electrocuted is the material that power poles are made from: steel or wood. It has been demonstrated that steel power poles electrocute more birds than wooden power poles, because the steel components act as electric conductors for perched birds. Although electrocutions occur with high and low voltage lines, most electrocutions do occur on lower voltage, distribution lines (APLIC, 1996).

In the past 35 years several power line designs have been created, which have decreased the electrocution rate for most bird species. Modifications to existing transmission lines or that have been incorporated into new transmission lines have been effective at reducing the number of casualties resulting from electrocution. Because the Site does not have a lot of perching sites there is potential for use of the new power line to be used as perch sites that would be frequented by hunting raptors. However, potential for electrocution of raptors should be minimized from new transmission line designs, including spacing of conductors and adequate insulation.

Other migratory bird species with declining trends are likely to nest in the pinyon-juniper habitat (western wood-pewee, black-billed magpie, rock wren, black-headed grosbeak), but there will not be any vegetation removed in pinyon-juniper habitat. Noise levels in pinyon-juniper habitat generated during construction of the Mill Facility would be above ambient noise levels. If increased noise occurs during nesting, species such as those above, and juniper titmouse (a Bird of Conservation Concern) could abandon nests within the affected area. If that occurred, it would be a short-term effect to individuals or nesting pairs and would not be likely to pose additional risk of population declines for those species by the Proposed Action.

Non-Game Wildlife. Impacts to non-game wildlife during construction would be similar to those discussed above in Section 4.5.1.1, General Impacts.

Aquatic Species

Impacts to non-game fish species due to construction are not anticipated unless there is an accidental release of petroleum products into the Dolores River or San Miguel River while en route to the Site. Potential effects are discussed above in Section 4.5.1.1, General Impacts.

4.5.1.2.2 Operations

Vegetation

Indirect impact to vegetation may occur during operation of the Mill Facility if the Proposed Action displaces native and domestic herbivores, causing excessive browsing and/or grazing on vegetation resources that would otherwise not occur. Indirect impact to native vegetation could also occur if invasive, non-native species become established in disturbed areas and result in infestations that may limit or prohibit growth of native and/or desirable species. Weed seeds or cuttings of some species could be transported naturally (wind and water) or accidentally (vehicles or other equipment) to the disturbed areas. Also, weed seeds may be present in the native soil materials and the removal of vegetative cover and soil disturbance may promote weed establishment at the expense of the native species. Soil disturbance and potential weed

distribution due to surface disturbance, increased vehicle traffic, equipment placement and operation, foot traffic, and other activities associated with the Proposed Action may promote the spread of invasive plants and noxious weeds. Surface disturbance at the soil stockpiles that would be revegetated within one growing season of construction would be less likely to be infested by weeds than if left as exposed soil for longer periods.

Invasive, Non-Native Species

The potential for invasive, non-native species to become established, as described above and during construction, will continue during operation. Introduction of additional noxious and invasive weed species may occur as a result of ore trucks entering the Site from mines outside the county or state, including species not currently located at or within the vicinity of the Site.

Federally Listed Threatened and Endangered Species

Canada Lynx. Increased traffic (see Section 4.2, Transportation) due to long-term operation of the Mill Facility could potentially contribute to mortality of Canada lynx if dispersing animals are in the region. The extent of that contribution, however, is impossible to predict. Increased secondary impacts in the region surrounding the Mill Facility, not necessarily including the project area *per se,* (Comer, 1982) are possible due to an increased human population base and/or access, whether as a result of the requirements of the action itself (the workforce needed to construct or operate the Proposed Action) or as a consequence of the action (need for ancillary goods, services, opportunities resulting from the project).

Potential indirect or secondary effects could potentially include increased recreation demand (including off-highway vehicle – OHV use), increased habitat conversion, habitat degradation by human encroachment, and increased illegal harvest (Comer, 1982). Illegal shooting of lynx within the region surrounding the Site and/or within the region could potentially increase above existing levels due to similar secondary impacts and improved access. Improved access could lead to increased legal furbearer harvest. Inadvertent legal use of traps targeting other species could result in taking a lynx (USFWS, 2009a); however, the level of risk for mortality due to shooting or trapping is impossible to estimate.

Mexican Spotted Owls. Maximum noise at the Property Boundary during operations has been estimated at 60 dBA. Within the closest pinyon-juniper habitat to the Mill Facility (approximately 750 feet away), the maximum noise level is estimated at 64 dBA, less than the expected level sufficient to disturb Mexican spotted owls but loud enough to possibly cause alert behaviors if owls were present.

Endangered Colorado River Fish. Operation of the Mill Facility would require water to be withdrawn at the rate of 141 gpm from the Chinle Formation which is hydrologically connected to Dolores River and is within the Upper Colorado River Basin. The water withdrawal equates to an average annual depletion of 227 acre-feet. The USFWS has determined that water depletions within the Upper Colorado River Basin are likely to adversely affect the four endangered fish species and their designated critical habitats. However, the USFWS has also determined that depletion impacts can be offset by 1) one-time contribution to the Recovery Program in the amount of $18.99 per acre-foot (the current rate for Fiscal Year 2009-2010) of the project's annual depletion, and 2) appropriate legal protection of in-stream flows pursuant to State law, and accomplishment of activities necessary to recover the endangered fish species as specific under the Recovery Implementation Program Recovery Action Plan (RIPRAP). Because there is no federal action agency with responsibility for the Proposed Action, Energy Fuels is not required to contribute to the Recovery Program (Gelatt, 2009). Once mill operations

begin, however, Energy Fuels proposes to make a one-time contribution of $4,310.73 to the RIPRAP or to another program that is focused on the conservation and recovery of endangered Colorado River fish.

The potential impacts to endangered Colorado River fish from the minute probabilities associated with a spill of uranium/vanadium ore, yellowcake, chemical reagents, or petroleum products in the Dolores River or San Miguel River during operations are the same as those discussed above for endangered Colorado River fish in Section 4.5.1.1, General Impact.

Candidate Species

Gunnison's Prairie Dog. During operations, Gunnison's prairie dogs could possibly pass through the chain-link fence and/or burrow beneath. Depths of Gunnison's prairie dog burrows range from 33 inches to over 6.5 feet (Pizzimenti and Hoffmann, 1973) and burrow diameters may be as small as 3.6 inches (Verdolin et al., 2008). Most common mesh sizes for chain-link fence are 2 inches or more (2.25 and 2.375 inches). Gunnison's prairie dogs could suffer direct mortality or injury if they access the evaporation ponds or tailings cells. The raffinate solution and tailings solution is potentially acutely and chronically toxic to wildlife because of low pH and elevated metal concentrations (Visus, 2009).

Gunnison Sage-grouse. The Proposed Action could potentially hinder re-establishment of Gunnison Sage-grouse populations in East Paradox Valley during operations. In general, sage-grouse are sensitive to disturbance from roads and noise during breeding (Braun et al., 2002). Females avoid nesting and utilizing brood-rearing habitats in areas with high levels of human presence related to oil and gas industrial activities (Holloran, 2005). The traffic and noise associated with operations and traffic on SH 90 could similarly affect Gunnison Sage-grouse if they do occupy habitats in the Paradox Valley.

BLM Sensitive Species and State of Colorado Species of Special Concern

Mammals. Night lighting would be present during operations, and could act as barriers to bat movements such as described during construction. Loss of foraging habitat can adversely affect bats. Potential use by foraging bats of the retention pond on the southern end of the Site may be limited by noise and other disturbances associated with operations. The Proposed Action would impact 247.6 acres of big sagebrush and 167.0 acres of mixed grasslands that provide feeding habitats for these species (CDOW, 2009b).

Revegetation of disturbed sites with grasses may attract Botta's pocket gophers. Potential impacts to pocket gophers would be similar to that described above for Gunnison's prairie dog if they were to enter the evaporation ponds and tailings cells.

The potential impacts to river otters associated with a spill of uranium/vanadium ore, yellowcake, chemical reagents, or petroleum products in the Dolores River or San Miguel River during operations are the same as those discussed above for endangered Colorado River fish in Section 4.5.1.1, General Impact.

Birds. Increased traffic during operations would increase the potential for vehicular collisions with wildlife and potential mortality for bald eagles scavenging along roadsides.

Project components within 300 meters of potential burrowing owl nesting sites (i.e., abandoned Gunnison's prairie dog burrows) include the barbed wire perimeter fencing, spoil storage sites, access roads, and pipelines to water wells. The barbed wire fence could provide additional

elevated perches near potential nest burrows in grassland areas used for foraging, potentially benefiting the western burrowing owl. However, the spoil storage sites would be approximately 30 feet high, altering the existing, relatively flat and open landscape. It is possible that burrowing owls would permanently vacate the abandoned prairie dog burrows along the western portion of the Site adjacent to the spoil storage sites, although the amount of disturbance that burrowing owls will tolerate before nest desertion is unknown (Marks and Ball, 1983).

Western burrowing owls and other burrowing mammals inhabit mixed grasslands. Approximately 167.0 acres of mixed grassland habitat would be removed and/or disturbed during construction of the Mill Facility, removing potential suitable grassland habitat available within the Site that could be used by burrowing mammals, providing potential habitat for western burrowing owls. Indirect effects are possible to potential western burrowing owl foraging habitat such as mixed grasslands within 300 meters (984 feet) of disturbances that provide low vegetation cover and allows visibility and access to prey. Access roads would traverse through mixed grassland habitat, increasing fugitive dust and potentially affecting burrowing owl prey species.

One threat identified for the western burrowing owl includes collisions with moving vehicles and barbed wire fence because this species flies low to the ground (USFWS, 2003b). It is possible that an increase in traffic associated with the Proposed Action and erection of barbed wire fence along the perimeter of the Site may increase owl mortality.

Fish. The potential impacts to fish species of special concern associated with a spill of uranium/vanadium ore, yellowcake, chemical reagents, or petroleum products in the Dolores River or San Miguel River during operations are the same as those discussed above for endangered Colorado River fish in Section 4.5.1.1, General Impact.

Terrestrial Wildlife

Big Game. Increases in traffic during operations are discussed above in Section 4.2, Transportation. Increased traffic could potentially increase mule deer mortality on several routes. Similarly, elk vehicle-related mortality would most likely increase during operation of the Mill Facility. Increased pronghorn mortality due to traffic associated with operations is expected to be minimal. As described for project effects during construction, mule deer and elk wintering in the vicinity of the Site could suffer direct mortality due to additional fencing proposed along the perimeter of the Property Boundary.

Most indirect effects to mule deer and other wildlife are associated with degradation and/or alterations to habitats (habitat loss). The Proposed Action would impact mule deer and elk by reducing the amount of habitat available and/or causing diminished use of habitats adjacent to human activities, as described above under construction. There would be long-term similar losses of habitats supporting elk on winter range, severe winter range and winter concentration areas. Because densities of elk on winter ranges are less than mule deer densities, numbers of elk supported by lost habitat are less than effects to mule deer.

Due to increased traffic, mule deer are likely to disperse away from the location as described above for construction. Similar dispersion of wintering elk away from the Site during operations is also expected and could result in lower winter habitat functionality as a result.

Small Game. Impacts to small game species during operations would be similar to those described above in Section 4.5.1.1, General Impacts. Small game birds and mammals are not expected to be affected by compounds present in the evaporation pond or the tailings cells.

Construction of a 6-foot chain-link fence topped with three-strand barbed wire surrounding each facility is expected to be a completely effective deterrent to small game mammals (assumed to be lagomorphs and carnivores). Bird netting would be placed on wooden support poles elevating it over the evaporation pond. The netting would completely seal off access to the pond because nets would be fastened at the base to wood furring strips. The bird netting is designed with two-inch openings to prevent access from waterfowl and presumably would prevent small game birds (e.g., mourning doves) from penetrating the 2-inch net mesh. However, as discussed below for migratory bird species, the 2-inch net mesh currently included in the netting design is larger than mesh recommended by USFWS for excluding most migratory bird species from pits or ponds.

Three tailing cells have been proposed, each covering approximately 30 acres. Each tailings cell would provide capacity for approximately 13 years after which, the cell would be closed with a vegetative cap and the next cell put into use concurrently. During the operative life of the tailings cell, the tailings solution from the tailings slurry would collect on the surface and be recovered and pumped back to the mill for reuse by a floating pump barge. At most, the tailings solution could encompass an area of approximately 30 acres. The tailings solution can be acutely and chronically toxic to wildlife because of its low pH and elevated metal concentrations (Visus, 2009).

To discourage bird use of the fluctuating levels of tailings solution that collects within the tailings cells, Energy Fuels has proposed to place bird balls on top of the ponded portion of the cells to effectively eliminate birds from landing on the water. Bird balls float on top of exposed water and prevent birds from landing on the water by creating a physical barrier and disguising the surface of the water within the tailings cells. USFWS (2009f) has identified the use of bird balls as a potential solution to excluding wildlife and preventing mortality at various industrial wastewater impoundments including cyanide ponds, coal-fired power plant evaporation ponds, and acidic water impoundments. For example, bird balls have been used effectively to deter birds from using ponds at the Yatela gold mine in Mali, significantly reducing the amount of bird deaths associated with leach ponds from 554 per year to just two bird deaths per year (AngloGold Ashanti, 2004 and 2005).

Use of bird balls are generally accepted as an effective means of excluding small game birds (e.g., mourning doves) from the ponded water within the tailings cells. Mill Facility personnel would inspect the tailings cells on a daily basis and identify and record any wildlife mortalities, and where possible, implement measures to reduce or eliminate future occurrences.

Migratory Birds. Impacts to migratory birds during construction could potentially result from birds landing in the tailings cells or evaporation ponds. This would be greatly reduced by the use of netting and bird balls as discussed above for Small Game.

Non-Game Wildlife. Impacts to non-game wildlife during construction would be similar to those discussed above in Section 4.5.1.1, General Impacts. In addition, direct mortality could occur if non-game wildlife are able to access the evaporation ponds and/or tailings cells as discussed above for Small Game.

Aquatic Species

Potential impacts to fish species of special concern during operations would be associated with a spill of uranium/vanadium ore, yellowcake, chemical reagents, or petroleum products in the Dolores River or San Miguel River during operations are the same as those discussed above for endangered Colorado River fish in Section 4.5.1.1, General Impact.

4.5.1.2.3 Closure

Vegetation

The majority of the Site would be returned to rangeland use, with the exception of the tailings cells, which would be capped with an engineered soil cover. The engineered covers are designed to isolate the byproduct material and eliminate the potential for the byproduct to enter groundwater (Kleinfelder, 2009c). The tailings cell cover would be covered with rock mulch while the outslopes would be covered with rock. All areas would be seeded; however, vegetation on the tailings cells would likely be more sparse than surrounding areas due to the rock armor. On other areas of the Site, successful and timely revegetation efforts are critical to establishing good vegetative growth and minimizing weeds.

Invasive, Non-Native Species

The potential for invasive, non-native species to become established, as described above and during construction, would continue during closure.

Federally Listed Threatened and Endangered Species

Canada Lynx. Risk of vehicle collisions with lynx would be less during closure than during construction or operations.

Mexican Spotted Owls. Risk of impact to Mexican spotted owl due to noise during closure is unknown because the species' distribution at that time cannot be predicted.

Endangered Colorado River Fish. Impacts to endangered Colorado River fish species due to closure are not anticipated unless there was an accidental release of petroleum products into the Dolores River or San Miguel River while en route to the Site. Potential effects are discussed above in Section 4.5.1.1, General Impacts.

Candidate Species

Gunnison's Prairie Dog. Impact to Gunnison's prairie dogs are not expected during closure. A bio-intrusion barrier would be placed on top of the tailings cell materials which would consist of three-inch rock (cobbles) in a native soil matrix to restrict burrowing animals up to the size of prairie dogs (Kleinfelder, 2009c; Golder, 2009c).

Gunnison Sage-Grouse. During the closure of the Mill Facility, Gunnison Sage-grouse could be impacted by noise as discussed above for construction and operations.

BLM Sensitive Species and State of Colorado Species of Special Concern

Mammals. Similar effects to bats' echolocation due to noise expected during construction would also affect bats during site closure.

Birds. Traffic associated with closure would be considerably less than during construction or operations and therefore, the risk of vehicle collisions with bald eagles would be less.

Risk of impact to western burrowing owls due to noise 40 years from now is unknown because the species' distribution at that time cannot be predicted.

Fish. Impacts to aquatic species during closure are not anticipated unless there is an accidental release of petroleum products into the Dolores River or San Miguel River while en route to the Site. Potential effects are discussed above in Section 4.5.1.1, General Impacts.

Terrestrial Wildlife

Big Game. Risk of vehicle collisions with mule deer and elk would be less during closure than during construction and operations.

Small Game. Impacts to small game species during closure would be similar to those described above in Section 4.5.1.1, General Impacts. It is expected that burrowing animals up to the size of prairie dogs would be restricted from the tailings cells by the bio-intrusion barrier.

Migratory Birds. During closure, much of the same equipment that was used during construction is expected. Noise effects to breeding migratory birds are likely to be similar to effects during construction and operation.

Non-Game Wildlife. Impacts to non-game wildlife during closure would be similar to those discussed above in Section 4.5.1.1, General Impacts.

Aquatic Species

Impacts to aquatic species during closure are not anticipated unless there is an accidental release of petroleum products into the Dolores River or San Miguel River while en route to the Site. Potential effects are discussed above in Section 4.5.1.1, General Impacts.

4.5.2 Protective/Mitigation Measures

Vegetation

The following protective/mitigation measures would be implemented to mitigate impacts to vegetation resources from construction, operation, and closure of the Proposed Action:

- Energy Fuels would develop and implement a weed control plan to minimize potential impacts and expansion of noxious weeds (CDOW, 2008).
- During construction, Energy Fuels would retain and stockpile topsoil (6 to 12 inches) and vegetative matter to use during interim and final reclamation of the Site as described in the *Specifications for Closure and Reclamation of Mill Facilities* (Golder, 2009c). Topsoil stockpiles would be seeded and mulched, using certified weed-free seed mix and mulch during the first appropriate growing season after topsoil stripping and stockpiling to minimize infestation of invasive and noxious weeds and stabilization during the life of the project.
- During construction, sediment control measures would be utilized, including weed-free hay bales, silt fences, and temporary detention basins as described in the *Stormwater Management Plan* (Golder, 2009a).
- Dust suppression would be used on roads (magnesium chloride, water), ore pads, tailings cells, and evaporation ponds to eliminate fugitive dust from negatively affecting native vegetation within the Site.
- Energy Fuels would implement the measures included in the *Tailings Cell Closure Design Report* (Kleinfelder, 2009c) the *Specifications for Closure and Reclamation of Mill Facilities* (Golder, 2009c), the *Mill Decommissioning Plan* (Kleinfelder, 2009b), and

the *Mill Decommissioning and Reclamation Cost Estimate* (Energy Fuels, 2009h) which describe methods for recontouring, topsoil redistribution, soil preparation, fertilization, and revegetation, including a recommended seed mixture, mulching, seeding methods, and timing.

- Energy Fuels would exclude livestock from revegetated and rehabilitated areas to promote complete revegetation. Exclusion would continue until the vegetation in the reclaimed area is established and self-sustaining.
- Energy Fuels would include revegetation status in the reports required by CDPHE.

Wetlands

Although no USACE jurisdictional wetland features or Waters of the United States are expected to be impacted during construction, operation, and closure of the Mill Facility, the following design measures would be implemented to avoid impacts to wetland features:

- Energy Fuels would locate project components and access roads away from the non-jurisdictional retention pond.
- According to Energy Fuels' Stormwater Management Plan (Golder, 2009a), the Mill Facility (the area within the Mill License Boundary) is designed as a "zero discharge" facility, so that all runoff would be contained on-site in lined ponds and cells and recycled for use in the mill. No contaminated water would enter natural drainages or groundwater systems according to the *Facility Operating Plan* (Visus and Energy Fuels, 2009a).
- Surface water runoff outside of the Mill License Boundary would be routed via diversion berms into natural drainage channels on the east and west sides of the Mill License Boundary (Visus, 2009).
- Tailings cells and evaporation pond would be equipped with multiple liners and leak collection and recovery systems to provide containment of 11e.(2) byproduct material during operations. During closure, the tailings would be dewatered and the mill, ore pad, and evaporation ponds would be removed and placed in the final tailings cell. The tailings cells would be capped with an engineered cover that is designed to provide containment of 11e.(2) byproduct material for 200 years, and, to the extent practicable, 1,000 years with no active maintenance or controls to minimize the potential for the 11e.(2) byproduct material to impact groundwater (Kleinfelder, 2009c and Criterion 6(1)(i)).
- Energy Fuels would follow measures in their SPCC (Energy Fuels, 2009b) and Material Containment Plan (Energy Fuels, 2009c) which include methods to contain spills and prevent oils/chemicals from reaching Waters of the U.S.

Invasive, Non-Native Species

The following protective/mitigation measures would be implemented to mitigate impacts from noxious weeds during construction, operation, and closure of the Proposed Action:

- Energy Fuels would develop and implement a Weed Control Plan to minimize potential impacts and expansion of noxious weeds (CDOW, 2008).
- Weed-free sedimentation barriers would be used.
- The soil stockpile would be revegetated during the first growing season to minimize infestation of invasive and noxious weeds.

- Revegetation would occur during the first growing season following closure.
- Energy Fuels would conduct weed control monitoring and implement weed control measures, as necessary, on a biannual basis (spring and fall) to limit the occurrence of noxious weeds on the property. The program would start prior to construction and continue until the site is successfully reclaimed. Records would be kept of the weed surveys and herbicide applications.

All Wildlife Species

The following protective/mitigation measures will be implemented to mitigate impacts to threatened, endangered, and candidate species, BLM sensitive species and State of Colorado Species of Special Concern, and terrestrial wildlife from construction, operation, and closure of the Proposed Action:

- Employees would receive environmental awareness training during project orientation. Energy Fuels would provide information about: native wildlife including ESA-listed species, BLM sensitive species and Colorado State special status species, and terrestrial wildlife within the Site and vicinity, sensitivity to various kinds of impacts; consequences of poaching; information about federal and state wildlife laws.
- Recreational hunting would not be allowed on Site. Energy Fuels would encourage its employees and contractors to report any incidents of poaching immediately to the CDOW, such as through the program “Operation Game Thief.” Energy Fuels would place “No Hunting” signs on the Property Boundary.
- Energy Fuels would erect a 6-foot chain-link fence topped with three strands of angled barbed wire around the tailings cells and evaporation ponds to eliminate entry of larger terrestrial wildlife (Visus, 2009). A fine mesh wire fence or hardware cloth apron extending 2 feet below the ground surface would be buried around the outside perimeter of the chain-link fence to minimize or eliminate burrowing animals from entering tailings cells and evaporation ponds. Fine mesh fencing extending to 3 feet above ground around the inside perimeter of the chain-link fence would be placed to prevent smaller, ground-dwelling wildlife (i.e., pocket gophers and other rodents, lizards, and snakes) from entering tailings cells and evaporation ponds. Energy Fuels would inspect the fence daily, and repair, as necessary.
- Bird netting would be placed over the evaporation pond to eliminate birds and other wildlife species from entering potentially toxic raffinate solution. Netting would be securely fastened to the pond-top perimeter to seal off access to the ponds at ground-level.
- Bird balls would be used in the ponded portion of tailings cells to disguise the tailings solution and prevent birds from landing on the tailings solution (USFWS, 2009f).

Threatened, Endangered, and Candidate Species

The following protective/mitigation measures would be implemented to mitigate impacts to threatened, endangered, and candidate species from construction, operation, and closure of the Proposed Action:

- Energy Fuels may cooperate in ongoing efforts to reopen sagebrush habitats/remove pinyon-juniper woodlands on Monogram Mesa to mitigate for impacts to Gunnison Sage-grouse by the Proposed Action. The off-site mitigation could create usable habitat further

south and east of the Site and close the gap between occupied habitat in Dry creek Basin and potentially suitable habitat in East Paradox Valley.

- Energy Fuels would follow measures in their *SPCC Plan* (Energy Fuels, 2009b) and *Material Containment Plan* (Energy Fuels, 2009c) which include methods to contain spills and prevent oils/chemicals from reaching Waters of the U.S.

BLM Sensitive Species and State of Colorado Species of Special Concern

The following protective/mitigation measures would be implemented to mitigate impacts to BLM sensitive species and State of Colorado Species of Special Concern from construction, operation, and closure of the Proposed Action:

- To minimize attracting bats and disrupting bat feeding behaviors, Energy Fuels would utilize monochromatic orange sodium lamps that do not attract insects or bats, except in those locations where health, safety, or security considerations require additional lighting. Night lighting would be the direct cut-off variety that point down and minimize lateral light glare.
- Energy Fuels would conduct burrowing owl surveys prior to construction and soil storage site use. If this species is present, Energy Fuels would maintain a 328- to 984-foot (100 to 300 meter) disturbance buffer around nest burrows to prevent possible disturbance to adjacent burrows and foraging habitat (Colorado Partners in Flight, 2000a). Energy Fuels would avoid affecting occupied burrows until vacated. If destruction of potential burrows is unavoidable, Energy Fuels would consider creating artificial burrows away from impacted areas (see Marks and Ball, 1983).
- Energy Fuels would minimize fugitive dust on adjacent burrowing owl foraging habitat from access roads and milling operations through application of magnesium chloride and/or water on the roads and pads.

Terrestrial Wildlife

The following protective/mitigation measures would be implemented to mitigate impacts to terrestrial wildlife from construction, operation, and closure of the Proposed Action:

- Risks of collisions of project-related vehicles with big game and other terrestrial wildlife would be reduced but not eliminated with the majority of ore, reagent, and fuel deliveries scheduled during daylight hours.
- Energy Fuels would erect barbed wire perimeter fencing around the Property Boundary to permit big game passage to the extent possible. Fence would be no taller than 42 inches with at least 12-inch spacing between the top two wires to minimize big game entanglement with the fence. Bottom wire would be at least 16 to 18 inches off the ground to allow passage of young deer and elk. If domestic cows with calves are present in adjacent pastures and calf penetration is an issue, fencing could be designed so that the bottom wire could be lowered although bottom wires 16 inches off the ground would hold livestock. Energy Fuels would visually inspect and maintain the fence, as needed, so that wires are taut to minimize entanglement.
- Vegetation removal would occur prior to May 15 or after July 15 to avoid take of migratory bird species, nests, or eggs (BLM, 2007).
- Energy Fuels would require that contractors install raptor-safe transmission lines and they would be inspected to determine if raptor perch deterrents are warranted.

- Energy Fuels would use bear-resistant containers and collect refuse frequently to minimize potential for conflicts with bears at the Site.
- The Site would be revegetated with species that are palatable for livestock and wildlife. Weeds would be controlled to maintain native vegetation.
- Energy Fuels would coordinate with CDOW to develop a Habitat Improvement Plan (HIP) to provide off-site compensatory mitigation that would improve wildlife habitat within the vicinity of the Site (CDOW, 2008). Potential projects could include:
    - Weed management and control actions on big game winter ranges and/or Gunnison Sage-grouse nesting, brood-rearing, and/or wintering ranges;
    - Road decommissioning with habitat restoration;
    - Control of pinyon-juniper vegetation encroachment into sagebrush-dominated habitats to enhance habitat for wintering big game, Gunnison Sage-grouse, and sagebrush obligate wildlife species.
    - Options/practices to include maintaining open space, excluding subdivisions and keeping an agricultural base of operations compatible with wildlife, excluding fencing or other developments that are restrictive to wildlife migration and movement, or grazing management systems.
    - Grazing management to include options, with the owner's or permittee's concurrence, to improve habitat quality for wildlife.
    - Habitat improvements may be considered as standard procedures for managing habitat, or for offsite mitigation where important habitats could potentially be improved to restore habitat functions impacted in other areas (i.e., reintroduce controlled burns, develop water resources, eliminate cheatgrass, etc.).

<u>Aquatic Species</u>

The protective/mitigation measures for Aquatic Species would be the same as those listed for Wetlands.

4.5.3 Monitoring

Every 5 years, prior to renewing the Mill License with the CDPHE, Energy Fuels would conduct surveys at the Site and immediate vicinity for Threatened, Endangered, and Candidate Species, BLM Sensitive Species, and State of Colorado Species of Special Concern, as well as for wildlife. The potential species present would be determined by a qualified biologist using information provided by the BLM, CDOW, and the USFWS. The RSO would review the survey results and summarize the findings for submittal to the CDPHE as part of the license renewal application.

Revegetation monitoring of disturbed areas would be conducted following seeding of disturbed areas. This includes reclamation concurrent with operations when practical. Species used for revegetation will include native grasses and forbs as specified in the *Specifications for Closure and Reclamation of Mill Facilities Report* (Golder 2009c). Revegetated areas would be monitored to document the success of the seeding efforts and identify areas where further efforts (e.g. reseeding, installing temporary structural erosion controls, etc.) may need to be employed. Revegetation is a stormwater BMP; therefore, its progress would be evaluated on a monthly basis during BMP Inspections. Disturbed areas are considered satisfactorily revegetated when the vegetative cover is sufficient to minimize erosion.

Energy Fuels would conduct a weed survey of the Site in the spring and in the fall and would implement subsequent weed control measures to minimize the occurrence and spread of

noxious weed species. Weed survey results would be reported to the CDPHE in the annual report along with measures and practices employed for weed control including Pesticide Application Records.

A discussion of radiological monitoring associated with ecological resources is provided in Section 4.11, Public and Occupational Health.

4.6 AIR QUALITY

4.6.1 Environmental Impacts

4.6.1.1 General Impacts

Energy Fuels submitted an air permit application to the CDPHE Air Pollution Control Division (APCD) for authorization to construct the Mill Facility (Kleinfelder, 2009a) and would be required to obtain approval of the Construction Permit prior to commencing construction of the Mill Facility. Once the Construction Permit has been approved, Energy Fuels will have 18 months to begin construction unless a time extension is approved due to various acceptable circumstances. The air permit application is based on processing 1,000 tpd of uranium/vanadium ore; however, the Mill Facility would initially process 500 tpd of uranium/vanadium ore. Energy Fuels plans to ultimately ramp up to processing 1,000 tpd of uranium/vanadium ore so to avoid potential circumvention of the air quality rules, the air permit application must be based on the planned 1,000 processing rate even though other regulatory permits would initially be based on the 500 tpd processing rate.

Energy Fuels submitted several Air Pollutant Emission Notices (APENs) to APCD (Kleinfelder, 2009a and 2009j) detailing estimated project emissions during operations. Emissions associated with construction and closure, for the most part, are not required to be addressed in the APENs or the air permit application. Therefore, most of this discussion focuses on potential impacts during operation of the Mill Facility. Emissions of radionuclides and associated potential impacts are discussed in Section 4.11, Public and Occupational Health.

4.6.1.2 Construction, Operations, and Closure Impacts

4.6.1.2.1 Construction

Emissions during construction would be limited to those associated with land-clearing and construction equipment and would include particulate matter emissions in the form of fugitive dust and combustion emissions associated with fuel-burning equipment. Because the land development for the Proposed Action is expected to continue longer than 6 months in duration and would cover an area greater than 25 acres in size, Energy Fuels would be required to prepare an APEN form for land development. Energy Fuels would also be required to follow measures described in the Fugitive Dust Control Plan included in the APEN to minimize fugitive dust.

4.6.1.2.2 Operations

The APCD uses the information provided in the APENs to determine whether the development project requires an air permit. The APCD completed their preliminary analysis and requested additional information. Energy Fuels provided the additional information in November 2009 (Kleinfelder, 2009j).

Emissions from the Mill Facility would be considered either non-fugitive emissions or fugitive emissions. Fugitive emissions are emissions from facilities or activities that could not reasonably pass through a stack, chimney, vent, or other equivalent opening. In determining if a facility is a

"major source" or "minor source," only non-fugitive emissions would be considered for comparison against the thresholds for facilities that are not considered a "Categorical Source" by the EPA (of which the Mill Facility is not). Potential emissions from the Mill Facility do not exceed the thresholds for a major source permit and therefore, Energy Fuels is seeking a "minor source permit" from the APCD. Based on the estimated emissions, the Prevention of Significant Deterioration (PSD) thresholds would also not be exceeded.

In conversations between Energy Fuels and APCD, PM_{10} is the only emission that is anticipated to be a concern and therefore, Energy Fuels conducted baseline monitoring for PM_{10} to get a background concentrations at the Site as reported in the *Meteorology, Air Quality, and Climatology Report* (Kleinfelder, 2009i). Impact modeling will be conducted to demonstrate that PM_{10} emissions added to this background measurement would not cause an exceedance of either the National Ambient Air Quality Standards or the Colorado Ambient Air Quality Standards.

Emissions Inventory and Controls

Kleinfelder (2009a) estimated both the controlled and uncontrolled potential to emit emission values. These are summarized in Table 4.6-1 and are provided in detail in the APENs submittal (Kleinfelder, 2009j).

The process components for the Mill Facility have been categorized into the following specific areas:

- Area 100 – Ore Handling and Grinding
- Area 200 – Leaching
- Area 300 – CCD Thickeners and Tailings Disposal
- Area 400 – Uranium Solvent Extraction (SX)
- Area 500 – Uranium Precipitation
- Area 600 – Vanadium Oxidation and SX
- Area 700 – Vanadium Precipitation
- Area 800 – Reagents
- Area 900 – Utilities and Buildings
- Area 1000 – General Plant.

A description of the specific process areas is provided in Section 2.0, Alternatives. Potential emission sources as well as emission controls for each area are briefly described below.

Ore Handling and Grinding. Sources of fugitive particulate matter emissions include ore delivery truck travel on the main haul road, unloading the ore from the trucks onto the dumping platform, transferring the ore from the dumping platform to the ore pad, and wind erosion of the ore stockpiles. The feed system processes including unloading ore into the grizzly screen to the apron feeder, transferring ore from the apron feeder to the conveyor belt, and transferring ore from the conveyor belt to the Mill would also be sources of particulate matter emissions. Once the ore is mixed with water and ground into slurry, particulate matter emissions are considered to be negligible. Particulate matter emissions would be controlled by enforcement of low speed limits, treatment of roads with magnesium chloride, motion sensing water sprays, and spraying the ore stockpiles and the ore pad travel routes with water. Drive-through curtains would be placed over the open side of the feed hopper building and water sprays would be located at the grizzly screen. Air from the grizzly screen, coarse feed hopper, and apron feeder area would be vented to a dust collecting baghouse. A dust scrubber would be connected to the discharge end of the SAG Mill with a control efficiency of 99 percent.

Table 4.6-1
Potential Emissions Associated with Operation of the Mill Facility

Emission Type	PM	PM10	PM2.5	NOx	SO2	CO	VOC	Total HAPs	Sulfuric Acid	Ammonia
Controlled PTE										
Fugitive Source Total (tons per year)	151.07	52.97	5.80	0.00	0.00	0.00	214.00	0.03	14.21	0.00
Non-Fugitive Source Total (tons per year)	10.45	8.75	8.50	7.24	1.78	9.54	37.05	0.20	7.76	5.15
Total (Fugitive and Non-Fugitive)	161.52	61.71	14.30	7.24	1.78	9.54	251.05	0.23	21.96	5.15
Uncontrolled PTE										
Non-Fugitive Source Total (tons per year)	59.95	54.73	52.52	18.57	1.78	9.54	37.05	0.59	7.76	5.41

Acid Leaching. Sulfuric acid emissions would be generated from the acid leaching process prior to the reactions going to completion and therefore, the pre-leach and leach tanks are enclosed and vented to a wet Venturi scrubber. The pre-leach thickener and pre-leach clarifier tanks are open tanks and would not generate a significant amount of emissions because the chemical reaction is anticipated to be at completion prior to entering these tanks. The Area 200 Venturi scrubber would yield 99 percent control for sulfuric acid emissions.

Counter Current Decantations Thickeners. No emissions were calculated for this process.

Tailing Cells. Emissions from the tailings cells would include wind erosion of the tailing cell beaches which would create fugitive particulate matter emissions and radionuclides (which are discussed in Section 4.11), and evaporation of the tailings cell solution which would emit VOCs and sulfuric acid mist. During the cooler months, it is anticipated that the beaches would remain moist; however during the hotter months, the beaches would be sprayed with tailings water or raffinate to control particulate matter emissions.

Evaporation Ponds. Emissions from the evaporation ponds would include wind erosion of the evaporation pond beaches which would create fugitive particulate matter emissions and evaporation of the solution which would emit VOCs and sulfuric acid mist. During the cooler months, it is anticipated that the beaches would remain moist; however during the hotter months, the beaches would be sprayed with a raffinate spray to control particulate matter emissions.

Uranium Solvent Extraction. Particulate emissions would be generated by the diatomaceous earth used in the polishing filters; however, a dust collector with 99 percent control efficiency would be used to control particulate emissions (to less than 1 pound per year) from the bag breaker and mixing tank. Other emissions from this process area include evaporative VOC emissions from the mixer settler tanks and other process tanks.

Uranium Precipitation. All emissions associated with this process area are assumed to be negligible.

Vanadium Oxidation and Solvent Extraction. Emissions from this process area are mostly evaporative VOCs associated with the mixer settler tanks and other process tanks. Other emissions (inorganic) are assumed to be negligible.

Vanadium Precipitation and Packaging. Emissions from this process area would include ammonia emissions; however, the vanadium precipitation tanks and rotary kiln would be vented to a packed-bed wet scrubber to remove the ammonia fumes providing 99 percent control efficiency. Particulate emissions would be generated by the rotary kiln, vanadium dryer, belt filter, casting wheel, and fusion furnace; however, these sources would be vented to scrubbers providing 99 percent control efficiency.

Reagent Delivery, Preparation, and Storage. Most of the reagents are exempt from emissions reporting. Sulfuric acid and ammonia are non-criteria reportable pollutants. There would be some sulfuric acid emissions; however, ammonia emissions would be negligible because the storage tank is a pressure vessel designed to prevent vapor from escaping.

Diatomaceous earth, ammonium sulfate, and flocculant would emit particulate matter emissions during the unloading and mixing operations; however, the diatomaceous earth and ammonium sulfate systems are equipped with dust filters for emission control.

Utilities and Buildings. Emissions from the boilers would result from propane combustion. All three boilers are connected to a single 100-foot-high stack that would vent combustion exhaust to the atmosphere. The boilers would employ 30 ppm low NO_x burners for emission control. Although three boilers exist, only two would be in operation at any given time with the third as a backup.

The gasoline storage tank would generate VOC emissions. Both propane tanks are exempt from emissions reporting based on Colorado Regulation 3, Part II.D.1.zz because the tanks have capacities less than 60,000 gallons and the tanks are pressure vessels sufficient to prevent vapor loss (requirements of Regulation 7, Section IV). All three diesel tanks are exempt from emissions reporting by Regulation 3, Section II.D.1.fff because the tanks have less than 400,000 gallons annual throughput.

General Plant. Emissions from the firewater pump engine and standby generator would be generated from diesel combustion; however, neither system employ emission controls as the equipment is used for emergency purposes only. The worker vehicles and product shipment trucks would emit fugitive particulate matter emissions from traveling on the main haul road. Additionally, vehicle traffic on secondary unpaved roads due to security and equipment monitoring would also generate fugitive particulate emissions.

Reasonably Available Control Technology (RACT) Analysis

A review of the APCD regulations pertaining to Reasonably Available Control Technology (RACT) was conducted by Kleinfelder (2009j). Pursuant to 5 CCR-1001-5 3.C.2.a, a facility is required to apply RACT for regulated criteria pollutants in areas that are classified as either nonattainment or that are in attainment with a maintenance program. The Site is in an area that is in attainment and is not under a maintenance program for any regulated criteria pollutant (PM_{10}/$PM_{2.5}$, VOCs, NO_x, SO_x, and CO). Therefore, RACT is not triggered for any criteria pollutant per this rule.

Pursuant to 5 CCR-1001-9 7.V.A, a facility may not dispose of a volatile organic compound (VOC) by evaporation or spillage unless RACT is utilized. According to discussions with the APCD, this regulation is considered to be applicable because the solvent extraction process results in VOC-containing liquids (primarily kerosene) to be discharged to the evaporation ponds and tailings cells where it can then evaporate. Therefore, a RACT analysis is required and has been conducted for reducing VOC emissions from the Proposed Action (Kleinfelder (2009j).

The RACT analysis specifies the effectiveness of control strategies for reducing VOC emissions from the process, tailings cells, and evaporation ponds. Emissions that remain after application of RACT analysis would be considered fugitive emissions subject to approval of the APCD.

Approach. RACT is considered to be the lowest emission limitation that a particular source is capable of meeting by the application of control technology that is reasonably available, considering technological and economic feasibility. Accordingly, the RACT analysis identified reasonably available control technologies and evaluated the economic and technological feasibility of those options. The analysis also evaluated changes to the operational practices, materials used, management practices, and other environmental factors/consequences.

Conclusions. Several processing upgrades and waste minimization techniques as well as a review of process control technologies were identified for the RACT assessment. Process upgrades and waste minimization practices that were identified and that would be implemented include the following:

Covered uranium and vanadium SX tanks: Covered uranium and vanadium SX tanks would reduce VOC emissions from the process by approximately 90 percent during normal operation and by approximately 75 percent overall considering the tanks may be occasionally opened. The reduction in VOC emissions with the covers is estimated to be 109 tons per year. This option is considered both technologically feasible and economically feasible.

A crud centrifuge and raffinate buffer tank: The raffinate buffer tank and crud centrifuge would be used, respectively, to collect the solvent extraction solution during an upset condition and recover the organic solution from emulsified and entrained mixtures. This technique alone would reduce the amount of kerosene added to the system by approximately 279 tons per year, given two major upset conditions, and therefore by direct mass balance, would reduce the annual VOC emissions from the evaporation ponds by 279 tons per year. This option is considered both technologically feasible and economically feasible.

High efficiency pressure leaf filters: Pressure leaf filters are high efficiency particle removal filters. These filters, used in place of typical sand filters, are designed to effectively remove suspended solids and contaminants from aqueous solutions to minimize the potential for emulsification during the SX process. Use of these filters is estimated to reduce the amount of kerosene added to the organic makeup solution by 25 tons or more per year. This option is considered both technologically feasible and economically feasible.

Energy Fuels also anticipates that some of the residual organics in the raffinate would not evaporate, but rather be permanently entrained with the tailings cells, which would be capped at the time of closure. The process upgrades and waste minimization measures proposed by Energy Fuels would significantly reduce the potential losses of organic compounds thus reducing the amount of organic solution going to the evaporation ponds. Annual kerosene usage would be reduced from 663 tons per year (tpy) to 250 tpy by incorporating feasible process upgrades and waste minimization practices. By mass balance approach, process emissions (non-fugitive emissions) would be reduced from 145 tpy to 36 tpy (a reduction of 109 tpy) and fugitive emissions would be reduced from 518 tpy to 214 tpy (a reduction of 304 tpy) for a total reduction of 413 tpy of VOCs.

In addition to process upgrades for waste minimization, Kleinfelder (2009j) conducted an evaluation of process controls that could be used to remove VOCs from the raffinate solution. The feasibility of implemented each of the control technologies was also evaluated and it was determined that the control technologies are infeasible for direct add-on control of the process effluent without first removing the VOC out of solution into an air stream. The process control technologies evaluated and the reasons for the determination of technically non-feasible include:

Steam stripping: The raffinate stream contains suspended solids and may also contain emulsified crud not suitable for use in a steam stripping column. Also, the raffinate would require extensive pretreatment due to its low pH.

Air stripping: Kerosene has low volatility and would not rapidly enter into the vapor phase, causing this control technology to be highly inefficient.

Biological organic compound destruction: This control technology is very sensitive to environmental factors because living organisms are used. Due to the fact that the raffinate has high metal concentrations and a low pH, this type of control would not be technologically feasible.

Chemical oxidation: Kerosene would not be highly reactive to an oxidation process and other constituents in the raffinate would likely react much faster, causing unknown reactions and emissions, this technology is not considered technologically feasible.

Adsorption: Non-polar compounds, such as kerosene, can be adsorbed onto the surface of activated carbon. Activated carbon is used with non polar compounds however, the ability to desorb (remove) the organic compounds is difficult and the carbon could become easily contaminated by other compounds, suspended solids, and emulsified materials. Therefore, this technology would not be considered technologically feasible.

Membrane separation: Due to the low molecular weight of kerosene and presence of suspended particulates, this technology would not be considered technologically feasible.

Liquid-liquid extraction: Because the raffinate is a mixture or aqueous acids, suspended solids, emulsified materials, and organics, this process would not be considered technologically feasible.

An economic feasibility assessment is not required because no add-on control technology was known to be technologically feasible.

4.6.1.2.3 Closure

Emissions during closure would be similar to those during operations. Energy Fuels would implement their Fugitive Dust Control Plan to minimize impacts from fugitive dust emissions.

4.6.2 Protective/Mitigation Measures

- Energy Fuels would implement the following protective/mitigation measures to reduce impacts to air quality as a result of the Proposed Action:

- Energy Fuels would enforce low speed limits on roads within the Mill Facility to reduce particulate matter emissions.

- The unpaved main haul road would be treated with magnesium chloride with the first application typically in the spring and two to three additional treatments through the summer, as necessary. Supplemental watering of the road to control fugitive particulate matter emissions may occur during dry and windy periods.

- Motion sensing water sprays would be located at the dumping platform dump points for emission control. Both the ore stockpiles and the ore pad travel routes would be sprayed with either water or a raffinate solution from the Mill.

- Emissions at the feed hopper building area would be controlled through the use of drive-through curtains over the open side of the building as well as water sprays located at the grizzly screen. Further, air from the grizzly screen, coarse feed hopper, and apron feeder area would be vented to a dust collecting baghouse and then through a stack to the atmosphere.

- The vibratory feeder area and discharge end of the SAG mill would be connected to a dust scrubber with a control efficiency of 99 percent.

- The pre-leach and leach tanks would be enclosed and vented to a Venturi scrubber which would provide 99 percent control for sulfuric acid emissions.

- During the hotter months, the beaches of the tailings cells and evaporation ponds would be sprayed with tailings water or raffinate to control particulate matter emissions.

- Tanks in the vanadium precipitation and packaging area would be vented to a packed-bed wet scrubber to remove the ammonia fumes providing 99 percent removal efficiency for particulate emissions.

- The diatomaceous earth and ammonium sulfate systems would be equipped with dust filters for emission control.

- Ammonia would be stored in a pressure vessel designed to prevent vapor from escaping.

- Low NO_x burners would be used on the boilers for emission control.

- The uranium and vanadium SX tanks would be covered to reduce VOC emissions from the process by approximately 90 percent during normal operation and by approximately 75 percent overall considering the tanks may be occasionally opened.

- Solvent extraction solution would be collected during an upset condition and the organic solution would be recovered from emulsified and entrained mixtures reducing the amount of kerosene added to the system by 279 tons per year.

- Pressure leaf filters would be used to reduce the amount of kerosene added to the organic makeup solution by 25 tons or more per year.

- Energy Fuels would prepare and implement a Fugitive Dust Control Plan to minimize impacts from fugitive dust during construction and closure.

4.6.3 Monitoring

Air quality and meteorological monitoring would occur in accordance with the *Operational Monitoring Plan* (Visus and Energy Fuels, 2009b). During construction and operation of the Mill, data would be collected at five air monitoring stations (network) located on site (three stations) and one each upwind and downwind of the site vicinity in order to obtain a representative block of data for assessment. Monitoring would continue through the operational phase and until closure and reclamation activities have been satisfactorily completed. The five monitoring locations, see below, would be the same as those used for baseline data collection (Kleinfelder, 2009i).

For PM_{10} samples, air particulate filters would be run for 24 continuous hours on a 1-in-3 day sampling schedule. Filters would be changed between sampling days. The filters would be submitted to the laboratory for analysis of PM_{10} content on a monthly basis.

Meteorological data would be collected continuously at Air Monitoring Sites No. 1 and No. 2 and retrieved on a daily basis via an automated Data Collection System (DCS). The following parameters are measured based on EPA MMGRMA guidance (EPA, 2000): wind speed, direction and sigma theta; vertical wind speed; temperature; relative humidity; delta temperature; barometric pressure; solar radiation; precipitation (Site No. 1 only); and evaporation (Site No. 1 only).

4.7 NOISE

4.7.1 Environmental Impacts

4.7.1.1 General Impacts

4.7.1.2 Construction, Operations, and Closure Impacts

4.7.1.2.1 Construction

Noise levels 50 feet away from typical construction equipment used to construct an industrial site are provided in Table 4.7-1 (WSDOT, 2008). Assuming that noise due to construction would be classified as point sources, the standard reduction for point source noise is 6 dB per doubling of distance (with hard surface conditions such as bare ground, rock, or pavement) from the source (WSDOT, 2008). Ground conditions may further attenuate noise from a point source by an additional reduction of 1.5 dB per doubling of distance (under soft site conditions, including irregular ground and vegetated surfaces) from the source so that noise reduction could be 7.5 dB per doubling of distance. Distances at which noise from construction equipment would attenuate to 40 dBA under hard site and soft site conditions are included in Table 4.7-1.

Table 4.7-1
Average Maximum Noise (Lmax) at 50 feet from Construction Equipment[1]

	Equipment	Noise dBA (Lmax measured at 50 feet)	Distance (feet) to Attenuate to Assumed Ambient Noise Level of 40 dBA	
			Soft Site Reduction At 7.5 dB per double of distance	Hard Site Reduction At 6 dB per double of distance
Construction Activity	Shovel	87	3,850	11,403
	Warning Horn	83	2,660	7,184
	Compactor	83	2,660	7,184
	Dozer	82	2,425	6,400
	Excavator	81	2,211	5,702
	Grader	80	2,016	5,080
	Roller	80	2,016	5,080
	Front End Loader	79	1,838	4,525
	Backhoe	78	1,676	4,032
	Dump Truck	76	1,393	3,200
	Pickup Truck	75	1,270	2,851
	Flatbed Truck	74	1,158	2,540
Drilling	Mounted Impact Hammer	90	5,080	16,127
	Auger Drill Rig	84	2,917	8.063
	Rock Drill	81	2,211	5,702
Materials Handling	Concrete Pump Truck	81	2,211	5,702
	Crane	81	2,211	5,702
	Concrete Mixer Truck	79	1,838	4,525
Stationary Equipment	Jackhammer	89	4,631	14,367
	Pneumatic Tools	85	3,200	9,051
	Generator	81	2,211	5,702
	Pump	81	2,211	5,702
	Air Compressor	78	1,676	4,032
	Welder Torch	74	1,158	2,540

[1] Source: WSDOT, 2008.

During construction of the Mill Facility, it is estimated that an average of 65 trucks per day would arrive at the Site, with the highest vehicle estimates occurring during the second and third quarter of 2011. Most construction-related traffic (90 percent) is expected to arrive from the east on SH 90 and would consist mostly of light vehicles transporting workers to the Site (Table 4.7-

2). Construction-related traffic would increase daily traffic on SH 90 east of the Site by nearly 40 percent above the 2008 average annual daily traffic volume. Less of an increase in construction traffic (only 4.5 percent) is expected on SH 90, arriving from west of the Site.

All project-related construction traffic, when added to the 2008 daily volume on SH 90 (530 vehicles per day) would produce the estimated noise levels 50 feet away from the highway (Table 4.7-2). Distances estimated for traffic noise on SH 90 to attenuate to background levels (assumed to be 40 dBA) under soft site or hard site conditions are also included in Table 4.7-2. The expected increase in vehicular traffic during construction would generate the highest noise levels because of traffic volume on SH 90 arriving from Vancorum, east of the Site. However, the distance for construction traffic noise from the highway to attenuate to background levels of 40 dBA is estimated to increase by only about 300 feet (soft site reduction) or by 2,440 feet (hard site reduction), a very conservative estimate.

Table 4.7-2
Estimated Noise Generated by Project-Related Traffic on SH 90 during Construction

Approach Direction on SH 90	Daily Traffic on SH 90 Due to Construction		Total Volume (added to 2008 baseline)	Estimated Hourly Traffic Volume	Estimated Noise (dBA) Level at 50 feet [1]	Distance (feet) to Attenuate to Assumed Ambient Noise Level of 40 dBA	
	Trucks	Light Vehicles				Soft Site Reduction At 4.5 dB per double of distance	Hard Site Reduction At 3 dB per double of distance
East	30	180	740	74.0	61.9	1,590	8,580
West	4	20	554	55.4	60.8	1,290	7,060

[1] Derived from the progressive relationship between traffic volume and associated noise provided in WSDOT's (2008) Table 7-3, hourly traffic volumes, traveling at 65 miles per hour.

There are five known residences and one structure within 5.5 miles of the Site. The loudest construction noises would be associated with clearing and grading, materials handling, and stationary equipment in Table 4.7-1 would attenuate to background noise at each of the five residences.

4.7.1.2.2 Operations

During the operation of the Mill Facility, there would be an estimated 20 to 30 trucks per day (40 to 60 trips per day) hauling ore to the Mill Facility. Of those, a maximum of 18 trucks per day (38 ore truck trips per day) are expected to arrive on SH 90 from the east and a maximum of 12 trucks per day (24 truck trips per day) are expected from Utah, traveling on SH 90 from the west. In addition to ore deliveries, traffic during operations would include water trucks, tankers, and semi-trailers delivering materials and fuel, miscellaneous delivery trucks, straight-day and shift workers, and visitors. With the exception of some shift worker traffic, most of this traffic would occur during daylight hours. Operational traffic on SH 90, arriving from the west, would include 38 truck trips and 10 light vehicle trips daily, increasing the existing traffic level by over 13 percent. Operational traffic arriving from the east would increase more than 24 percent of the 2008 average daily traffic volume.

All project-related operations traffic, when added to the 2008 daily volume on SH 90 (530 vehicles per day) would produce the estimated noise levels 50 feet away from the highway (Table 4.7-3). Distances estimated for traffic noise on SH 90 to attenuate to background levels (assumed to be 40 dBA) under soft site or hard site conditions are also included in Table 4.7-3.

Table 4.7-3
Estimated Noise Generated by Project-Related Traffic on SH 90 during Operation

Approach Direction on SH 90	Daily Traffic on SH 90 Due to Operation		Total Volume (added to 2008 baseline)	Estimated Hourly Traffic Volume	Estimated Noise (dBA) Level at 50 feet [1]	Distance (feet) to Attenuate to Assumed Ambient Noise Level of 40 dBA	
	Trucks	Light Vehicles				Soft Site Reduction At 4.5 dB per double of distance	Hard Site Reduction At 3 dB per double of distance
East	58	70	658	65.8	61.5	1,470	7,670
West	38	10	578	57.8	61.0	1,340	6,400

[1] Derived from the progressive relationship between traffic volume and associated noise provided in WSDOT's (2008) Table 7-3, hourly traffic volumes, traveling at 65 miles per hour.

Ore unloading and loading activities would be the primary source of noise generated during operations. In particular, the backup alarms from the front-end loaders and highway trucks are expected to generate the loudest noises at the Mill Facility. Warning horns are expected to attenuate to background levels 2,660 feet away (soft-site reduction) or 7,184 feet away (hard-site reduction). Soft-site conditions surrounding the Site are more realistic due to vegetative ground cover. Other operations, which generate high noise levels, would be located within enclosed buildings (e.g., the SAG mill). For comparison, the estimated maximum noise level occurring at the Property Boundary was modeled using conservative assumptions and determined to be 60 dBA (Baker, 2008). This level is well below the most restrictive maximum permissible noise level of 75 dBA established by Montrose County for gravel mining operations located within 1,320 feet of an existing residence or an existing platted subdivision. The estimated maximum noise level at the Property Boundary occurs at the south end of the Site, approximately 800 feet south of the Mill if the attenuation rate of 6 dB per doubling of distance is assumed (hard-site reduction) or about 460 feet if the attenuation rate of 7.5 dB per doubling of distance is applied (soft-site reduction).

4.7.1.2.3 Closure

During the closure of the Mill Facility, much of the same equipment that was used during construction is expected (see Table 4.7-1). Traffic associated with closure would be the highest between the 6th and 8th quarters of closure during which traffic could peak at 30 one-way trips to and from the Site per day (60 trips). Closure-related traffic patterns would likely be similar to construction and operational traffic on SH 90 but traffic volumes would be less than during construction and operation. Traffic noise on SH 90 would be less than estimates made for construction (Table 4.7-2) or operation (Table 4.7-3), above.

4.7.2 Protective/Mitigation Measures

There are no protective/mitigation measures identified to mitigate noise-related impacts resulting from the Proposed Action.

4.7.3 Monitoring

There is no noise-related monitoring proposed.

4.8 HISTORIC AND CULTURAL RESOURCES

4.8.1 Environmental Impacts

4.8.1.1 General Impacts

A determination of "no historic properties affected," pursuant to 36 CFR 800.5 of the NHPA, is recommended for both the 880-acre Site and the 80-acre well field, contingent upon the

avoidance of all sites recommended eligible and upon concurrence by OAHP of all sites recommended not eligible (ERO, 2007 and 2009b).

The Proposed Action has the potential to affect nine archaeological sites (5MN8271, 5MN8272, 5MN8273, 5MN8274, 5MN8276, 5MN8277, 5MN8278, 5MN8281, and 5MN8283). All of these sites are located in planned disturbance areas. Four of the nine sites located in planned disturbance areas were trenched to evaluate their potential for subsurface cultural deposits; all were negative. One additional site (5MN8276) was collected to exhaust its data potential. An additional four sites (5MN8275, 5MN8279, 5MN8280, and 5MN8282) may be impacted in the future, depending on project development. Baseline documentation exhausted the research potential of these four sites, along with the remaining sites located in planned disturbance areas. None of these 13 sites identified were eligible for NRHP listing.

At the time of the 2007 Class III inventory on the 880 acres, sites 5MN8269 and 5MN8270, which are recommended as NHPA eligible, were not located in an area of proposed surface disturbance. Subsequently, groundwater monitoring wells and access roads were proposed for the area surrounding these two sites. A treatment plan was then submitted to and approved by the Colorado State Historic Preservation Officer in October 2008. In March 2009, ERO submitted the first addendum to the cultural inventory report (ERO, 2009b), which describes mitigation treatments for the two potentially impacted sites. Treatment included excavating 6.5 ft x 6.5 ft area (2 m x 2 m) area over what is called Feature 1 at site 5MN8269. Excavation resulted in the identification of a small slab-lined hearth surrounded by an associated activity area, with a date range of 760 to 510 B.C. (ERO, 2009b). Site 5MN8270 treatment included a geomorphological assessment and 100 percent collection of surface artifacts. ERO concluded that the work exhausts all data potential for 5MN8270 and completely mitigates Feature 1 at 5MN8269 (ERO, 2009b).

Isolated finds, by definition, are not eligible for listing on the NRHP. Because these resources are not eligible for listing on the NRHP, they do not need to be considered further in project planning. Energy Fuels has prepared an *Unanticipated Discovery Plan* which outlines the proposed cultural resource compliance procedures to be followed during construction and other surface disturbing activities (see *Operational Monitoring Plan* – Visus and Energy Fuels, 2009b). The discovery procedures needed to identify, record, and evaluate any buried cultural resources detected during surface disturbance activities are summarized in the plan. Also presented are the criteria for site evaluations and procedures to be followed in the rare case of the discovery of human remains.

4.8.1.2 Construction, Operations, and Closure Impacts

4.8.1.2.1 Construction

The greatest potential for an unanticipated discovery of cultural resources would likely occur during construction when most surface disturbing activities would occur. However, cultural resource sites in the area tend to be located near or on the mesas with NRHP eligible sites found in the central portion of the valley where construction activities would be concentrated. Energy Fuels would follow measures in their *Unanticipated Discovery Plan* if cultural resources are encountered as described in *Operational Monitoring Plan* (Visus and Energy Fuels, 2009b).

4.8.1.2.2 Operations

There is little potential for disturbance of known cultural sites or unanticipated discovery during operations because surface disturbance should be minimal during this period and would have to be cleared with the RSO prior to startup (Visus and Energy Fuels, 2009b). Most of the projected

surface disturbance that would occur during operations would be for the construction of Tailings Cells B and C. If surface disturbing activities encounter cultural resources during operations, Energy Fuels would follow their *Unanticipated Discovery Plan* (see *Operational Monitoring Plan* – Visus and Energy Fuels, 2009b) if cultural resources are found.

4.8.1.2.3 Closure

The potential for impact to cultural resources during closure would be minimal because the work would be generally confined to previously disturbed areas. Energy Fuels would follow their *Unanticipated Discovery Plan* if cultural resources are found.

4.8.2 Protective/Mitigation Measures

Energy Fuels would implement the following measures to mitigate potential impacts to Cultural Resources under the Proposed Action. Adherence to these stipulations would adequately protect unidentified cultural resources and prevent adverse effects on potential eligible and need data properties:

- All four sites located in the 80-acre well field would be avoided by ground disturbance, where feasible, regardless of eligibility status.
- Where outstanding, Energy Fuels' cultural resources consultant would continue and complete Native American consultation.
- If newly discovered cultural resources are identified during project implementation, work in that area would stop and the SHPO would be notified immediately (36 CFR §800.13) according to Energy Fuels' *Unanticipated Discovery Plan* (see *Operational Monitoring Plan* – Visus and Energy Fuels, 2009b).
- Strict adherence to the confidentiality of information on the description and location of archeological resources (43 CFR 7.18).
- Inform all persons associated with construction and maintenance of the Proposed Action that they would be subject to prosecution for knowingly disturbing historic or archaeological sites, or for collecting artifacts.

4.8.3 Monitoring

ERO conducted mitigation treatments on sites 5MN8269 and 5MN8270. If project-related, ground-disturbing activities take place in the area around Feature 1 of site 5MN8269, additional monitoring would be recommended. Sites 5MN8284, 5MN8286, and 5MN9206, recommended as NHRP-eligible, would be avoided and protected. If project-related ground-disturbing activities occur in their vicinity, monitoring would be necessary. Energy Fuels would implement the cultural resources monitoring procedures provided in the *Operational Monitoring Plan* (Visus and Energy Fuels, 2009b).

4.9 VISUAL/SCENIC RESOURCES

4.9.1 Environmental Impacts

4.9.1.1 General Impacts

4.9.1.2 Construction, Operations, and Closure Impacts

4.9.1.2.1 Construction

Visual impacts during construction would be temporary and would include the presence of large vehicles and construction equipment and materials necessary to construct the Mill Facility. The stripping of vegetation over a large area and the creation of the soil stockpiles on the west end of the site would also present a temporary visual impact until such time that the soil stockpiles are revegetated and the facilities are constructed.

4.9.1.2.2 Operations

Visual resource impacts from the Site would be most prominent when the evaporation ponds are completed to full 80-acre capacity sometime near the later portion of its 40-year production life. Operation of the Mill, and the initial series of evaporation ponds and tailings cells, would be noticeable in the middleground viewsheds for observers traveling on SH 90. The evaporation ponds and the administration building would be approximately 675 feet from the road at their closest point. An approximately 9,000 ft^2 administration building and associated parking area would be a similar distance from SH 90 and would be clearly visible to observers using the road.

The ponds and eventual three tailings cells (covering 30 acres each) would have low-profile containment embankments, with the majority of their storage capacity located below the existing ground level. The embankments, protective 6-foot-high fencing, and bird netting over the evaporation ponds may be noticeable to observers. Embankment soil color and shape would be in contrast with the existing foreground and background landscape features. Figure 4.9-1 depicts a preliminary facility rendering looking north from the top of Davis Mesa. Impacts to visual resources would be the most prominent from ridge- and mesa-top viewpoints, although fewer observers would see the Site from these locations. SH 90 can be seen running through the valley north of the evaporation ponds.

The Mill Facility and associated ore pad would be approximately 0.75 miles south of SH 90 and would sit about 100 feet higher in elevation than SH 90. The Mill Facility buildings would have varying heights up to 85 feet and would be visible in the middle-background from SH 90 but are not expected to dominate the view of the casual observer. Tailings cell and pond embankments would screen some portions of the buildings. Outdoor lighting at the Mill Facility would change the nighttime viewshed in that the Site would be illuminated in a place where no lights previously existed.

Visual resources observed from the key observation points (KOPs) shown in Figures 3.9-1 and 3.9-2, Section 3.9, on SH 90 are not expected to be significantly impacted by the Site. However, middle and background viewsheds would be altered. To a large extent, the existing open pit mine overburden pile, vegetation alterations, waste rock dumps, mine buildings, and access roads present in the landscape around the Site currently draw the attention of observers on SH 90. The Site would be an obvious addition to the human developments in the area, but it would not dominate the landscape.

Figure 4.9-1
Piñon Ridge Mill Site Facility Rendering from the top of Davis Mesa

4.9.1.2.3 Closure

Following mill decommissioning, the Site would be regraded and reclaimed, and the tailings cells would be closed and covered (reference tailings closure). Visual impacts would be limited to the fenced area of the covered tailings cells that would look similar to the reclaimed Durita site.

4.9.2 Protective/Mitigation Measures

Utilizing the perspective of the KOPs identified in Section 3.9, the following measures would be implemented to mitigate potential impacts to visual/scenic resources from the Site:

- All aboveground facilities would be painted to blend with the surrounding landscape characteristics with an appropriate color selected from the BLM Standard Environmental Colors chart or a similar color reference.
- Outdoor lighting would be down-directed, with fixtures having a 90 degree cutoff, in order to eliminate glare and minimize upward light scattering.
- An efficient lighting scheme would be designed so that the minimum amount of lighting required for safety and security is provided.
- Fences would be coated or painted with non-reflective surfacing, or an appropriate color that blends with the surroundings.

- Minimize disturbance and control erosion by avoiding steep slopes and by minimizing the amount of construction and ground clearing needed for roads, staging areas, and crane pads.
- To the extent practicable, facility construction and placement would utilize natural features in the landscape to screen operations from observers.
- All disturbed areas would be re-contoured and re-vegetated to blend with the natural topography as soon as possible after disturbance, where practicable.
- Dust abatement measures would be practiced on the gravel roads and parking lots, as needed.

4.9.3 Monitoring

Extensive monitoring strategies for visual/scenic resources are not planned for the Mill Facility. However, short-term visual resource analysis from KOPs would be necessary to determine if the above mitigation measures are employed effectively. Changes could be made to the mitigation measures to better resolve impacts, based on KOP analysis.

4.10 SOCIOECONOMICS

4.10.1 Environmental Impacts

4.10.1.1 General Impacts

Most socioeconomic impacts, including those related to population, employment, housing, community services, and government revenues, would be associated with the size of the workforces needed to construct, operate, and close the Mill Facility. Direct workforce requirements would be greatest during the construction phase. The direct workforce requirements would be supplemented by indirect employment largely associated with mining and transporting feedstock ore to the Mill Facility. Fiscal impacts associated with the Proposed Action would continue throughout construction, operation, and closure.

Local Workforce. An analysis of the regional demographic and economic characteristics of western Montrose County and the nearby communities of Norwood, in northern San Miguel County, Colorado, and La Sal, in eastern San Juan County, Utah, suggests that this area could provide approximately 61 workers to the Mill Facility (see Table 4.10-1). This estimate is based on several assumptions, including the age of people most likely to be interested in working at the Mill Facility, the portion of people commuting to other counties for work who would be interested in working at the Mill Facility, and the portion of applicants that would qualify for work at the Mill Facility.

Population Impacts. NRC Guidance for Environmental Reports for Uranium Mills requires that a proposed project's impacts on population distribution be evaluated for all areas within 50 miles (80 km) of the proposed site (NRC, 1982a). An 50 mile (80 km) radius around the Site includes portions of Delta, Dolores, Mesa, Montezuma, Montrose, Ouray, and San Miguel counties in Colorado, and Grand and San Juan counties in Utah (see Figure 3.10-1).

A sizeable portion of the permanent workforce is expected to come from the local area. Therefore, the Proposed Action is not likely to impact regional population distributions. While the project may attract some workers from Norwood and La Sal, the majority of permanent mill workers would be likely to reside in western Montrose County. Thus, communities in western Montrose County are most likely to experience the socioeconomic impacts from the Proposed Action.

Table 4.10-1
Estimated Potential Local Workforce

Employment measure	Nucla CCD	Town of Norwood	La Sal CDP
2008 population[1]	2,812	462	353
Percent of Population 20 to 39 years of age[2]	21.3%	22.4%	29.5%
July 2009 county unemployment rate[3]	8.2%	5.3%	9.6%
Unemployed workers 20 to 39 years of age	49	5	10
Employed workers 20 – 39 years of age	550	98	94
Percent of CCD workers working in other counties[4]	29.1%	7.3%	5.2%
Workers in other counties interested in working at the mill[5]	80	4	2
Prospective applicants at the mill	129	9	12
Potential workers from the local area[6]	52	4	5

[1] 2008 Census population estimate for Norwood (U.S. Census Bureau, 2009a). County growth rate between 2000 and 2008 applied to 2000 Census population for Nucla CCD and La Sal CDP (U.S. Census Bureau, 2000a; CDOLA, 2009a; Utah Governor's Office of Planning & Budget, 2009).
[2] Source: CDOLA, 2009a; Utah Governor's Office of Planning and Budget, 2009.
[3] Source: U.S. Bureau of Labor Statistics, 2009b.
[4] Source: U.S. Census Bureau, 2000a.
[5] Assumes that 50 percent of workers commuting outside the county for work would be interested in working at the Mill.
[6] Assumes that 40 percent of applicants possess the relevant job skills and pass drug tests.

Environmental Justice Impacts. NRC Environmental Review Guidance for Licensing Actions Associated with NMSS Programs - NUREG-1748 (NRC, 2003a) requires that the impacts on minority and low-income populations of projects in rural areas be evaluated across a 4-mile radius around the proposed site. As discussed in Section 4.10.4, there are only two housing structures with no more than five residents within 4 miles of the Site. Because the surrounding area is so sparsely populated, the Proposed Action would not result in a disproportionately high and adverse human health or environmental impact on minority or low income populations.

Economic Impacts (Income and Employment). The Proposed Action would have direct economic benefits through its creation of jobs related to construction, operations, and closure of the Mill Facility. The Proposed Action would provide additional indirect benefits to local and regional businesses through the purchases of goods and services, such as power, fuel, equipment, and parts. Businesses providing consumer goods and services would also benefit from the increased demand of the workers. This type of indirect demand, also known as induced demand, would be further stimulated by the increased purchasing power of people employed by businesses that support the Mill Facility and its workers.

Housing Impacts. A sizeable portion of the permanent workforce is expected to currently reside in the local area, and the Proposed Action is not expected to have a long-term impact on the residential housing market. Housing impacts during each phase of the Proposed Action are discussed in the Construction, Operations, and Closure sections of this Section.

Land Value Impacts. The potential exists that the Proposed Action would negatively affect property values in the Paradox Valley (Corbell, 2009). Land values are influenced by public perceptions, and it is difficult to predict the long-term perceptions of the Mill Facility. Agricultural and residential sale prices in San Juan County, Utah, provide an indication of the impact of perceptions of a Mill Facility on surrounding property values. The White Mesa Mill, which is located 6 miles south of Blanding Utah, is currently the only operating uranium mill in the United

States. According to the County Assessor, farmland in San Juan County typically sells in 40 to 80 acre parcels for between $400 and $500 an acre, and there is no discernable difference between the value of farmland around Blanding and the value of farmland in other parts of the county (Randall, 2009). A comparison of residential sale prices in Blanding and Monticello (the only other incorporated town in San Juan County) found a minimal difference between average residential sale prices in each town. In mid-October 2009, the average selling price of homes on fewer than 5 acres was $160,010 in Blanding and $162,375 in Monticello. The median price, which indicates the mid-range value of selling prices, was $145,000 in Blanding and $143,000 in Monticello (National Association of Realtors, 2009). By both measures, the difference in residential sales prices between the two towns is less than 2 percent. While far from a rigorous analysis, this indicates that the long-term impacts to agricultural and residential land values in the Paradox Valley from the Proposed Action would be minimal.

Community Services Impacts. Existing community service facilities in western Montrose County are currently underutilized, and the Proposed Action is not expected to have long-term impacts on local service providers. The paragraphs below provide an overview of the community service impacts that are discussed in greater detail in the Construction, Operations, and Closure sections of this Section.

Schools. Neither school district in the local area faces capacity or staff constraints. In 2008, both enrollments and pupil/teacher ratios in the West End RE-2 School District and the Norwood R-2J School District were lower than they have been in school years earlier in the decade.

Medical Services. The Basin Clinic in Naturita and Uncompahgre Medical Center in Norwood would provide primary health care to mill workers and their families. Neither facility currently faces staffing or facility constraints in treating additional patients. Both facilities are likely to benefit from any additional demand in primary health care services from mill workers and their dependents as these individuals would be insured patients whose payment for services would help defray the clinics' costs of providing medical services to uninsured and under-insured patients.

Public Safety. The handling of on-site emergencies at the Mill Facility would follow Energy Fuels' *Emergency Response Plan (*Energy Fuels, 2009e), which was developed in consultation with local law enforcement agencies and fire departments and would be further refined and updated with their input during operations to insure that adequate personnel and equipment would be available to support emergency response efforts. On-site training exercises would also be conducted with local agencies at least once per year to establish lines of communications and responsibilities for various types of incidents (Energy Fuels, 2009e).

Water and Wastewater Services. The Proposed Action would not have an adverse impact on water or wastewater treatment facilities in the local area. The planned source of process water at the Mill Facility is groundwater, which would be pumped from a series of on-site and adjacent off-site wells. Potable water would be imported to the site from Naturita. Process wastewater would be treated onsite and recycled in a zero discharge system (Energy Fuels, 2009f).

Fiscal Impacts. The fiscal impacts associated with the Proposed Action would occur primarily through property tax and sales and use tax paid by Energy Fuels. All of Montrose County is designated by the State of Colorado as an Enterprise Zone. Therefore, Energy Fuels would be eligible for tax credits that would apply to the company's income tax liability to the State of Colorado.

Property Tax. Local governmental taxing entities assess property taxes largely to fund local school operations and local government services. A 29 percent assessment rate applies to all business and industrial property in Colorado. Table 4.10-2 shows the taxing districts that would assess property taxes on the Mill site and each district's 2008 tax rate (*i.e.* mill levy).

Table 4.10-2
Taxing Districts and 2008 Mill Levies
Applicable to the Piñon Ridge Mill Site[1, 2]

Taxing District	2008 Mill Levy
Montrose County	18.039
RE-2 West End School District	25.918
Montrose Library District – Naturita	3.83
Southwest Water Conservation District	0.216
San Miguel Water Conservancy District	0.052
Total mill levy (Tax Area 25018)	48.055

[1] Source: Montrose County, 2009d.
[2] Source: Montrose County, 2009e.

Sales and Use Tax. Sales and use taxes paid on direct and indirect sales related to the Mill Facility would provide revenues to state, county, and local governments. Sales tax applies to goods that are purchased in the taxing area in which they are used, while use tax applies to goods that are purchased outside the taxing area in which they are used. The State of Colorado assesses a 2.9 percent sales tax and a 2.9 percent use tax. Montrose County assesses a 1.75 percent sales tax, 1 percent of which funds the Road and Bridge Department, and 0.75 percent of which funds public safety programs. The county has a 1 percent use tax that applies to purchases of vehicles and building materials. Use taxes on building projects in Montrose County are based on 1 percent of the estimated costs associated with physical structures only and are paid at the time the building permit is issued (White, 2009). The towns of Naturita and Nucla each impose a 4 percent sales tax and the City of Montrose imposes a 3 percent sale tax (Colorado Department of Revenue, 2009b).

Colorado Enterprise Zone Tax Credits. The Colorado Enterprise Zone Program is designed to encourage job creation and capital investment in economically depressed areas by providing tax credits to businesses that promote economic development activities. Montrose County is part of Colorado Enterprise Zone 10 (Keckler, 2009, and Colorado Office of Economic Development and International Trade, 2009). Because the Site is located in an enterprise zone, Energy Fuels would be eligible for tax credits and incentives that would apply to the company's income tax liability to the State of Colorado. Enterprise zone tax credits include:

- A 3 percent investment tax credit on equipment purchased for exclusive use in an enterprise zone.
- A $500 job tax credit on each new employee hired at a new facility located in an enterprise zone.
- A 2-year $200 job tax credit for each new business facility employee who is insured under a qualifying employer-sponsored health insurance program.

Enterprise Zone tax credits do not apply to sales and use tax or property taxes.

The following sections discuss in greater detail the socioeconomic impacts that are likely to occur in each phase of the Proposed Action.

4.10.1.2 Construction, Operations, and Closure Impacts

4.10.1.2.1 Construction

Workforce. Energy Fuels expects that approximately 20 percent of the construction workforce would consist of workers residing in western Montrose County (the Nucla CCD), the Town of Norwood and the La Sal Census Designated Place (CDP). Construction of the Mill would involve two major types of subcontractors: general (civil, structural, mechanical, and piping), and electrical/instrumentation. A number of specialty contractors would also be required for pre-engineered buildings, scaffolding, tank erection, insulation, fire protection, liner installation, power supply, and support activities. The primary trades required for construction of the Mill would include millwrights, welders, pipe fitters, electricians, and unskilled laborers (Golder, 2009b). Energy Fuels intends to ask contractors to employ as many skilled and unskilled workers as possible from the local area as possible. Contractors typically have construction crews that travel to various job sites, so local workers would either have suitable specialized skills or fill general construction jobs.

According to the *Construction Plan* for the Piñon Ridge Mill, the project would be constructed over a 21 month (seven quarter) period. The construction workforce would increase from 25 workers in the 1st quarter to a peak of 200 workers in the 4th and 5th quarters as discussed in the *Construction Plan* (Golder, 2009b). Based on the assumption that local workers would comprise 20 percent of the construction workforce, Table 4.10-3 shows the estimated number of local and non-local workers.

Table 4.10-3
Construction Workforce Estimates[1]

Calendar Quarter	Work Quarter	Total Workers[1]	Local Workers[2]	Non-local Workers
3rd Qtr 2010	1	25	5	20
4th Qtr 2010	2	45	9	36
1st Qtr 2011	3	125	25	100
2nd Qtr 2011	4	200	40	160
3rd Qtr 2011	5	200	40	160
4th Qtr 2011	6	150	30	120
1st Qtr 2012	7	10	2	8

[1] Source: *Construction Plan* (Golder, 2009b).
[2] Includes residents of the Nucla CCD, Town of Norwood, and La Sal CDP

The construction workforce is estimated to peak at 200 construction workers. In 2008, annual wages paid in the construction sector in Montrose County averaged $38,480 (U.S. Bureau of Labor Statistics, 2009a). Table 4.10-4 shows the typical wage range in western Colorado for a variety of construction occupations that would be required to build the mill (CDLE, 2009).

The IMPLAN economic impact model was used to estimate the total economic impact of the Mill Facility Montrose County. The modeling results estimated that in-county expenditures on construction would generate 326 direct, indirect, and induced full- and part-time jobs over the 21-month construction period. The IMPLAN modeling results also indicated that construction would generate approximately $14.3 million in total labor income (including wages and salaries, benefits, and proprietors' income) and $35.5 million in total sales to Montrose County businesses (Berger, 2009).

Table 4.10-4
Annual Wages for Construction-Related Occupations in Western Colorado, 2008[1]

Occupation	Range of Annual Wages[2]
Cement masons and concrete finishers	$29,036 - $42,412
Construction laborers	$20,339 - $33,189
Construction trades workers	$24,967 - $45,506
Earth drillers	$37,091 - $47,990
Electricians	$28,470 - $52,948
Industrial machinery mechanics	$38,097 - $55,130
Paving/surfacing/tamping equipment supervisors	$37,502 - $42,863
Pipelayers	$26,234 - $39,863
Plumbers, pipefitters and steamfitters	$32,843 - $52,772

[1] Source: CDLE, 2009.
[2] Excludes benefits.

Population Impacts. The Proposed Action is expected to attract construction workers from across western Colorado and eastern Utah. Construction workers are transient workers who do not tend to relocate permanently to communities near the job site, and, therefore, would not impact regional population trends.

Housing Impacts. The construction workforce associated with the Proposed Action would not impact the demand for long-term housing in the local area. During peak construction periods (the 4th and 5th quarters of construction), approximately 160 non-local construction workers could be expected to need short-term housing. As discussed in Section 3.10.6.2, short-term housing accommodations near the Site include 77 motel rooms and 11 short-term apartment/house/mobile home rentals in Naturita, Norwood and Paradox. There are also 119 RV sites in Naturita and Norwood, and a mobile home park in La Sal that could provide additional opportunities for RV placement. At its peak, the mill's construction workforce would be likely to fully occupy available short-term rentals in the local area. This could lead to upward pressure on short-term housing prices including motel rates, month-to-month apartment rents and RV site fees.

Community Services Impacts. Potential impacts to community services during construction include those related to schools, medical services, public safety, and water and wastewater services.

Schools. Because dependents do not typically accompany construction workers to temporary job sites, construction would likely result in only small increases in local school enrollments.

Medical Services. During construction, the Basin Clinic in Naturita would provide first-call emergency medical services to injured construction workers. In the case of emergencies requiring on-site treatment, it is likely that emergency medical technicians with the Nucla/Naturita Fire Protection District or Paradox Volunteer Fire Department would be called upon for assistance. Construction of the Mill Facility could place additional short-term burdens on these volunteer response units, particularly between the 3rd and 6th quarters of construction, when between 125 and 200 construction workers would be at the Site.

Public Safety. The need for site security during construction would be addressed by a security fence with gated access installed around the site. A guard posted at the main entrance along SH 90 would control access to the Site during working hours. The gate would be locked and the

site secured at all other times (Golder, 2009b). During the 12-month period covering the 3rd through sixth quarters of construction, local law-enforcement officials could face an increase in traffic- and alcohol-related offenses committed by construction workers during their off-hours. Thus, construction of the Mill Facility could place additional short-term burdens on local law enforcement officials.

Water and Wastewater Services. Construction of the Mill Facility is not expected to impact water or wastewater treatment facilities in the local area. Groundwater would be used for construction-related activities, but at levels lower than those projected for operations. Sanitary wastes generated during construction would be collected in portable, self-contained toilets and hauled to an appropriate disposal site and would not impact local waste services.

Fiscal Conditions. Over the 21 month construction period, the sales and use tax revenues associated with construction expenditures would include approximately $2.48 million to the State of Colorado, $286,118 to Montrose County, and $33,769 to each of the towns of Naturita and Nucla (see Table 4.10-5). These estimates are based on several assumptions, all of which are intended to produce conservative revenue estimates. Estimated sales and use tax revenues to the State of Colorado consider all direct capital expenditures related to construction and a portion of household spending of income derived from mill construction. Sales tax revenues from household spending were estimated by adjusting the IMPLAN model's estimated total labor income to exclude benefits and tax liabilities. Benefits were estimated to account for 28 percent of total income, and taxes (*e.g.* income taxes and social security insurance) were estimated to account for 13 percent of income minus benefits (Berger, 2009). The resulting estimate of disposable income was further adjusted to account for spending on taxable items only. Nationally, 37.1 percent of household income is spent on housing and health care, which are not taxable (U.S. Bureau of Labor Statistics, 2007). Therefore, the sales tax revenues associated with household spending estimated in this analysis apply to 62.9 percent of the IMPLAN model's estimated disposable income.

Estimated sales and use tax revenues to Montrose County are based on 1 percent of the estimated costs associated with constructing physical structures on the Site, and 0.75 percent of direct purchases made in Montrose County. Energy Fuels expects that they would spend approximately $6.3 million in Montrose County on construction materials such as fencing, concrete, road base, and asphalt (Monok, 2009). A sales tax of 0.75 percent would be due on these construction materials at the point of purchase in Montrose County (Barnett, 2009). Estimated sales tax on household spending was adjusted to account for spending on taxable items only.

Due to limited commercial and retail outlets in Naturita and Nucla, the analysis assumed that only 15 percent of household spending on taxable items would occur in each of these towns. It is likely that, over time, economic activity associated with the mill would support local business expansion and stimulate local spending. Although the majority of household spending associated with construction of the Mill is likely to occur in other municipalities, not enough is know about where this spending would occur to estimate sales tax revenues to other local governments.

Table 4.10-5
Estimated Sales and Use Tax Revenues – Construction Phase

Taxing Entity	Estimated Sales and Use Tax
Colorado sales and use tax[1]	$2,483,217
Montrose County sales and use tax[2]	$286,118
Naturita sales tax[3]	$33,769
Nucla sales tax[3]	$33,769

[1] Includes sales and use taxes on direct mill expenditures and 62.9 percent of household spending.
[2] Includes 1 percent Montrose County use tax on building materials, 0.75 percent sales tax on in-county purchases, and 62.9 percent of household spending.
[3] Assumes that 15 percent of taxable household spending occurs within town limits.

During the 21 month construction period, the Proposed Action would generate approximately $37,796 in property taxes. Property taxes were estimated by multiplying the unimproved land value of the Site by a 29 percent assessment rate and then by the 2008 mill levy. Table 4.10-6 shows the estimated distribution of property tax revenues across the site's taxing entities.

Table 4.10-6
Estimated Property Tax Revenues – Construction Phase[1]

Taxing District	Property Taxes
Montrose County	$14,187
RE-2 West End School District	$20,384
Montrose Library District - Naturita	$3,012
Southwest Water Conservation District	$170
San Miguel Water Conservancy District	$41
Total property taxes	$37,796

[1] Based on real property value of land only (Vigil, 2009) and 2008 mill levies (Montrose County, 2009d).

4.10.1.2.2 Operations

Workforce. At a processing rate of 500 tpd of uranium/vanadium ore, the Mill Facility would employ 85 workers. This operational workforce would include 25 people working in management and administrative capacities on a straight day (8 hour) schedule, 5 days per week; and 60 people (four 15 person crews) working in milling and processing facilities on a rotating 24-hour shift schedule (three 8 hour shifts per day), 7 days per week (Visus, 2009).

Energy Fuels anticipates that the operational workforce would include some construction workers, such as electricians, instrumentation workers, boiler makers, and mechanics, who transition to permanent positions on the maintenance crews. Energy Fuels expects that approximately 80 percent of the operational workforce would consist of workers already residing in the local area. (The analysis of the potential local workforce shown in Table 4.10-1 indicates that this is a realistic expectation.) This suggests that the mill would attract approximately 17 new full-time workers to the area (see Table 4.10-7). Given the region's mining history, Energy Fuels expects that some of these new residents would be previous out-migrants who left Montrose County in search of job opportunities elsewhere. Whether the workers are former

residents who are returning or new residents to the area, this is the approximate size of the mill's workforce that would impact the population in western Montrose County and would create the demand for additional housing and public services.

Table 4.10-7
Operational Workforce Estimates (Direct Employment)

Worker category	Total Workers[1]	Local Workers[2]	Non-Local Workers
Straight-day schedule	25	20	5
Shift schedule	60	48	12
Total operational workers	85	68	17

[1] *Special Use Permit Application* (Visus, 2009).
[2] Includes residents of the Nucla CCD, Town of Norwood and La Sal CDP.

Wages for most jobs at the Mill Facility would range between $40,000 and $75,000 per year, including benefits (Visus, 2009). Table 4.10-8 shows the typical wage range in western Colorado for a variety of occupations that would be required to operate the mill (CDLE, 2009). Note that the reported wages do not include benefits, which typically add 35 to 50 percent to an employee's annual compensation package.

Table 4.10-8
Annual Wages for Industrial-Facility Related Occupations in Western Colorado, 2008[1]

Occupation	Range of Annual Wages[2]
Electricians	$28,470 - $52,948
General maintenance and repair workers	$24,130 - $40,665
Industrial machinery mechanics	$38,097 - $55,130
Machinery maintenance workers	$28,395 - $60,708
Millwrights	$40.477 - $49,056
Office and administrative support occupations	$19,789 - $35,809
Office and administrative support supervisors	$25,358 - $51,539
Plant and system operators	$39,852 - $58,933

[1] Source: CDLE, 2009.
[2] Excludes benefits.

In addition to the direct employment, the Proposed Action would generate indirect employment by stimulating regional mining activities. According to the *Mine Operations Plan* for the Piñon Ridge Mill, approximately 228 workers would be employed mining and transporting ore to the Mill (see Table 4.10-9). Most of these jobs would be in counties that supply ore to the Mill. Energy Fuels anticipates that mines in Montrose, Mesa, and San Juan (Utah) counties would supply the majority of the feedstock to the Mill (Energy Fuels, 2009d). Table 4.10-10 shows typical wage ranges of mining-related occupations (excluding benefits) in Western Colorado.

Table 4.10-9
Indirect Employment Associated with Mill Operations[1]

Indirect employment source	Number of workers
Mining employment	210
Haulage contractors (truckers)	18
Total mining-related employment	228

[1] Source: *Mine Operations Plan* (Energy Fuels, 2009d).

Table 4.10-10
Annual Wages in Mining and Transportation-Related Occupations in Western Colorado, 2008[1]

Occupation	Range of Annual Wages[2]
Excavating and loading machine workers	$37,427 - $55,148
Extraction workers	$29,796 - $54,940
Transportation and material moving occupations	$21,246 - $42,515
Truck drivers, heavy and tractor trailer	$31,047 - $43,984

[1] Source: CDLE, 2009.
[2] Excludes benefits.

The IMPLAN model indicated that the mill would generate approximately 315 direct, indirect, and induced full- and part-time jobs in every year of its operation. Many of these jobs would be related to mining activities in Montrose and adjacent counties. Other jobs associated with economic activity generated by the mill would be located in commercial centers in Montrose County, including Naturita and Nucla. The modeling results also suggested that the project would generate $18.7 million annually in regional labor income and $140 million in regional business sales every year that the Mill is in operation (Berger, 2009).

Population Impacts. Operational workers are permanent employees who tend to settle in the area where their jobs are located. Energy Fuels anticipates that residents of the local area would comprise 80 percent of the mill's operational workforce. Because the mill is expected to attract fewer than 20 workers from outside the area, the Proposed Action would not be likely to cause substantial shifts in regional population distributions. It is likely that small communities near the Mill, including Naturita, Nucla, Bedrock, and Paradox, would see an influx of population.

Housing Impacts. Because of the small influx of new residents, the mill's operational workforce is not expected to face severe housing constraints that could lead to escalating housing prices in the local area. If indirect employment related to economic activity associated with the Mill led to further population gains, there could be short-term increases in housing prices. It is likely that the local housing market would respond relatively quickly to any increase in the demand for housing through the provision of new residential construction.

Community Services Impacts. Potential impacts to community services during operations include those related to schools, medical services, public safety, and water and wastewater services.

Schools. Because fewer than 20 operational workers are expected to relocate their families to western Montrose County, Mill operations would result in a relatively small increase in local school enrollments, well within the capacities of local schools.

Medical Services. Operation of the Mill Facility would not be likely to have an adverse impact on medical service providers in the local area. On-site emergency management systems would include an ambulance and heliport for emergency medical response. Treatment of on-site accidents would follow the Energy Fuels' *Emergency Response Plan* (Energy Fuels, 2009e). Energy Fuels expects that most emergency response actions at the Mill would be handled by trained employees under the direction of the RSO (Energy Fuels, 2009e).

Public Safety. The Proposed Action is not expected to have long-term adverse impacts on the provision of public safety services in the local area. Energy Fuels intends to implement several measures to insure site security during Mill operations as outlined in the *Security Plan* (Energy Fuels, 2009i). The portion of the site licensed for uranium processing would be surrounded by a chain-link fence topped with barbed wire. A secondary road would be constructed around the perimeter of the fence to allow for daily security inspections. All access points to the Site would be gated and controlled. A guardhouse would be installed near the main entrance to control all traffic entering the site from SH 90. The guardhouse would be manned 24 hours per day, 7 days per week (Visus, 2009).

The handling of on-site emergencies during operation would follow Energy Fuels' Emergency Response Plan, which was developed in consultation with local law enforcement agencies and fire departments to insure that adequate personnel and equipment would be available to support emergency response efforts (Energy Fuels, 2009e). As discussed previously, Energy Fuels would also conduct training sessions with local responders to establish procedures and methods for dealing various potential incidents. On-site fire management systems include a firewater loop with hydrants and hose reels. Sprinkler systems and fire extinguishers are also located in the various buildings, where appropriate (Visus, 2009).

The small influx of operational workers into the local area would not be likely to increase the response demands placed on local law enforcement officials.

Water and Wastewater Services. Operation of the Mill Facility is not expected to have an adverse impact on water or wastewater treatment facilities in the local area. During operations, groundwater would be used for process components, dust suppression systems, the truck wash, fire hydrants, and water trucks. At a processing rate of 500 tpd, the Mill's process water and potable water consumption rate is estimated to be 144 gpm. This corresponds to a daily consumption rate of 207,360 gallons per day. In the event that groundwater sources cannot supply the Mill Facility's full process water requirements, Energy Fuels has a backup purchase agreement with the Town of Naturita for a maximum of 150,000 gallons of untreated water per 24 hour period for up to 40 years (Energy Fuels, 2009f).

Energy Fuels intends to install a separate potable water system using water imported to the Site. Energy Fuels plans to purchase approximately 30,000 gallons of potable water per week from the Town of Naturita (Energy Fuels, 2009f). This represents less than 1 percent of the treatment plant's unused treatment capacity.

Process wastewater would be treated on-site and recycled in a zero discharge system as described in the *Water and Wastewater Plan* (Energy Fuels, 2009f). Sanitary wastewater would

be conveyed to an on-site septic system for treatment, and the Proposed Action would not require wastewater service from a public wastewater treatment system (Energy Fuels, 2009f).

The anticipated influx of new residents associated with operations is not likely to be large enough to impact local water and wastewater treatment facilities. The Mustang Water Authority's water treatment plant currently uses 25 percent of its capacity (Carter, 2009). Wastewater treatment plants in both Naturita and Nucla currently use approximately 30 percent of their respective capacities (Carver, 2009; LaBondy, 2009).

Fiscal Conditions. Spending associated with operations would result in annual sales tax revenues of approximately $241,516 to the State of Colorado, $120,000 to Montrose County, and $58,841 to each of the towns of Naturita and Nucla (see Table 4.10-11). These estimated sales tax revenues consider direct spending by the Mill on expenditures that Energy Fuels expects would be subject to sales tax (Vigil, 2009) and 62.9 percent of estimated disposable income derived from mill operations (Berger, 2009). This analysis assumed that commercial and retail opportunities expand in Naturita and Nucla during Mill operations, and that 20 percent of taxable household spending would occur in each of these two towns. Although some household spending associated with income derived from Mill operations is likely to occur outside Montrose County, not enough is know about where this spending would occur to estimate sales tax revenues to other local governments.

Table 4.10-11
Estimated Annual Sales Tax Revenues - Operational Phase

Taxing entity	Annual Sales Tax
Colorado sales tax[1]	$241,516
Montrose County sales tax[2]	$120,000
Naturita sales tax[3]	$58,841
Nucla sales tax[3]	$58,841

[1] Includes sales tax on taxable mill expenditures and 62.9 percent of household spending.
[2] Assumes that 80 percent of taxable spending occurs in Montrose County.
[3] Assumes that 20 percent of taxable household spending occurs within town limits.

The annual property taxes that would be paid on the Mill Facility are estimated to range between $1.9 million in Year 1 and $1.1 million in Year 10 over the first 10 years of the Mill's life (see Table 4.10-12). Property taxes were estimated by multiplying the property value of the Mill Facility by the assessment rate and then by the 2008 mill levy. Energy Fuels provided information concerning expected real and personal property values, including annual depreciation schedules, at the Mill (Vigil, 2009).

Table 4.10-12
Estimated Property Taxes During First Ten Years of Mill Operation[1]

Tax-Paying Year	Montrose County General[2]	RE 2 West End School District	Montrose Library District - Naturita	Southwest Water Conservation District[2]	San Miguel Water Conservancy District[2]	Total Property Taxes
Year 1	$701,375	$1,007,718	$148,914	$8,398	$2,022	$1,868,428
Year 2	$666,647	$957,822	$141,541	$7,982	$1,922	$1,775,913
Year 3	$631,918	$907,925	$134,167	$7,567	$1,822	$1,683,399

Tax-Paying Year	Montrose County General[2]	RE 2 West End School District	Montrose Library District - Naturita	Southwest Water Conservation District[2]	San Miguel Water Conservancy District[2]	Total Property Taxes
Year 4	$597,190	$858,028	$126,794	$7,151	$1,721	$1,590,885
Year 5	$562,462	$808,131	$119,421	$6,735	$1,621	$1,498,370
Year 6	$527,733	$758,235	$112,047	$6,319	$1,521	$1,405,856
Year 7	$493,005	$708,338	$104,674	$5,903	$1,421	$1,313,341
Year 8	$474,236	$681,371	$100,689	$5,679	$1,367	$1,263,341
Year 9	$439,508	$631,474	$93,315	$5,263	$1,267	$1,170,827
Year 10	$404,780	$581,577	$85,942	$4,847	$1,167	$1,078,313

[1] Estimates based on information provided by Vigil, 2009 and Montrose County, 2009d.
[2] Tax district is subject to TABOR revenue caps.

It is important to note that these property tax estimates are based on 2008 mill levies, which may change over the life of the project. In particular, taxing districts that are subject to revenue limits set by the Colorado Taxpayers' Bill of Rights, also known as the TABOR Amendment, are required to adjust their mill levies downward if an increase in assessed valuation causes that tax entity to exceed its TABOR revenue cap. The calculation of TABOR revenue caps takes into account an inflationary cost adjustment, population growth, and new construction. Montrose County, the Southwest Water Conservation District, and the San Miguel Water Conservancy District are subject to TABOR revenue restrictions. Therefore, an increase in assessed valuation that caused the property tax revenues to any of these districts to exceed their TABOR limit would require that the tax district lower its mill levy, thereby lowering the property tax liability of all taxpayers in the district. The RE-2 West End School District and Montrose County Library District have "de-Bruced" and can keep additional tax revenues that would result from increasing assessed valuations (CDOLA, 2009e).

4.10.1.2.3 Closure

Workforce. Mill closure would result in the loss of the 85 operational jobs. Some mill workers, such as supervisors, radiation program workers, and equipment operators could be retained through the project's closure phase. Energy Fuels expects that decommissioning and reclaiming the Mill Facility would be conducted over approximately a 3-year period. The typical daily workforce would include approximately 10 people: seven equipment operators performing the reclamation work, and three supervisory/radiation program workers. Daily crew size could range from two to 15 operators, depending on the amount of scheduled work as discussed in the *Mill Decommissioning and Reclamation Cost Estimate* (Energy Fuels, 2009h). Given its small size and the availability of skilled mill employees trained in radiation protection procedures, it is likely that the closure workforce would be comprised of local workers that worked at the Mill during the operations phase.

Current wages for equipment operators are approximately $18.75 per hour (Energy Fuels, 2009h). This corresponds to an average wage rate of $39,000 per year, excluding benefits. Wage levels are likely to change considerably by the time scheduled Mill closure would occur in the year 2052.

Population. In the event that former mill workers would have to leave western Montrose County in order to secure employment, Mill closure could lead to population losses in local communities. If local economies expanded and diversified over the Mill's 40 year operational life, it is likely that potential population losses due to Mill closure would be mitigated by job

creation in other local businesses. Subsequent socioeconomic impacts associated with Mill closure would largely depend on potential population losses, which, in turn, would be influenced by the amount of economic development that occurs in western Montrose County over the next 42 years.

Housing. Potential population losses associated with Mill closure would result in depressed housing market conditions; that is, falling housing prices and slowing residential sales. Depending on the size of the local economy, Mill closure could result in falling housing prices regardless of out-migration.

Community Services. Population losses due to Mill closure could result in falling school enrollments. Mill closure would not be expected to have an adverse impact on medical service providers and public safety officials, nor on local water and wastewater treatment facilities.

Fiscal Conditions. Based on current tax rates, over the 33 month closure period, sales and use tax revenues associated with closure would include $194,868 to the State of Colorado, $116,687 to Montrose County, and $2,612 to each of the towns of Naturita and Nucla (see Table 4.10-13). Energy Fuels estimates that it will spend approximately $6,458,400 on rocks and sand products during closure (Energy Fuels, 2009h). This analysis assumes that these materials would be purchased in Montrose County. An estimated $662,857 in total labor income would be associated with mill closure. Estimated sales tax revenue from household spending is based on adjustments to total labor income to consider the portion of disposable income spent on taxable items only.

Table 4.10-13
Estimated Sales and Use Tax Revenues – Closure Phase

Taxing Entity	Estimated Sales and Use Tax
Colorado sales and use tax[1]	$194,868
Montrose County sales and use tax[2]	$116,678
Naturita sales tax[3]	$2,612
Nucla sales tax[3]	$2,612

[1] Includes sales tax on taxable mill expenditures and 62.9 percent of household spending.
[2] Includes sales tax on taxable mill expenditures and assumes that 80 percent of taxable household spending occurs in Montrose County.
[3] Assumes that 25 percent of taxable household spending occurs within town limits.

Based on the closure schedule for the Mill Facility, most of these revenues would be expected in the 2nd and 3rd years of closure as discussed in the *Mill Decommissioning and Reclamation Cost Estimate* (Energy Fuels, 2009h). Final closure would result in the loss of sales tax revenue associated with mill expenditures and household spending of income derived from mill operations, and the loss of property tax revenue based on real and personal property values at the Mill Facility.

4.10.2 Protective/Mitigation Measures

Energy Fuels would implement the following measures to mitigate socioeconomic-related impacts resulting from the Proposed Action:

- Energy Fuels would encourage contractors to employ local workers on construction crews to minimize impacts on short-term housing and community services caused by an influx of temporary workers.
- Energy Fuels would encourage skilled tradesmen from the local area (e.g. electricians, instrumentation workers, boiler makers, and mechanics) who are part of the mill's construction workforce to transition to permanent positions on the mill's maintenance crews to minimize impacts on community services due to population fluctuations.
- Energy Fuels would minimize the demand on local emergency responders through implementation of the *Emergency Response Plan* (Energy Fuels, 2009e).
- Site security measures would include a security fence with limited access points, a manned guardhouse at the site entrance to control all traffic entering the Site from SH 90, and a secondary road around the perimeter of the fence to allow for daily security inspections which would minimize impacts of law enforcement officials caused by security breaches. These measure would be implemented according to Energy Fuels' *Security Plan* (Energy Fuels, 2009i).

4.10.3 Monitoring

No monitoring has been proposed for mitigation measures related to socioeconomic-related impacts.

4.11 PUBLIC AND OCCUPATIONAL HEALTH

4.11.1 Environmental Impacts

4.11.1.1 General Impacts

Through the life of the Mill, the Mine Safety and Health Administration (MSHA) and CDPHE would be the primary health and safety regulators (MSHA for nonradiological issues and CDPHE for radiological issues). The governing agencies, their respective regulations, and the subjects of the various regulations include, but are not limited to:

- **Mine Safety & Health Administration (30 CFR)**
  - Subpart C (Part 56.4), Fire Prevention and Control (Flammable and combustible liquids and gases)
  - Subpart D (Part 56.5), Air Quality and Physical Agents (exposure limits, monitoring, control, and restricted chemicals
  - Subpart K, Metal and Nonmetal Mine Safety and Health
  - Subpart O (Part 56.16), Materials Storage and Handling
  - Part 56.20014, Prohibited areas for food and beverages (toxic material areas)
  - Mine Improvement and New Emergency Response Act of 2006 (MINER Act), (Emergency Response Plan requirement)

- **Colorado Department of Public Health and Environment**
  - 6 CCR 1007-1, Part 3, Licensing of Radioactive Material
  - 6 CCR 1007-1, Part 4, Standards for Protection against Radiation
  - 6 CCR 1007-1, Part 18, Licensing Requirements for Uranium and Thorium Processing

- **Environmental Protection Agency (40 CFR)**
  - Part 61, Subpart W, National Emissions Standards - Radon from Mill tailings

  - Part 68, Chemical Accident Prevention Provisions.
  - Part 190, Environmental Radiation Protection Standards For Nuclear Power Operations
  - Part 192, Health And Environmental Protection Standards For Uranium And Thorium Mill Tailings
  - Part 302, Designation, Reportable Quantities, and Notification
  - Part 355, Emergency Planning and Notification.

- **Colorado Dept of Labor and Employment, Division of Oil and Public Safety**
  - 7 CCR 1101-5, Boiler and Pressure Vessel Regulations
  - 7 CCR 1101-14, Storage Tank Regulations

- **U.S. Department of Transportation and Colorado Department of Transportation**
  - 49 C.F.R., Parts 100 – 185
  - 2 CCR 601-8, Traffic Regulations Governing the Use of the Tunnels on the State Highway System
  - 8 CCR 1507-25, Rules and Regulations Concerning the Permitting, Routing & Transportation of Hazardous and Nuclear Materials and the Intrastate Transportation of Agricultural Products in the State of Colorado

Throughout construction and operation of the Mill Facility as well as during closure and post-closure monitoring, Energy Fuels would be required to implement radiological and safety programs that comply with 6 CCR 1007-1 to protect the health and safety of workers and the public. CDPHE and MSHA would review, approve, and enforce these plans, requiring revisions and updates, where necessary, throughout the life of the Mill Facility. The plans include:

- *Facility Operating Plan* (Visus and Energy Fuels, 2009a). This plan provides a comprehensive narrative of the Mill Facility design, operation, system controls, and maintenance procedures for each mill component. At the start of milling operations, comprehensive operating procedures would be developed for each area of the Mill to guide mill operators in performing routine and non-routine tasks.

- *Health and Safety Plan* (Energy Fuels, 2009h). This plan is designed to inform mill personnel of the rules, procedures, and work practices that are in place to protect them from injury. The plan presents the following information: guidelines for reporting unsafe conditions in the workplace; policy on employee conduct; safety personnel organizational structure; use of personal protection equipment; health and safety programs and procedures (e.g., HazCom Program, Administrative Procedures, General Health and Safety Procedures, and Radiological Health and Safety Procedures); and procedures for radiation work permits.

- *Operational Monitoring Plan* (Visus and Energy Fuels, 2009b). This plan presents the protocols for ongoing monitoring of environmental resources, process waste attributes and controls, and Health and Safety aspects during operation of the Mill Facility. Specifically, this plan provides monitoring schedules and procedures to assess radiation doses and the radionuclides in the mill effluents and environment during operations.

- *Emergency Response Plan* (Energy Fuels, 2009e). This plan identifies possible incidents (i.e., fire/explosion, chemical spill, transportation accident; medical, severe weather) that may occur and provides identification, response, and notification procedures for those incidents. The plan identifies the responsibilities of personnel in the

event of emergencies and describes on-site and off-site protective actions. The plan lists the required response equipment that would be available to personnel, and describes the required training of on-site personnel. It also includes provisions for annual on-site emergency response training exercises with local response personnel including firefighters, medical personnel, and members of the county sheriff's department.

- *Material Containment Plan* (Energy Fuels, 2009c). This plan provides employees with information to safely store and handle materials necessary for milling uranium and vanadium as well as information regarding expedient and comprehensive spill response procedures. The materials include chemical reagents, fuels, ore, processing streams, and tailings and raffinate waste streams. The plan provides detailed Material Safety Data Sheets for the various materials, which include information, such as: potential health hazards, potential safety/environmental hazards, handling methods, first aid procedures, containment requirements, maintenance requirements, and spill response and notification.

- *Spill Prevention, Control and Countermeasure Plan* (Energy Fuels, 2009b). The SPCC Plan provides spill response and reporting procedures for petroleum products including diesel and gasoline fuels, motor oil, hydraulic oil, transmission fluid, and used oil. The plan provides procedures for preventive maintenance (tank and containment system integrity, security, buried pipe protection, secondary containment protection, field repairs, spill containment kits) and procedures for transfer operations. Energy Fuels would provide SPCC training as a part of every new employee's training.

Prior to working at the Mill, employees would be required to take 40 hours of comprehensive MSHA training that focuses on both nonradiological health and safety concerns and appropriate safeguards at the Mill. Additionally, employees who work in radiological control areas would be trained as "radiation workers" in accordance with 6 CCR 1007-1, Part 4 (CDPHE, 2005b). During this time, they would be trained in the requirements and procedures of the plans described above. New employees would receive additional hands-on task training in the mill from mill supervisors, safety personnel, and senior operators. Safety refresher courses would also be given periodically by safety and operations personnel on a routine basis. Annual retraining would be conducted as required by MSHA and CDPHE. Qualified employees would be given the opportunity to take more advanced emergency response training including use of self-contained breathing apparatus and emergency medical procedures.

Routine operation of the Mill would result in nonradiological and radiological impacts to mill workers, surrounding flora and fauna, and the general public. These impacts, which are quantified in this section of the ER would be small. This section also examines the potential for accidents and possible impacts resulting from accidents.

4.11.1.1.1 Nonradiological Impacts

Nonradiological impacts to public and occupational health include the potential for accidents and exposure to chemical reagents, fuels, feedstock, and process and waste streams during construction, operations, and closure of the Mill. The potential for accidents and exposures to chemicals would be minimized by implementation of and adherence to the federal and state regulations governing health and safety at the Mill Facility.

4.11.1.1.2 Radiological Impacts

As provided in Section 3.11, radiation is energy given off by matter in the form of rays or high-speed particles. Radiation that originates from cosmic rays, radon in the air, naturally-occurring

radioactive materials in soil, water and food such as uranium, and other naturally occurring radionuclides can damage plant, animal, and human cells. For exposure to low levels of radiation, the impacted cells may not be damaged or the damage may be repaired within the cell. However, a high radiation dose may cause physical damage within the cell or the cell may become cancerous years later. Similar to many chemical agents, as the radiation dose increases, the potential for physical damage and illness increases.

Radioactivity is the number of atoms in the material that decay and release ionizing radiation in a given time period. The amount of energy deposited in living tissue by ionizing radiation is called the “dose” and is measured in millirems (mrem). On average, people living in Colorado receive a dose of about 400 mrem each year from natural background radiation. Approximately two-thirds of this background dose originates from radon in the air with the remainder comprised of cosmic radiation, radioactive carbon, and potassium contained within the body, and gamma radiation emitted by radioactive materials in the ground (i.e., radium, uranium, and thorium).

Under CDPHE regulations (6 CCR 1007-1, Part 4.6.1.1), mill workers are limited to an annual radiation exposure limit of 5,000 mrem/year. Today, the annual effective dose (i.e., incremental dose above background) received by a mill worker is typically less than 100 mrem/year. The maximum exposure limit set by CDPHE, codified at 6 CCR 1007-1, 4.14, (as well as the NRC) (10 CFR 20, Subpart D-Radiation Dose Limits for Individual Members of the Public) for the general public at the Property Boundary and beyond is 100 mrem/year above background. Adherence to this limit is verified through sampling and monitoring. Exposure at the nearest residence is expected to be 10 mrem/year or less. Given that the nearest downwind residents are located 3 to 4 miles east of the property (see Figure 3.10-2), it is unlikely that an increase in radiation above background levels could be detected at these locations. The exposure limits for mill workers and the general public have been set conservatively by regulatory agencies based on input from health professionals and numerous health studies. Energy Fuels must maintain radiation levels below these regulatory limits.

Radiological impact of mill operations to the mill employees and visitors would be managed, measured, assessed and documented by the Radiation Safety Officer (RSO) and staff. Doses are determined from mill area air samples, breathing zone air samples, uranium in urine bioassay samples, and by direct measurement of radiation in the Mill. Procedures for collecting the samples and making the measurements are presented in the *Health and Safety Plan* (Energy Fuels, 2009h). Radiation doses would be evaluated regularly, including on a daily basis for some operations. Employee dose reports from the RSO would be sent to employees. Additionally, copies would be sent to mill management and to the Radiation Safety Committee to ensure doses are being maintained “as low as reasonably achievable” (ALARA).

4.11.1.1.3 Accident Scenarios

A list of possible radiological and nonradiological accident scenarios associated with construction and operation of the Mill Facility are provided in Table 5.1 of the *Risk Assessment* (SENES, 2009a). Accidents occurring at the Mill Facility may include fire, explosion, chemical releases, or involve transportation. Accidents involving chemical reagents or process solutions may expose workers and/or the public to radiological and nonradiological impacts from inhalation or ingestion, skin or eye irritation, or mild to serious burns. To limit the possibility and seriousness of accidents and to provide for response action in the event of an accident, Energy Fuels has prepared and would implement various health and safety plans, described above. The plans will help ensure that (SENES, 2009a):

- The normal operation of the mill is safe for workers, members of the public, and is protective of the environment, and that potential impacts from radioactive and other hazardous materials will be maintained ALARA.
- The frequency and probability of accidents and malfunctions are reduced; and
- During a potential accident and malfunction event, the consequences and potential impact to health, safety, and environment will be minimized.

Additional information regarding the risks associated with possible accidents during milling operations is presented in Section 4.11.1.3.3.

4.11.1.2 Construction

4.11.1.2.1 Nonradiological Impacts

Nonradiological public and occupational health impacts during construction of the Mill Facility would be similar to those at any construction site. The risks of events such as trips and falls, strains, electrocution, crushing, and pinching associated with project activities such as working at heights, working with heavy equipment both during construction and during routine operation of the plant would not be different from those on any other industrial project of similar scope and duration (SENES, 2009a). Potential spills during construction would likely be associated with equipment refueling and maintenance. Construction contractors would be required to have and implement a Health and Safety Plan and a SPCC Plan. The Health and Safety Plan would meet MSHA requirements under 30 CFR Subpart K and the SPCC Plan would meet EPA's requirements under the Oil Pollution Prevention regulation (40 CFR Part 112).

Montrose County and the State would inspect the Mill Facility buildings; the State would conduct electrical and gas inspections and the County would inspect the structural components. Occupancy would be permitted if the buildings pass the inspections.

4.11.1.2.2 Radiological Impacts

Radiological impacts above the naturally-occurring radiological baseline conditions at the Site (see Section 3.11), would be minimal during the construction period. Ore could be delivered ear the end of the construction period, but it would not be processed until the Mill is operational. Fugitive dust from stockpiled ore would be controlled through the use of water sprays and chemical dust suppressants, as necessary. A temporary license boundary would be established around the ore pad and radiological controls would be implemented for personnel and equipment entering and leaving the licensed area.

4.11.1.3 Operations

4.11.1.3.1 Nonradiological Impacts

<u>Mill Workers and General Public</u>

As discussed above, trips, falls, strains, electrocution, crushing, and pinching associated with project activities such as working at heights, working with heavy equipment, and working around moving parts and electrical systems would all present potential hazards during operations. Additionally, the Mill Facility would use a variety of chemical reagents and other materials, which would be delivered from offsite vendors on a routine basis and stored onsite. Table 4.11-1 provides a list of the more common materials that would be used and stored onsite. Standards for the use and storage of nonradioactive, hazardous chemicals are promulgated and enforced by federal and state agencies such as MSHA, CDPHE, CDOPS, and the EPA. Specific

quantities or uses of chemicals that require certain controls, procedures, safety measures, or reporting protocols are defined in the standards.

Table 4.11-1
Materials that May Be Used or Stored Onsite

Material	Purpose	Maximum Quantity On-Site	Storage Location
Kerosene	Uranium Solvent Extraction	38,100	West of Solvent Extraction Building
Anhydrous Ammonia	Vanadium Solvent Extraction	12,000	West of Solvent Extraction Building
Ammonium Sulfate	Vanadium Precipitation and Packaging	6,280 cubic feet (solid power) and 11,800 gallon (solution)	Precipitation and Packaging Building
Sodium Hydroxide	Vanadium Solvent Extraction	1,100 gallons (50% Solution) and 4,500 gallons (8% Solution)	Solvent Extraction Building
Sodium Carbonate	Uranium Solvent Extraction Vanadium Solvent Extraction	26,400 gallons of slurry (31% by weight) 15,200 gallons dilute solution (15% by weight) 68,00 lbs (1,100 CF) (dry, temporary while delivered only, not sorted on-site as a solid)	Southeast of Precipitation and Packaging Building
Sulfuric Acid	Leach Circuit	258,000 gallons	Southeast of Mill Facility
Sodium Chlorate	Vanadium Solvent Extraction Leach Circuit	98,100 gallons (3% by weight)	Precipitation and Packaging Building
Hydrogen Peroxide	Uranium Precipitation and Packaging	7,100 gallons	Precipitation and Packaging Building
Alamine 336	Uranium Solvent Extraction	1,100 gallons	Warehouse
Isodecanol	Uranium Solvent Extraction	1,100 gallons	Warehouse
Diesel Fuel	Equipment Fuel	15,900 gallons	Northwest of Solvent Extraction Building
Gasoline	Equipment Fuel	2,000 gallons	Northwest of Solvent Extraction Building
Propane	Heating	36,000 gallons	West of Reagent Unloading Area Administration Building

The materials would be delivered to the Site by licensed haulers in USDOT-approved containers. These materials and fuels would be stored on-site in closed tanks and/or weatherproof buildings. The containers would be properly labeled and meet applicable storage regulations for the stored media, including secondary containment. Energy Fuels employees and contractors would be trained based on the plans listed above in proper handling, storage and use of the chemicals, reagents and fuels consumed on-site.

Chemicals, reagents and diesel fuel would be delivered to an area located outside the restricted area (i.e., Mill License Boundary) so that delivery trucks would not have access to mill process areas where licensed material is located and radiation levels are controlled and closely monitored. Trucks delivering chemicals and fuels to the Mill Facility would park within a concrete

apron that would be curbed and would drain to a containment area, and the storage tanks would be located within a reinforced concrete containment structure which would also protect them from vehicular traffic. Diesel and gasoline would be stored on-site in double-walled storage tanks situated within a common concrete containment, with a floor sump and protective aprons to collect spillage during fueling.

Bulk shipments of liquid reagents and fuels (e.g., sulfuric acid, sodium chlorate, kerosene, and diesel fuel) would be pumped to tanks that are located within various areas of the Mill Facility. Product lines, to the storage tanks and from the storage tanks to the processing buildings, are designed to be chemically resistant to corrosion (e.g., carbon steel or HDPE) and would be enclosed within a second line with leak detection. Process and reagent lines, which are not within a concrete secondary containment area, are placed inside an outer pipe sleeve, lined pipe rack, or lined trench. In each case, the secondary containment discharges into a concrete containment area with a double-contained floor sump. If the inner pipe develops a leak, the solution will drain by gravity to the double containment area and then to the sump. This system provides for containment and detection of leaks. Maintenance personnel would inspect leak detection points daily (Visus and Energy Fuels, 2009b).

Bulk shipments of dry chemicals and reagents such as sodium carbonate and ammonium sulfate would be blown or mixed with water to create a slurry and pumped into storage tanks located within the Mill License Boundary. Similarly, propane would be delivered directly to tanks located within a fenced area outside the Mill License Boundary. Packaged shipments of chemical reagents such as sodium hydroxide and diatomaceous earth would be offloaded at the warehouse along with parts, lubricants, and other chemicals needed in the daily operation of the Mill Facility. These products would be packaged in drums, plastic totes, and crates.

During operations, similar to many other industrial operations, releases of large amounts of hazardous chemicals (see Table 4.11-1), which could adversely affect public and occupational health and safety, are possible (SENES, 2009a). However, they are generally considered unlikely, given commonly applied safety practices, extensive and comprehensive regulations and the history of safe use of these chemicals. The frequency of catastrophic failure of large storage tanks are in the order of 10^{-4} per year (i.e., once every 10,000 years), while the frequency for catastrophic failure of pressure vessels, such as an ammonia storage tank, is in the order of 10^{-5} per year or once every 100,000 years for any similar tank or pressure vessel (Center for Chemical Process Safety of the American Institute of Chemical Engineers – CCPS, 1989). The risks associated with this class of events are no different than at any similar industrial facility, and are independent of the radiological characteristics of a uranium mill. In fact, the risks would be expected to be less than at similar industrial facilities due to the rigorous work control and training programs required at Atomic Energy Act licensed facilities.

Strong bases such as ammonia (NH_3) and sodium hydroxide (NaOH) and strong acids such as sulfuric acid (H_2SO_4) will strongly react with each other, and with water, if accidentally mixed. Therefore, their storage tanks would be located in separate secondary containment areas. In addition, precautions would be taken to ensure that these chemicals do not inadvertently come into contact with each other during operations. A spill of toxic or corrosive chemicals, such as sulfuric acid, inside the mill processing areas would pose no significant impact to the public; however, workers in close vicinity of the spill may come into contact with such chemicals. The application of common safety practices and associated safety training for handling and use of chemicals is expected to lower the likelihood of large release events and therefore lower the risk to acceptable levels.

The mill process areas, ore pad, tailings cells, and evaporation ponds are designed as "zero discharge" facilities. Accidents, while highly unlikely, involving the feedstock, the processing streams, or the waste streams could pose nonradiological risks to workers due to high temperatures and extremely low pH of some processing solutions. The risks would be mitigated by implementation of Energy Fuels' plans listed above. Emissions from the vanadium fusion and packaging circuit would be controlled through the use of scrubber systems to minimize worker exposure to particles of vanadium and other metals. The mill facilities with potential for release of dust or toxic fumes (e.g. dryers, precipitation tanks, leach tanks) would also be equipped with baghouses and/or wet scrubbers to minimize emissions of dust or fumes to the atmosphere (SENES, 2009a).

Catastrophic failure of a storage tank, as discussed above, is a very unlikely scenario. However, in a more probable accident, it is possible that the line connected to the storage tank could be ruptured, in which case the release rate would be substantially less. In either event, the *Emergency Response Plan* (Energy Fuels, 2009e) would be implemented to protect workers and the public, as well as to provide containment and control over the release. Procedures for safely responding to releases of various chemicals are provided in the *Material Containment Plan* (Energy Fuels, 2009c).

The impact of the use and handling of hazardous chemicals during routine mill operations on the members of the public and wildlife is expected to be zero. SENES prepared a *Risk Assessment* for the project in which multiple accident scenarios were identified and the non-radiation and radiation risks were quantified based on frequency and severity of impact. Overall, the off-site impacts of credible accidents involving hazardous chemicals were determined to be small, while impacts to workers could be moderate (SENES, 2009a). However, the risks of on-site impacts to workers would be mitigated by formal and rigorous training requirements and operational and emergency response procedures.

Wildlife

The tailings and raffinate solutions in the tailings cells and evaporation ponds can be acutely and chronically toxic to wildlife because of their low pH and elevated metal concentrations (Visus, 2009). The liners would also be slick and relatively steep (3H:1V), which could prevent larger hoofed mammals from exiting a tailings cell or evaporation pond should they accidentally enter the area. Therefore, wildlife would be excluded from the tailings cells and evaporation ponds by implementation of the following measures.

- A 6-ft high chain-link fence topped by three strands of barbed wire would be installed around the entire perimeter of the tailings cells and evaporation ponds. The fence would be inspected daily and repaired, as necessary, to prevent access to the area by wildlife.
- Bird balls would be placed on top of the ponded portion of the tailings area to prevent birds from landing on the water. The hollow balls are made of plastic and float on top of the water concealing the water surface and creating a physical barrier.
- Woven bird netting would be installed over and along the sides of the evaporation pond network. The bird netting has two-inch openings and is clipped to stainless steel cables suspended in a grid between wooden support poles. The 25-ft long wooden poles are implanted 8.5 feet into the ground (i.e., the netting is located 16.5 feet above ground) and supported by wire strung from a series of concrete anchor points.

- Mill personnel would inspect the tailings cells and evaporation ponds on a daily basis. As part of their inspection, they would identify and record any wildlife mortalities and, where possible, implement measures to reduce or eliminate future occurrences.

4.11.1.3.2 Radiological Impacts

The potential for radiological impacts exists throughout the various operations required to process uranium. Risks would be avoided or mitigated through implementation of the mill design and health and safety plans which are presented in the license application. These plans were designed to comply with the following regulations and related guidance:

- CDPHE 6 CCR 1007 -1 Parts 4 – Standards for Protection Against Radiation
- CDPHE 6 CCR 1007 -1, Part 18 - Licensing Requirements for Uranium and Thorium Processing
- CDPHE 6 CCR 1007 -1, Part 18, Appendix A - Criteria Relating to the Operation of Uranium Mills and the Disposition of the Tailings or Wastes From These Operations
- US EPA 40 CFR 190 – Environmental Radiation Protection Standards for Nuclear Power Operations
- U.S. EPA 40 CFR 192 – Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings
- U.S. EPA 40 CFR 61, Subpart W – National Emissions Standard for Radon Emissions from Operating Mill Tailings
- American National Standards Institute Practices for Respiratory Protection, ANSI Z88.2
- U.S. Nuclear Regulatory Commission Regulatory Guide 8.30 - Health Physics Surveys at Uranium Recovery Facilities
- U.S. Nuclear Regulatory Commission Regulatory Guide 8.31 – ALARA Programs at Uranium Recovery Facilities
- U.S. Nuclear Regulatory Commission Regulatory Guide 8.22 – Bioassay at Uranium Mills
- MSHA 30 CFR 57.5037 to 57.5047 – Radiation Protection Standards (as may be applicable to surface operations)

Radiological Exposure Pathways – General

Energy Fuels has provided a *Radiological Exposure Pathways Report* (Savignac, 2009a), which describes the activities associated with the Mill Facility that may result in radiation exposure to the individuals working at the mill or the public near the Mill. Excerpts from that report follow.

Radiological exposure pathways originate with a source of radioactive materials. The radionuclides pass through an exposure medium, such as air or water, are transmitted and produce a radiation dose to plants, animals, and/or humans. The potential sources of radionuclides at the Mill Facility are discussed below:

- Of the 15 radionuclides presented in the uranium-238 decay series, the following radionuclides have sufficiently long half-lives to be transferred from their source, through the exposure medium to plants, animals, and/or humans:
    - U-238
    - U-234
    - Th-230
    - Ra-226
    - Pb-210

- U-238 and U-234 would be largely present in the Mill where the uranium is separated from the ore and concentrated to create the final product, yellowcake, which consists mainly of $U0_3$ and $U0_4$ and their hydrates. The yellowcake would be packaged in drums and shipped via truck from the Mill Facility for further processing. Yellowcake would be a source of exposure to humans inside the mill from process liquids leaking and drying on equipment and the floor and during the drying and packaging process.

- U-238, Ra-226, Th-230, and Pb-210 would be present in the dust generated by ore transfer operations at the ore pad. Rn-222 would also be released from the ore present on the ore pad. Dust may be generated at the ore pad by truck travel on the ore pad, dumping the ore from truck onto the pad, and picking up the ore and dumping it into the grizzly. Dust would also be generated from wind erosion of the ore pile. The fugitive dust and radon would be pathway sources for exposure to humans and animals. Dust from these operations would be controlled with water sprays.

- Ra-226, Th-230, Pb-210 and limited amounts of U-238 and U-234 would be present in the tailings placed in the tailings cells. No more than two 40-acre cells may be open at any one time (NESHAPS regulations in 40 CFR 61) and available for dusting. In the case of the Mill Facility, no more than two of the 30-acre cells would be open at one time, limiting the exposed tailings beaches to 60 acres. Sprinkling of tailings solution or raffinate on the beaches would minimize dust generation but some tailings solids may dry out on the beaches and become airborne. Radon would be produced from the beaches and, to some degree, from tailings solutions. The dust and radon would be pathway sources for exposure to humans and animals. Liquids containing these sources would be prevented from entering pathways to plants, animals, and/or humans by the lining system under the tailings.

- Th-232 and its decay products may be present in some uranium ores. The decay chain consists of 12 elements of which radium and thorium are long-lived radionuclides. Because ore would be coming from a variety of mines in the area and thorium exists in limited quantities in a few of the ores, only limited amounts of Th-232 would be anticipated in the mill feed. Th-232 would pass through the mill and would be discharged and contained within the lined tailing impoundment. Until such time as Th-232 would be present in large quantities in ore sent to the mill, Th-232 in ore dust and/or in tailing dust would not be considered a major pathway for radiation exposures.

- Uranium decay series elements would be present in low concentrations in the uranium ore processed at the mill. The Mill Facility would have four stacks that would release particles of uranium and its progeny:

    - The semi-autogeneous grinding (SAG) mill process vent stack from the SAG mill dust scrubber
    - The leach train vent gas scrubber stack
    - The vanadium dryer dust collector and packaged bed scrubber stack

    These four stacks would release limited quantities of radionuclides from effluent control systems in the Mill as documented by Kleinfelder (2009i) and Two-Lines (2009). These stacks would be considered minor pathway sources. The uranium vacuum dryer is a zero discharge system and would not emit radionuclides.

Radiation Exposure Pathways – Mill Workers

The pathways that may result in radiological impact to mill employees and visitors would be exposure to gamma rays from radionuclides in the Mill and exposure from the inhalation of yellowcake dust, ore dust, and radon progeny. The radiological risks associated with the individual milling operations are described below according to their potential exposure pathways (i.e., air, water, flora/fauna). An analysis of the possible radiological accident scenarios follows the exposure pathways discussion.

Air Exposure Pathways. Inhalation would be the main pathway of radionuclides from the Mill Facility to employees and people in the vicinity of the Mill. Airborne radioactivity may be generated during the individual milling activities: 1) ore receiving/grinding, 2) leaching, 3) uranium recovery, and 4) during tailings disposal. Transportation of ore and yellowcake may also result in airborne radioactivity.

Ore Receiving/Grinding. The ore pad, located outside the mill buildings, is where the ore would be unloaded from the ore trucks for temporary storage before being transferred to the mill feed and grinding circuits. Typically, the ore would be delivered to the dumping platform where the trucks would dump their ore without entering onto the ore pad and the restricted area of the licensed facility. However, there may be an occasion where the ore would be delivered directly to the ore pad. Should it be necessary for an ore truck to enter onto the ore pad, it would be decontaminated in the truck wash and scanned before leaving.

Upon delivery to the dumping platform or the ore pad, the ore could be moist or dry depending on its source. The surface of the ore can dry quickly, especially in the warmer summer months, which could result in the generation of wind-blown dust. Water sprays and/or misters would be used at the dumping platform and the ore pad to minimize fugitive dust emissions during unloading and ore handling. The dumped ore would be moved to the ore stockpile area on the ore pad or directly to the feed hopper using front end loaders. During this transfer of the ore, fugitive dust would be controlled by spraying the stockpiles and roadways with water. Radon and particulates generated from ore handling and storage on the ore pads would be pathways to humans.

The ore would be moved to the ore feed system via a front end loader. The loader opening into the feed hopper building would be covered with a split, heavy-duty plastic curtain to minimize fugitive dust. In addition, a series of water sprayers or misters would provide for direct dust control at the grizzly. Within the feed hopper area, the primary dust control would be provided by a dust-collecting baghouse. The mill operations personnel would operate and maintain the baghouse dust collection system in compliance with the air quality permit issued by the Air Pollution Control Division of CDPHE. Particulates and radon from the ore feed system would present a potential pathway to humans.

Stationary air monitoring devices would be located in the ore handling areas to measure concentrations of uranium dust. Personnel working in these areas would wear breathing zone monitors to test the air they breathe and half-mask particulate (i.e., canister type) respirators if warranted. Additionally, the front-end loader operator may wear a breathing zone monitor within the loader cab.

The ore feed system would transfer the ore to the SAG mill where water would be added and the ore would be ground into a slurry. Particulate matter emissions are considered to be negligible in this area since the ore is mixed with water and ground into a slurry. However,

during this grinding process, radionuclides would be released to the air inside the mill. During operations, these emissions would be monitored by the mill RSO and staff and would be addressed in their evaluation of radiation doses to mill personnel. Ultimately, radon (Rn-222) would be discharged to the atmosphere by the mill ventilation system or by diffusion through the ventilation system and open doors and windows to the atmosphere, which would present potential pathways to humans. Particulate airborne emissions would be sent to a dust collector and mill stack, which would be another potential pathway.

A stationary air monitoring device would be located at the SAG Mill feed point to measure concentrations of uranium dust. Personnel working in the SAG Mill area would wear breathing zone monitors on occasion to test the air they breathe. They would also be provided with canister-type particulate respirators for use in dustier locations.

Leaching and Solvent Extraction. The slurried ore from the SAG mill would be temporarily contained in two large pulp storage tanks and then fed into the leaching, thickening, and clarifying units that feed the solvent extraction system where uranium and vanadium are recovered and concentrated. These are all wet processes that do not generate dust. Some dust could be generated if spills in any of these areas are allowed to dry out. In the pre-leach and leach circuits, sulfuric acid and radionuclide emissions would be sent to a scrubber that would be vented through a stack, presenting a potential pathway. Maintenance and operations personnel working inside the leach building, counter current decantation pump house, and solvent extraction buildings would, at times, wear breathing zone monitors to test the air they breathe. Stationary air monitoring devices may also be utilized in these buildings if warranted by data obtained from the breathing zone monitors.

Uranium Precipitation and Packaging. A stationary air monitoring device would be located in the solvent extraction building to measure concentrations of radioactive dust particles that could result from dried leaks or spills. Mill personnel working in this area may also be required to occasionally wear breathing zone air samplers.

The precipitation tanks would be completely enclosed. When reagents are added to the solution, acidic and caustic fumes would be generated. These fumes would be vented to the wet Venturi scrubber located in the northeast end of the precipitation and packaging building. The system would consist of a suction fan, gas scrubber, and a scrubber pump that recycles the captured particles in the bottom of the scrubber to the pre-leach circuit. The scrubbed air would be vented to the atmosphere through a stack. The scrubber system would be electrically interlocked with the feed pumps so that the circuit would shut down if the emission controls are not operating.

The yellowcake packaging area would have its own heating, ventilating, and air conditioning system, and two sets of doors (vestibules) would remain closed at the exits to provide additional containment of air-borne particles. Only required operations personnel would be allowed within the packaging area and they would be required to wear appropriate personal protective equipment (PPE) including air-purifying respirators, gloves, and coveralls. A viewing area would be provided above the packaging area for guests and non-operations personnel. The packaging area would be routinely washed down to prevent the accumulation of dust on the surfaces of equipment and walls.

As air is heated and water evaporates in the yellowcake dryer, the moist air would be drawn through the dryer's baghouse unit where particles would be captured on the filter socks. When the socks become loaded, an automatic shaker would shake the sock cage and the dust would

fall back through the baghouse port into the dryer. The air flowing from the baghouse would be drawn by a vacuum to a condenser where the water and any remaining particulates would be removed from the air and pumped to the uranium thickener feed box. The clean air would be vented back to the yellowcake packaging room.

In addition to the dust and vapor control measures, a stationary air monitoring device would be located in the packaging area to measure concentrations of uranium in the air. Personnel working in the packaging area and drying room would wear breathing zone monitors and would be required to wear canister-type particulate respirators. Additionally, routine bioassays would be conducted on these personnel to determine the total uranium that has been inhaled and ingested.

Tailings and Raffinate Disposal. The mill tailings would be discharged from the milling operation and are the milling byproduct from which most of the uranium has been removed. The Th-230, Ra-226, and Pb-210 originally present in the ore would still be present in the tailings after the milling process. The tailings would be discharged from the mill as a sand-water slurry to the tailings cell where most of the tailings remain wet or damp. The presence of a pool of tailings liquid over a portion of the tailings cell would suppress the generation of tailings dust. However, solid tailings in the beaches above the pond water level could dry and become a source of wind-blown tailings particles, especially during the warmer summer months. The uncovered beach area is limited to 80 acres (two phased cells at 40 acres each) or less under federal regulations (40 CFR 61, Subpart W). In the case of the Mill Facility, the tailings cells are 30 acres each, limiting the exposed area to 60 acres total. Energy Fuels would minimize the generation of tailings dust by spraying tailings liquid over the solid tailings during operations. These solutions would contain high concentrations of salts and would be effective in forming a hard crust over the tailings. The liquid in the pond and the salt crust would suppress most of the radon emissions from the tailings (NUREG-0706, Vol. 1, p 5-8, footnote b). When a tailings cell has been filled to capacity, it would be capped with a soil cover to eliminate the potential for wind-blown tailings dust and reduce radon emissions to below federal (40 CFR 61, Subpart T) and CDPHE (6 CCR 1007-1, Part 18, Appendix A) mandated limits.

The stationary air monitoring devices installed to collect baseline air quality data would also function to measure concentrations of radioactive particulates generated from the tailings cells and evaporation ponds. These results would be compared with the Mill Facility's air emission permit limits. The air monitoring devices are located at three onsite locations and two offsite locations both east and west of the Mill Facility. Periodic windblown surveys would also be conducted to assess concentrations in the soil, both east and west of the tailings cells.

Equipment Released from the Mill. Equipment operating within the Mill License Boundary would be surveyed (and results documented) when leaving the site to prevent release of radioactivity above regulatory limits to be released to public areas. Any vehicle or equipment leaving the license boundary area would be scanned for radiation by a technician. If the piece of equipment passes the radiation scan, it would be allowed to exit the site. If the vehicle or piece of equipment does not pass the radiation scan, it would be directed to the truck wash station for decontamination. The truck wash would be a touchless system utilizing high pressure sprays to remove any dirt or mud.

Water Exposure Pathways. The Site is located in a semi-arid environment. There are no rivers or perennial streams near the Site, and groundwater is limited to the south portion of the Site and lies at approximately 400 hundred feet or more in depth. The dry washes that cross the Site from south to north occasionally contain running water for a short period of time after a

significant rain event. Engineering controls, such as diversion channels, would be used to direct this running water away from the facility limiting the potential for this water to come in direct contact with the mill infrastructure. Runoff from the zero-discharge area would be collected and contained on-site in the lined stormwater ponds, which would be monitored and maintained by mill personnel. The stormwater ponds would discharge to the evaporation pond should a large (i.e., plus 100-year) storm event occur (Kleinfelder, 2009a). Contaminants that might be carried in runoff from the Site would be contained within this system of surface drainage controls and disposed of in the stormwater and evaporation ponds. Because of the lack of inhabitants near the Mill Facility and the lack of waterborne sources of radioactivity, potential radiological impacts to humans from the surface water pathway is negligible.

The Mill Facility components that may provide water exposure pathways for radiation are identified and the associated protective features that have been designed for each are described below.

Ore Pad Facility. Approximately 1 acre of the ore pad would be lined with concrete and the remaining 5 acres would be lined with a geosynthetic clay liner covered with a protective layer of compacted native soils and roadbase (i.e., gravel) materials. The ore pad is designed as a zero-discharge facility with berms surrounding its perimeter to isolate drainage and with the pad base sloped to a lined stormwater pond. The stormwater pond is separated from the ore pad by a concrete sediment trap and sediments collected in the trap would be excavated as needed and placed back on the pad. The stormwater pond design incorporates a single composite liner system consisting of a HDPE geomembrane overlying a geosynthetic clay liner, overlying prepared subgrade soils. The pond is sized to contain runoff from the 100-year design storm event and pass the 1,000-year design storm event (to subsequent containment) with additional capacity provided by one foot of freeboard. Water collected in the stormwater pond would be pumped back onto the ore stockpile for dust control, as needed, or used in the mill process.

Process Lines. Process lines, which are not within a concrete secondary containment area, would be placed inside an outer pipe sleeve, lined pipe rack, or lined trench. In each case, the secondary containment would discharge into a concrete containment area with a double-contained floor sump. If the inner pipe developed a leak, the solution would drain by gravity to the double containment area and then to the sump. This system would provide for containment and detection of leaks. Mill maintenance personnel would inspect leak detection points daily.

The larger tailings and raffinate disposal and recycle lines would be located in a lined trench that would daylight at the tailings cell and evaporation ponds. With the exception of vehicle crossing points, the trench would be open and leakage would be detected through visual observation of the pipes. The lined trench would slope down from the mill to the tailings cells and evaporation ponds; therefore, if a leak were to occur in a disposal line, the solution would be contained within the trench liner and flow into a tailings cell or evaporation pond. Tailings personnel would inspect the tailings pipelines daily.

Tailings and Raffinate Disposal. Tailings would be pumped to three tailings 30-acre tailings cells (A, B, and C) over the life of the Mill Facility. Based on a production rate of 500 tpd, each tailings cell would have a design life of approximately 13 years and a minimum capacity to accommodate storage of 2.45 million tons of tailings with 3 feet of freeboard. The tailings cells are designed as permanent, zero-discharge, single-use facilities and would be lined accordingly. The tailings cells would be designed for stability and tailings containment under static and seismic (pseudo-static) loading conditions for both operating and post-closure conditions. The tailings would be deposited into the cells via pumping from the mill to perimeter discharge pipes

located at the surface of the active tailings cells, feeding perforated drop pipes extending down the lined slope on textured geomembrane rubsheets.

The tailings cells would be each designed with a primary and secondary liner system, an intervening leak collection and recovery system (LCRS), and a tailings underdrain system, consistent with the State of Colorado Rules and Regulations Pertaining to Radiation Control (6 CCR 1007-1, Part 18). Additionally, the tailings pool within each cell would be equipped with a surface water pump-back system as the water input rate is expected to exceed the rate at which water can percolate through the tailings to the underdrain system.

LCRS sumps have been included in the design of each tailings cell, with Tailings Cell A having two LCRS sumps. The LCRS design provides for capture and conveyance of the seepage through the upper (primary) tailings cell liner to a sump. Water collected in the LCRS sumps would be pumped back into the tailings pond. A critical consideration of this system is to maintain minimal hydraulic head on the lower (secondary) composite liner, thereby preventing a driving hydraulic force required for any seepage to occur to the environment.

Per Criterion 5E(3) of 6 CCR 1007-1, Part 18, Appendix A (CDPHE, 2001), the tailings cells have been designed with an underdrain system installed on top of the primary geomembrane liner at the base of the impoundment. This feature provides added effectiveness to the proposed liner system by lowering the hydraulic pressure within the overlying tailings, thereby reducing the driving head for seepage.

The liner system for the evaporation ponds would be identical to the tailings liner system with two exceptions: 1) the upper primary liner would be black (rather than white) to enhance evaporation rates; and 2) a geonet would be used for the LCRS along the side slopes of the cells instead of a drainage geocomposite. The evaporation system would consist of ten 4-acre ponds with the potential for future expansion to 80 acres as ponds fill with precipitated salts. Each cell would have a dedicated LCRS for seepage collection. The LCRS would be continuous beneath the primary liner and would drain to a sump equipped with water level indicators. Portable submersible pumps would be used to pump any water collected in the LCRS sump back to the evaporation cell.

Radiation Exposure Pathways – Flora and Fauna

The radiological impact on plants and animals results from pathways such as deposition of ore and tailings dust and consumption of water and vegetation by animals, and the uptake of water and nutrients by plants. Inhalation of radionuclides by animals near the Site may occur, but the magnitude of exposures should be very small as cattle only graze in the area on a seasonal basis and deer and elk also migrate in and out of the area on a seasonal basis. The maximum gamma exposure rate in the vicinity of a typical uranium mill tailing site is only a few mrem/yr. That exposure rate could approximate the maximum exposure rate to plants. That rate is very low and would not impact plants significantly. As a point of comparison, DOE guideline for dose to biota is ≤ 1 Rad / day (DOE, 2002).

Because the Mill is designed as a zero-discharge facility, the only potential source of radionuclides in the food chain pathway is the atmospheric deposition on the soil, vegetation, and through agricultural products. It was indicated in the *Estimates of Radiation Doses Report* (Two Lines, 2009) that the agricultural productivity of the land surrounding the Site is modest. Therefore, the fraction of total annual livestock feed requirements to be satisfied by pasture grass or locally grown stored feed was set at 50 percent or 0.5. The subsequent modeling

indicated that the dose to the public through the food chain is very small (Two Lines, 2009). This is because both uranium and radium have very low solubility in fat and, therefore, would be expected to have very poor bioaccumulation through the food chain (SENES, 2009a). Uranium and radium are also transported poorly from soils to plants (SENES, 2009a).

Although some fugitive dust would be expected downwind of the tailings cells and ore pad, the soil monitoring program outlined in the *Operational Monitoring Plan* (Visus and Energy Fuels, 2009b) is designed to minimize these occurrences through periodic sampling and, where appropriate, excavation of contaminated soils and placement within a tailings cell. Vegetation favored by cattle and wildlife would also be periodically sampled along the property boundary and at on-site and off-site air monitoring stations and analyzed to track and assess radioactivity levels in these grasses. In accordance with recommendations made in the *Baseline Survey of Radionuclides in Animal Tissues* (Whicker, 2008), Energy Fuels would also collect on-site samples of rabbit bone tissue for analysis of naturally occurring radionuclides on 5 year intervals.

Radiation Exposure Pathways – General Public

The MILDOS AREA modeling of off-site radiation dose indicates that the Mill Facility would have a minimal radiological impact within a 50-mile (80 km) radius. All of the doses would be below the 100 mrem/yr dose limit for individual members of the public, including radon and its progeny, but excluding natural background radiation (6 CCR 1007-1- 4.14 – CDPHE, 2005b).

Two Lines Inc. Radiation Risk Consultants conducted an assessment of off-site radiation doses from normal operations and the results are provided under a separate report, *Estimates of Radiation Doses to Members of the Public from the Piñon Ridge Mill* (Two Lines, 2009). Potential doses to the public from operations were modeled using calculated emissions data from point sources and expected radionuclide concentrations in surface materials that constitute the area sources. The emissions data were calculated by Kleinfelder and submitted in the Air Pollution Emissions Notices (APENs) (Kleinfelder 2009a) and APEN Response #1 Submittal (Kleinfelder 2009j). The expected radionuclide concentrations of area sources were based on the radionuclide concentrations of the ore with the expectation that uranium removal was 96 percent efficient.

The source terms considered in the model included the following (Two Lines, 2009):

- Mill Point Sources: Operational mill point sources include the feed hopper dust collector, SAG mill stack, leach building stack, vanadium dryer stack, and ore handling. As with some conventional mills, the Piñon Ridge Mill would not have fine ore storage.

- Ore: Approximately 100,000 tons of ore received could be stored on the ore pad. Emissions from the ore were modeled as described in NRC Regulatory Guide 3.59 (NRC, 1987). Material releases from wind erosion were accounted for in the model. Mean concentrations of uranium in the ore were assumed to be in equilibrium with decay products. The average effective area of the ore storage pad was set to 3 acres. This is a conservative average value based on an estimated maximum value of approximately 3 acres (Visus and Energy Fuels, 2009a).

- Tailings Cells: Wind erosion from the initial tailings cells were included in the source terms. It was assumed that uranium removal was 96 percent efficient. Uranium decay products were assumed to be in equilibrium with the original concentrations. Four

scenarios for location of tailings beaches during the life of the mill were modeled. These four scenarios indicate the points in time in which two tailings cells would be active simultaneously and the maximum area of tailings beaches would be exposed. Initially, each tailings impoundment will be below grade, which likely inhibits particulate transport. For simplicity, each tailings scenario was modeled separately as a single time step rather than attempting to use multiple time steps. This is a legitimate approach because mill operation would be essentially constant over the lifespan of each scenario (see Figure 6 – Two Lines, 2009).

Meteorological conditions greatly influence resuspension and dispersion of radionuclides from point and area sources. The Site has two meteorological stations that record wind speed, wind direction, and stability class simultaneously among other parameters. As suggested in the Yuan MILDOS-AREA Report (Yuan, 1989), wind data from the 10 m tower were used for the MILDOS modeling (Two Lines, 2009).

Food pathway parameters were set a at default value of 0.5 or 50 percent. This means for either individual or population receptors ½ of the total livestock feed requirement is satisfied by pasture, which is subject to contamination by potential mill releases. Potential dose from food pathways represents a very small number relative to inhalation doses, regardless of the food chain parameter. Because there is no dairy farm in the area, the milk pathway was not modeled (Two Lines, 2009).

A total of 27 receptor locations were modeled for the Piñon Ridge Mill analyses. These receptor locations include fifteen perimeter locations (fence line), six residences within 3 miles (5 km) of the Site, and six population centers within a 50-mile (80 km) radius of the Site (see Figures 2, 3, and 4 – Two Lines, 2009). The population distribution within 50 miles (80 km) of the Site was calculated by taking the average population density of the county in question and multiplying the area (km^2) of the annulus in question (for example, north 1 -2 km, southeast 60-70 km, etc.) by that county's population density (people/km^2) (see Figure 4 – Two Lines, 2009). This approach may somewhat skew the population density in the less-densely populated regions of a given county, but it likely has little influence on the total population dose which is spread over 7,760 mi^2 (20,000 km^2) (Two Lines, 2009).

MILDOS calculates doses for several different organs with and without radon. EPA regulations 40 CFR 190 (Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings) are doses excluding radon exposure since the 40 CFR 190 criterion is 25 mrem per year to any organ (except the thyroid for which the criterion is 75 mrem) or the whole body, excluding dose due to radon. The critical organs are the bone surface and the lung. The infant is the critical age group for lung dose and the teen, for bone dose. Doses to these organs as well as the effective doses were summarized for each age group. In addition, the total effective dose equivalent (TEDE), including radon decay products, was calculated for each age group (Two Lines, 2009).

The calculated estimates of the TEDE and the 40 CFR190 effective, bone and lung doses are given in Table 4.11-2 for the maximum receptor, regardless of age group or scenario, at each fence line receptor. This data includes contributions from tailings, ore storage, ore handling and operational point sources.

Table 4.11-2
Estimated Maximum Doses to Receptor Points at the Property Boundary for All Age Groups and Operational Scenarios

Receptor ID	TEDE (mrem/yr)	40 CFR 190 Dose (mrem/yr)		
		Eff	Bone	Lung
Fence 1	$4.34x10^{+00}$	$7.85x10^{-01}$	$3.56x10^{+00}$	$4.79x10^{+00}$
Fence 2	$2.11x10^{+00}$	$6.48x10^{-01}$	$2.06x10^{+00}$	$4.27x10^{+00}$
Fence 3	$1.20x10^{+00}$	$1.34x10^{-01}$	$6.38x10^{-01}$	$7.94x10^{-01}$
Fence 4	$2.27x10^{+00}$	$2.62x10^{-01}$	$7.70x10^{-01}$	$1.77x10^{+00}$
Fence 5	$1.44x10^{+00}$	$9.62x10^{-02}$	$1.21x10^{-01}$	$7.10x10^{-01}$
Fence 6	$3.53x10^{+00}$	$6.03x10^{-01}$	$4.17x10^{-01}$	$4.60x10^{+00}$
Fence 7	$7.16x10^{+00}$	$3.52x10^{-01}$	$2.34x10^{+00}$	$2.01x10^{+00}$
Fence 8	$3.68x10^{+00}$	$1.68x10^{-01}$	$1.45x10^{+00}$	$8.53x10^{-01}$
Fence 9	$3.55x10^{+00}$	$1.13x10^{+00}$	$1.38x10^{+01}$	$3.04x10^{+00}$
Fence 10	$3.87x10^{+00}$	$2.01x10^{+00}$	$2.44x10^{+01}$	$5.49x10^{+00}$
Fence 11	$3.56x10^{+00}$	$1.83x10^{+00}$	$2.17x10^{+01}$	$7.07x10^{+00}$
Fence 12	$3.49x10^{+00}$	$1.77x10^{+00}$	$1.84x10^{+01}$	$7.96x10^{+00}$
Fence 13	$6.76x10^{+00}$	$3.44x10^{+00}$	$2.17x10^{+01}$	$1.97x10^{+01}$
Fence 14	$9.04x10^{+00}$	$2.42x10^{+00}$	$8.47x10^{+00}$	$1.55x10^{+01}$
Fence 15	$6.12x10^{+00}$	$2.04x10^{+00}$	$6.51x10^{+00}$	$1.33x10^{+01}$
Maximum	**9.04**$x10^{+00}$	**3.44**$x10^{+00}$	**2.44**$x10^{+01}$	**1.97**$x10^{+01}$

The maximum TEDE at any actual receptor locations (residences and population centers) for various age groups at the property boundary is summarized in Table 4.11-3. It is important to note that in Colorado, individuals are exposed to an average rate of 400 mrem/yr (see Section 3.11).

Table 4.11-3
Maximum Total Effective Dose Equivalent (mrem/yr) for Various Age Cohorts at Actual Receptor Locations

Receptor	Total Effective Dose Equivalent (mrem/yr)
Infant	$4.62x10^{-01}$
Child	$4.39x10^{-01}$
Teen	$4.32x10^{-01}$
Adult	$4.31x10^{-01}$

For the nearest residences, the maximum radiation dose was 0.462 mrem/yr at the Boren residence. This value is 0.5 percent of the maximum allowable dose of 100 mrem/yr. For the population centers within 50 miles (80 km) of the Site, the maximum dose is estimated to be 0.172 mrem/yr at Bedrock, CO, or 0.2 percent of the maximum allowable dose of 100 mrem/yr. For the other nearby towns used as one of the receptor locations the calculated maximum dose ranged from 0.0218 to 0.125 mrem/yr.

Using populations out to 50 miles (80 km), population doses (person-rem/yr) from site releases were calculated for both TEDE and the dose to the bronchial epithelium of receptors. Population dose results are shown in Table 4.11-4 (Two Lines, 2009).

Table 4.11-4
Dose to Populations Surrounding the Piñon Ridge Site

	Dose to population (person-rem/yr)		
Dose	**Within 50 miles (80 km)**	**Outside 50 miles (80 km)**	**All**
TEDE	$7.39 \times 10^{+01}$	$3.14 \times 10^{+00}$	$3.88 \times 10^{+00}$
Bronchial dose	$4.04 \times 10^{+01}$	$1.99 \times 10^{+01}$	$6.03 \times 10^{+01}$

The maximum estimated annual population dose would be 0.739 person-rem/yr to the population within 50 miles (80 km) and 3.88 person-rem/yr to the entire U.S. population. It should be noted that there is no regulatory limit for population dose.

Estimated radiation doses to members of the public due to operations and material storage at the Mill Facility would be well below the criteria set in EPA 40 CFR 190 and CDPHE regulations 6 CCR 1007-1,Parts 4 and 18 (CDPHE 2005b and 2001). Incremental doses would be within the range of background variability. In no case did the estimated effective dose or dose to any single organ exceed 25 mrem per year as specified in 40 CFR 190 and Criteria 8 in Appendix A to Part 18 of CDPHE regulations. The effective doses from air-borne particulate matter were below the CDPHE Part 4.5.4 constraint limit of 10 mrem per year. The maximum calculated effective dose to any adult member of the public from all sources including radon was less than 100 mrem/yr, as specified in 4.14.1.1 of CDPHE regulations (Two Lines, 2009).

Doses to nearby residents would be well below doses that are received from natural background radiation. Doses from natural background each year to the total population ("collective dose") surrounding the site out to a distance of 50 miles (80 km) would be approximately 16,000 times higher than the annual doses that potentially result from the operation of the Mill Facility (Two Lines, 2009).

Transportation. The DOE performed an analysis, using four representative scenarios, to estimate exposures of the public from transportation shipments containing uranium ore in the Uranium Leasing Program Final EA (DOE, 2007). Table 4.11-5 presents the estimated radiological dose to the public from these four exposure scenarios. The largest radiation dose would be for the nearby resident, who would receive a dose of 0.22 mrem per year from the passing haul trucks.

Table 4.11-5
Exposure of the Public from Routine Transportation of Uranium Ore

Scenario	Estimated Public Dose
Individual in a vehicle in a traffic jam next to uranium ore truck for 30 minutes	0.026 mrem
Individual in a vehicle who passes an ore truck going the opposite direction	$7.4\ E^{-6}$ mrem
Individual in a vehicle stopped at an intersection when a uranium ore truck passes	$1.5\ E^{-5}$ mrem
Resident located 33 feet from a road used by uranium ore trucks for 1 year	0.22 mrem / yr
Source: DOE, 2007.	

4.11.1.3.3 Accident Scenarios

The *Risk Assessment* (SENES, 2009a) describes the environmental effects of possible accidents involving the release of nonradioactive and radioactive materials that could occur at the mill site. The methodology used to generate Table 4.11-6 is detailed in the *Risk Assessment* report (SENES, 2009a). SENES reviewed the Mill Facility's components and activities to determine potential, credible, accident scenarios. The sources of hazards were attributed to the following onsite materials: radioactive materials, flammable materials, and other toxic materials. A list of possible accident scenarios by mill component was then generated (SENES, 2009a – Table 5.1). The accident scenarios were classified and grouped based on the type of the accidents and their potential health and environmental impacts in order to reduce duplication between different process components. For each group a bounding accident scenario was selected to encompass the impacts of all accident scenarios in that group. The radioactive bounding case scenarios were:

- Conventional accidents and personnel injury due to typical project activities such as working at heights, working with heavy or processing equipment during construction or plant operation
- Spill of radioactive materials from storage tanks, transfer lines, valves, pumps, and other process equipment as well as during offloading
- Spill of nonradioactive materials and fuel from storage tanks, transfer lines, valves, pumps, and other process equipment as well as during offloading
- Failure of air cleaning systems and release of toxic fumes and/or radioactive dust
- Spill of tailings slurry from transfer line, pumps, or due to tailings cell embankment failure
- Fire involving flammable liquids in the storage area and SX circuit
- Propane explosion in boilers, kiln, dryer, and fusion furnace
- Airplane crash and catastrophic failure of all containments
- Tornado and high wind and dispersion of contaminants from stockpiles
- Flood and dispersion of contaminants from stockpiles
- Building fire
- Transportation accident resulting in potential release of materials to the environment (streams)
- Transportation accident resulting in a fire and release to air
- Transportation accident and release of ammonia to air

The bounding scenarios were then assessed for risk based on the potential frequency in combination with the potential severity of the impact. Table 4.11-6, excerpted from the Risk *Assessment* (SENES, 2009a), provides a summary of the assessment.

The Risk Assessment (SENES, 2009a) concluded that, with the exception of an airplane crash into the mill, that potential impacts to workers and the public from potential accidents were low to moderate and that the overall risk from accidents was low.

Table 4.11-6
Summary of Probabilities and Impacts for Accident Scenarios

Accident Scenario	Workers			Members of Public and Environment		
	Probability	Impact [1]	Risk	Probability	Impact [1]	Risk
Conventional Accidents and Personnel Injury	Medium	Low	Low	-	-	-
Unscheduled Explosion	Low	Moderate	Low	Low	Low	Low
Spill of Radioactive Materials	Low	Moderate	Low	Low	Low	Low
Spill of Non-Radioactive Materials and Fuel	Low	Moderate	Low	Low	Moderate	Low
Failure of Air Cleaning Systems	Low	Moderate	Low	Low	Moderate	Low
Spill of Tailings Slurry	Low	Low	Low	Low	Low to Moderate	Low
Fire Involving Flammable Liquids	Low	Moderate	Low	Low	Low	Low
Propane Explosion	Low	Moderate	Low	Low	Low	Low
Airplane Crash	Extremely Low	High	Low	Low	Moderate	Low
Tornado and High Wind	Low	Moderate	Low	Low	Low	Low
Flood	Low	Low	Low	Low	Low	Low
Building Fire	Low	Moderate	Low	Low	Low	Low
Transportation Accident and Materials Release	Low	Moderate	Low	Low	Moderate	Low
Transportation Accident Fire	Low	Moderate	Low	Low	Moderate	Low
Transportation Accident and Release of Ammonia	Low	Moderate	Low	Low	Moderate	Low

[1] Source: NUREG-1748 (NRC, 2003a)
SMALL(Low) Impact: The environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource considered
MODERATE Impact: The environmental effects are sufficient to alter noticeably, but not destabilize, important attributes of the resource considered.
LARGE (Hight) Impact: The environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource considered.

SENES also concluded that the radioactive materials handled at a uranium mill have relatively low specific activities (amount of radioactivity per unit mass, e.g., uCi/gram). The low specific activities require the release of exceedingly large quantities of material in order to potentially result in any measurable public health impacts; driving forces (energy sources, e.g) for such releases are generally lacking or extremely unlikely in the milling operation. In light of past experience, it is believed that even if major accidents did occur radiation exposures would be too small to cause any measurable deleterious effect on the health of the human population. A well trained workforce operating under rigorous emergency response procedures would minimize occupational impacts from occurrence of accidents and unplanned events. The bounding scenarios ranked in Table 4.11-6 are analyzed in detail in the Risk Assessment (SENES, 2009a).

4.11.1.4 Closure

Nonradiological Impacts

Nonradiological impacts to public and occupational health during closure include the potential for spills and releases of chemical reagents, fuels, feedstock, and process and waste streams that could expose workers to corrosive, toxic, or flammable chemicals. These types of risks would be minimized by implementing programs for training, air sampling, respiratory protection, exposure determination and inspections. Actions that would be taken reduce risks would include removing all known reagents and processing materials and cleaning out tanks, pipes, and other equipment to the extent practicable in an area of the mill prior to the start of demolition activities. Special care would be taken to thoroughly clean and ventilate tanks and other confined spaces that may contain explosive or toxic gases prior to using an acetylene torch to cut metal tanks and equipment into smaller pieces. Appropriate respiratory protection and personal protection equipment (PPE) (including clothing, hard hats, eyewear, and chemical, gloves and suits) for the task to be performed and chemicals that are involved would be worn during demolition activities. The demolition contractor would be required to provide detailed work plans showing the steps involved in each phase of the demolition work.

The risks of events such as trips and falls, strains, electrocution, crushing, and pinching associated with project activities such as working at heights, working with heavy equipment, or working in confined spaces would generally be greater than during operations due to the daily change in the work environment that would result from demolition activities. As secondary containment facilities are removed, there is also a greater risk of spills or releases to the environment of fuels, reagents, and other materials. Construction contractors would be required to have and implement a Health and Safety Plan and a SPCC Plan. The Health and Safety Plan would meet MSHA requirements under 30 CFR Subpart K and the SPCC Plan would meet EPA's requirements under the Oil Pollution Prevention regulation (40 CFR Part 112).

Radiological Impacts

Radiological impacts to the public and occupational health during closure of the site would primarily be related to residual radioactivity above background, which remains on equipment, structures and in soils. Closure of the Site would occur in accordance with Energy Fuels' Mill Decommissioning Plan (Kleinfelder, 2009b), which was developed in accordance with applicable State of Colorado regulations (e.g. Parts 4 and 18) and NRC technical guidance documents (e.g. NUREG 1757 – NRC, 2006).

Radiological protection procedures described in the *Health and Safety Plan* (Energy Fuels, 2009i), including the ALARA program, would apply to decommissioning operations. These would include exposure monitoring by collection of mill area air samples, breathing zone air samples, uranium in urine bioassay samples, and by direct measurement of radiation.

To minimize exposures while efficiently demolishing the site facilities, the decommissioning activities for the mill components would occur generally in the following order according to the *Mill Decommissioning Plan* (Kleinfelder, 2009b):

- Preparation of Detailed Decommissioning Plan
- Removal of Uncontaminated Systems, Equipment, and Structures
- Removal of Contaminated Systems and Equipment
- Removal of Contaminated Structures

- Soil Remediation
- Surface Restoration
- Surface and Ground Water Protection.(ongoing throughout decommissioning)

To minimize impacts, an ALARA analysis would be prepared as part of the detailed decommissioning plan. The ALARA analysis would consider appropriate potential benefits including (Kleinfelder, 2009b):

- collective dose averted,
- regulatory costs avoided,
- changes in land values,
- esthetics, and
- reduction in public opposition.

Prior to decommissioning, the inventory and radiological assessment (surveying) of mill systems and equipment would be updated to show the levels of contamination. Based on the results of these surveys and the approved radiological release limits, the systems and equipment would be classified as uncontaminated (i.e. available for unrestricted release to the public domain) or contaminated. Uncontaminated equipment and structures would be demolished using standard demolition techniques (Kleinfelder, 2009b).

After uncontaminated systems and equipment are removed from the mill area, the systems and equipment that are known or very likely to be contaminated above release limits would be removed from the mill area and placed into the vault in Tailing Cell C, described in the *Tailing Cell Closure Design Report* (Kleinfelder, 2009c).

Methods employed to remove contaminated systems and equipment would be mechanical, manual, or a combination of both. Methods would be selected by the decommissioning contractor and Energy Fuels based on considerations of worker safety, protection against release of contaminants using ALARA principles, and cost-effectiveness. As necessary for dust suppression, water sprays would be used; run-off (if any) from this activity would be collected in the stormwater ponds and discharged to the evaporation ponds.

Any contaminated materials that are intended to leave the site, both salvaged mill materials as well as equipment used in mill decommissioning, would be decontaminated below approved limits before being released from the site. Decontamination would be performed at the truck decontamination station located at the northeast corner of the mill pad (Kleinfelder, 2009b).

Contaminated structures would be decontaminated as necessary to facilitate safe handling and free release and would be demolished using primarily mechanical methods, with specific equipment selected by the demolition contractor and Energy Fuels based on considerations of worker safety, protection against release of contaminants using ALARA principles, and cost-effectiveness. Scaling and high-pressure washing would likely be employed to remove surface contamination. As necessary for dust suppression, water sprays would be used and run-off (if any) from this activity would be collected in the stormwater ponds and discharged to the evaporation ponds (Kleinfelder, 2009b).

Foundations of structures and equipment would be removed and disposed of in the vault. The exception would be those foundations below uncontaminated structures and located in areas where the mill pad was cut or excavated below natural grade. These foundations may be left in place and covered during final site grading (Kleinfelder, 2009b).

When mill operations cease, residual liquids would be transferred to one or more evaporation ponds as needed to evaporate the remaining liquid, and the solids would be removed to the tailings. Liners would be cleaned to remove wind-transportable solids and left in place until the disposal vault is ready. At that time liners would be cut into pieces and placed into the disposal vault. Eventually, only one pond would remain in operation to receive and evaporate the liquid collected in the tailing dewatering and leak collection systems. This last pond would remain in operation until drainage to the tailing Cell C dewatering system ceases. If necessary to expedite closure, native soil may be mixed into the residual liquid in the last pond to form a solid that can be excavated from the pond and placed in the disposal vault. The last pond liner can then be removed and placed in the disposal vault, as well (Kleinfelder, 2009b).

After removal of mill systems, equipment, and structures, the soil within and adjacent to the mill would be surveyed to determine if contaminant levels meet the concentration limits in 6 CCR 1007-1, Part 18, Appendix A, Criterion 6(6) including consideration of the “radium benchmark dose” as defined therein. Soil remediation would be performed in the following sequence after mill equipment and structures have been removed (Kleinfelder, 2009b):

- Initial survey;
- Soil clean-up;
- Final soil clean-up;
- Verification survey; and
- Final closure of Tailing Cell C (Cells A and B closed previously).

Final regrading of the Site would follow the verification survey. Some elements of regrading and revegetation related directly to the closure of Tailing Cell C may be delayed until that activity is complete.

A gamma (direct radiation) survey would be performed to evaluate potential areas where soil contamination might exceed radium 226 closure concentrations and/or exceed the radium benchmark dose that has been calculated for the site (6 CCR 1007-1, Part 18, Appendix A, Criterion 6(6)), based on gamma-radium correlations established in the baseline radiological investigation (ERG, 2009) and use of the RESRAD computer code to determine acceptable concentrations of other radionuclides to meet radium benchmark dose criteria. The initial gamma survey would be performed on grids with 100-foot (30-meter) spacing across the disturbance area with closer survey intervals applied as needed to delineate the extent of contamination. The gamma survey would be followed up by soil sampling would be conducted on a 30-foot (10-meter) grid at locations that register gamma readings correlating with Ra-226 concentrations exceeding 5 pCi/g above background. Samples would be tested for Ra-226 concentrations at depth intervals of 0 to 15 cm, and over a 15 cm thick layer of soils more than 15 cm below the surface. The necessity of conducting Th-232/Ra-228 testing (refer to NUREG 1620 (NRC, 2003b)) as part of the initial survey would be determined from analyses of ore, tailings, and process fluids conducted during mill operations.

Where surveys indicate that the above criteria have not been achieved, the soil would be removed to meet the criteria. Contaminated soil would be excavated and transported to the tailings Cell C vault for disposal (Kleinfelder, 2009b).

After soil clean-up has been performed, and before closure of the final tailings cell, a verification survey would be conducted on a 30-foot (10-meter) grid on areas used (and possibly contaminated) during the decommissioning process, or that were found to have excessive Ra-226 levels in the soil during the initial survey. Soil samples would be collected as described for

the initial survey at grid points where gamma readings indicate that Ra-226 in excess of closure criteria may persist after clean-up, and at random grid locations constituting up to 10 percent of the initial survey grid points.

Surface water runoff from direct precipitation on the mill area would be collected in the two stormwater ponds during decommissioning. When the soil clean-up is completed and before the verification survey is performed, these stormwater ponds would be removed and the sediments, liners, discharge pipes (to the evaporation pond), and control apparatus would be placed in the vault.

After the radiological survey confirms that all of the affected soils have been removed from a given location, the area would be graded and stabilized according to the *Specifications for Closure and Reclamation of Mill Facilities* (Golder, 2009c).

With the exception of the tailing cells, the mill site area surface would be restored by regrading to approximately the original (pre-construction) configuration, as illustrated in the closure design (Kleinfelder, 2009c). The surface water diversions constructed for the mill would be left in place to divert runoff away from the tailing cells. The regraded surfaces would be revegetated using the procedures and seed mixes described in *Specifications for Closure and Reclamation of Mill Facilities* (Golder, 2009c).

After decommissioning, the tailing cells would be the only mill features remaining that could be impacted by, or cause impact to, surface water. Surface water control structures originally constructed to divert sheet flow away from the mill and the tailing cells would be left in place and protected with riprap as described in the site drainage design (Kleinfelder, 2009d). The *Tailing Cell Closure Design Report* (Kleinfelder, 2009c) addresses erosion control measures, including grading and rock cover, to protect the tailing cells against erosion by surface water runoff. Those erosion control measures would be designed to protect the tailings from release for at least 1,000 years, accomplished by designing for erosion protection against the peak runoff from the probable maximum precipitation (PMP) event, as required by 6 CCR 1007-1, Part 18, Appendix A (CDPHE, 2001). The Tailing Cell Closure Design Report (Kleinfelder, 2009c) and post-closure monitoring would provide long-term protection against releases that could reach groundwater (Kleinfelder, 2009b).

Energy Fuels would meet the specific radionuclide concentration and public dose limits on the Site required for unrestricted use after decommissioning in accordance with 6 CCR 1007-1, Part 18, RH 18.8 (Decommissioning Requirements); in Part 18 Appendix A, Criteria 5A, 6(6) and 6(7) and NUREG-1757 Vol. 2 (NRC, 2006). The required site-specific assessment and dose modeling would be conducted.

Energy Fuels would cover the tailings cells in accordance with the *Tailing Cell Closure Design Report* (Kleinfelder, 2009c). The tailing cover, in combination with the tailing cell liners, would provide the system of barriers for the long-term containment of tailings. The tailing cell closure design is based primarily on the following performance objectives:

- Provide containment of byproduct for 1,000 years (Criterion 6(1)(i));
- Limit Radon flux from the cover surface to <20 pCi/m^{2}s (Criterion 6(1)(ii)); and
- Limit infiltration of moisture into, and release of contaminated liquid from, the tailings (Criteria 5B(1), 5E(3), 6(7), 7).

The tailing cells have been designed (Golder, 2008a) and would be constructed to provide long-term stability and minimal potential for erosion of slopes (Criteria 4C, 5A(5)) and prevent downward migration of contaminants that could impact groundwater (Criteria 5A(1), 5A(2), 5E(1), 5E(3)). The components of the tailing cell impoundment structures, liner, and dewatering system have been designed to satisfy the long-term containment criteria. These components would not be removed or altered by the tailing cover design and construction.

4.11.2 Protective/Mitigation Measures

General

- Implementation of the *Health and Safety Plan* (Energy Fuels, 2009j), *Emergency Response Plan* (Energy Fuels, 2009e), *Material Containment Plan* (Energy Fuels, 2009c), *SPCC Plan* (Energy Fuels, 2009b), and *Facility Operating Plan* (Visus and Energy Fuels, 2009a).
- Design of mill components to limit potential releases including “zero discharge” wastewater systems, “zero to low emission” air treatment systems, and provisions for secondary containment in mill and waste disposal systems.
- Compliance with applicable regulatory requirements, such as those of CDPHE, MSHA, USDOT, CDOPS, and the EPA.
- Implementation of comprehensive monitoring programs for workers and the environment.
- Implementation of a comprehensive training program.
- Restriction of wildlife access to the Site.
- Implementation of comprehensive site security.
- The trucking companies transporting ore, chemical reagents and fuel would implement an emergency response plan.
- Access to the Mill Facility would be limited to mill employees and authorized visitors. All personnel must enter and exit the restricted area (i.e., the Mill License boundary) through a controlled point.
- The mill facility, tailings cells, and evaporation ponds are designed as “zero discharge” stormwater and process water facilities.
- Emergency management plans for the Mill Facility would be prepared as part of the licensing effort with CDPHE.
- The primary Mill Facility is designed with concrete curbs, spill collection sumps and other forms of secondary containment in areas where reagents, process solutions and finished products (e.g., uranium oxide concentrate and vanadium oxide concentrate) are handled and stored.
- All process and waste solutions would be contained within the Mill and waste disposal system components of the Site.

Nonradiological

- A firewater loop with hydrants and hose reels at key locations would be installed.

- A sprinkler systems and fire extinguishers in accordance with building codes and county and state requirements would be installed.
- Piping would be designed to be chemically resistant and would be double-walled or contained within lined trenches in those areas outside the buildings where secondary containment systems would not otherwise be present.
- Leak detection and emergency shutoff systems would be installed in critical areas to minimize the volume of a release should a leak or equipment failure occur.
- Spill control kits would be present at strategic locations and employees would be trained in the proper methods for controlling, cleaning up and reporting spills of the various chemicals and process solutions present in the Mill.

Radiological

- Energy Fuels would construct the Mill Facility according to the *Site Drainage Analysis and Design Report* (Kleinfelder, 2009d), *Ore Stockpile Pad Design Report* (Golder, 2008g), *Tailings Cell Design Report* (Golder, 2008a) and *Evaporation Pond Design Report* (Golder, 2008h).
- Energy Fuels would implement the *Facility Operating Plan* (Visus and Energy Fuels, 2009a), Health and Safety Plan (Energy Fuels, 2009j), *Emergency Response Plan* (Energy Fuels, 2009e), *Operational Monitoring Plan* (Visus and Energy Fuels, 2009b), *Material Containment Plan* (Energy Fuels, 2009c) and SPCC Plan (Energy Fuels, 2009b).
- Energy Fuels would create a detailed decommissioning plan prior to decommissioning based on the general *Mill Decommissioning Plan* (Kleinfelder, 2009b).
- Energy Fuels would implement the *Tailing Cell Closure Design Report* (Kleinfelder, 2009c), *Stormwater Management Plan* (Golder, 2009a) and *Specifications for Reclamation of Mill Facilities* (Golder, 2009c).
- Air emissions would be minimized through use of modern pollution control equipment (e.g., baghouses, scrubbers) and through a variety of methods including the use of water sprays at the ore dumping platform, ore stockpiles and conveyor hopper.
- A dust collecting baghouse would be installed at the conveyor hopper to capture any dust generated during ore feeding into the hopper and conveyor system.
- A dust scrubber would be installed at the SAG Mill to capture any dust generated during mixing prior to the ore being mixed with water.
- Gas scrubbers would be installed at all emission points in the process train.
- The yellowcake dryer would totally contained the yellowcake with zero discharge.
- Other improvements would include using automated equipment within hermetically sealed rooms to package the yellowcake and vanadium oxide produced.
- The intent of the technical improvements and emission control devices proposed for the Mill Facility is to limit exposure of mill employees and the general public to ALARA levels of radiation and fugitive dust.
- Other protections include regular power washing of equipment and vehicles, monitoring the amount of time workers are exposed to radiation, and implementation of good housekeeping and personal hygiene measures.

- Despite the large buffer area between the Property Boundary and the closest residences, Energy Fuels must still meet regulatory limits for radiation dose at the Property Boundary.

Closure

- Energy Fuels would be required to post a decommissioning and reclamation bond that would cover the cost of a third-party contractor to close and reclaim the site including costs for state administration of the Project, contingencies, and long-term surveillance and monitoring as required by NRC guidelines.
- The decommissioning and reclamation bond would remain in full force during operations and would be periodically updated for inflation and changing onsite conditions (e.g., mill expansion, interim reclamation).
- The tailing cells would be covered to limit the release of radon to 20 picoCuries per meter squared per second (ρCi/m^2/s).
- All other areas within the Site would be restored to radium concentration limits of 5 picoCuries per gram (ρCi/g) in the top 15 centimeters (cm) of soil and 15 ρCi/g in 15 cm intervals below 15 cm depth above background and/or concentrations of radionuclides as determined per the radium benchmark dose approach of 6 CCR 1007-1, Part 18, Appendix A Criteria 6(6).
- Radiation monitoring would be provided for all employees, including contract employees, assisting in reclamation.
- Radiological contamination surveys would be conducted in the lunch rooms, change rooms, and offices at a typical frequency of once every week during active reclamation tasks.
- Decontamination procedures for personnel would include a radioactive activity scan of skin and clothing prior to leaving the site each day.
- All equipment coming in contact with tailings would be cleaned and surveyed in a designated area prior to removal from the site.

4.11.3 Monitoring

Nonradiological and radiological monitoring would be conducted in accordance with the *Operational Monitoring Plan* (Visus and Energy Fuels, 2009b).

Nonradiological

Monitoring of nonradiological chemical constituents in the ore slurry, tailings sand and supernatant, raffinate and evaporatic salts would be conducted on a quarterly basis to characterize these materials. These samples would be analyzed for various metals, major ions, and physical constituents as well as radiological parameters described below. The results would be evaluated to identify any constituents at levels that may adversely affect public or occupational health during normal operations or in the event of an accident, emergency or release. Other areas of the mill and off-site would be monitored on-site and in surrounding areas on a situational basis. This monitoring would be conducted if abnormal concentrations are suspected due to a chemical leak or accident at the Mill Facility. The methods and locations of monitoring would be situation and chemical specific and would be determined by the RSO on a per event basis (Visus and Energy Fuels, 2009b).

In addition, environmental monitoring would be conducted through the Effluent Monitoring Program for several media including surface water, groundwater, and air as provided above in the individual resource sections.

Radiological

Numerous monitoring systems would be utilized at the Mill Facility to maintain worker exposures to radioactive material ALARA and to verify that the work environment would be safe. The radiation monitoring program and procedures would be directed by the Facility's Radiation Safety Officer (RSO). Routine work in the mill would be performed in accordance with approved Radiation Health (RH) Procedures. Non-routine work tasks (i.e., activities for which established procedures do not exist) would require a Radiation Work Permit (RWP), administered by the RSO, that outlines the health and safety measures required while doing the work (Procedure RH-060 in Appendix D of the *Health and Safety Plan*, Energy Fuels, 2009j). An RWP would be required for any work with radioactive materials which has not been described in a written operating or maintenance procedure. According to Energy Fuels' *Health and Safety Plan* (Energy Fuels, 2009j), activities that may require a RWP include:

- Work on equipment (pumps, piping etc) in the near vicinity of any unshielded (shutter open) nuclear source.
- Work on the all bag houses or pollution control equipment which may contain radioactive material.
- Work involving processing equipment, e.g. work in a tank containing or suspected to contain concentrated uranium (yellowcake or pregnant solution) in a dry form or in such a form that contamination by ingestion or inhalation of radioactive materials could occur.
- Work offsite where occupational or environmental monitoring is necessary.
- Work as directed by the RSO or the Assistant RSO.

Radiological constituents would be monitored aggressively and frequently in occupational areas of the mill as part of the Health and Safety and ALARA programs. The results would be evaluated to identify any constituents at levels that may adversely affect public or occupational health during normal operations or in the event of an accident, emergency or release. The following specific radioactive measurements are included in the Radiological Monitoring Program:

- Direct Gamma Radiation;
- Personnel External Dosimetry via TLD/OSLs;
- Airborne Particulates - Long Lived Radionuclides;
- Radon Progeny in air;
- Surface Contamination Surveys;
- Bioassay, including Urinalysis and In Vivo Programs as necessary.

Procedures for these Radiation Safety Monitoring programs are included in the Piñon Ridge Mill *Health and Safety Plan* (Energy Fuels, 2009j).

Breathing-zone and area air samples would be used to estimate radionuclide intakes (and internal dose) via inhalation by mill workers. Additionally, exposure to soluble uranium would be limited to a weekly intake of 10 mg based on chemical toxicity. Air monitoring results would be reviewed by the RSO or designee within two working days after receipt of the analytical results. Under routine mill operating conditions, breathing zone air samples would be used to assess

radionuclide concentrations in air when those concentrations could be greater than 0.1 Derived Air Concentration (DAC). In contrast, area air samples would be used exclusively to measure air concentrations in areas where the radionuclide concentrations range from 0.01 to 0.1 DAC. Below 0.01 DAC, air samples would not be required but would be collected periodically to verify radionuclide concentrations in these areas remain low. Using the above criteria, the RSO would make the decision as to the types of air sampling and frequencies most appropriate for the work conditions (Visus and Energy Fuels, 2009b).

Elevated air concentrations of Rn-222 and its progeny may occur near ore storage bins, near crushing and grinding circuits, or in enclosed locations where large quantities of dry ore is stored. Indoor radon progeny (daughters), working level (WL), measurements in work areas would be the preferred sampling and measurement method utilized. However, the need for continuous radon progeny concentration measurements may be required, as determined by the RSO. The modified Kusnetz method for measuring radon progeny in working levels would be used to assess radon progeny concentrations. Automated equipment and systems for continuous radon in air measurement may also be used (Visus and Energy Fuels, 2009b).

Gamma radiation surveys would be performed at least semiannually throughout the mill and facility representative of where workers are potentially exposed. The RSO would evaluate methods to lower exposure rates to levels that are ALARA.

Surface contamination surveys (both for fixed and removal contamination) would be routinely conducted to maintain levels of radioactive material within both radiologically restricted and unrestricted areas ALARA to workers and the public (Visus and Energy Fuels, 2009b).

Bioassays would be required for all mill operation personnel potentially exposed to yellowcake. The urinalysis program that would be conducted at the mill would follow the intent of NRC Regulatory Guides 8.22, “Bioassay at Uranium Mills” and 8.25, “Acceptable Concepts, Models, Equations, and Assumptions for a Bioassay Program.” In- vivo lung counts would be conducted in response to confirmed urinalysis results in accordance with the criteria in NRC Regulatory Guide 8.22, “Bioassay at Uranium Mills” (Visus and Energy Fuels, 2009b).

Certain process materials in the mill would be inspected for, sampled, and analyzed to determine radiological and chemical compositions. The results of these samples would be used to model doses, calculate exposures, or evaluate occupational and public safety at the mill (Visus and Energy Fuels, 2009b).

In addition, environmental monitoring would be conducted through the Effluent Monitoring Program for several media including soil, surface water, groundwater, air, vegetation and animal tissue as follows (Visus and Energy Fuels, 2009b). The data collected from environmental samples would be used to assess undesirable trends relative to the results of the pre operational baseline characterization program. The operational radiological monitoring program will be conducted in accordance per NRC Regulatory Guide 4.14, Table 2. Additionally, the environmental monitoring data can be used to model doses to off-site receptors or evaluate the accuracy of modeled doses.

- Soil: Surface soil sample would be collected at four random locations across the Site, at each of the five air monitoring stations, and collocated with the four surface water samplers on an annual basis. In addition, the top 1 cm of soil would be collected from at least three locations each downwind of the evaporation ponds, each active tailings cell, and the ore pad. Soil sample would be analyzed for uranium, radium-226, and lead-210.

- Surface Water: Four surface water samplers are located within the three major downgradient drainages and one upgradient drainage. Samples would be collected following storm events creating sufficient run-off to sample on a quarterly basis for each type of run-off event (i.e. storm event and snowmelt). Samples would be analyzed for uranium, radium-226, radium-228, thorium-230, and lead-210 as well as nonradiological parameters described above.

- Groundwater: Groundwater would be monitored at the following locations and frequencies:
  - Thirteen on-site groundwater monitoring wells (four upgradient and nine downgradient of the mill) would be sampled monthly during the first year of operations and quarterly thereafter.
  - At least five production on-site and off-site production wells would be monitored for water levels biweekly to monthly during transient and static states, respectively. These wells would be sampled quarterly.
  - Five off-site wells would be monitored for productivity and field parameters quarterly and sampled annually.
  - One off-site spring (Stone Spring) would be monitored for flow and field parameters quarterly for the first two years of operation and semiannually thereafter. The spring would be sampled semiannually throughout operations.

  Groundwater samples would be analyzed for dissolved uranium, radium-226, radium-228, thorium-230, and lead-210 as well as nonradiological parameters described above. Production well PW-3 would be analyzed for total radionuclides as well because it would be used for stock watering as well. The wells would be monitored to warn of contamination from the mill site and to evaluate changes in on-site and off-site water quality induced by pumping of the productions wells.

- Total Suspended Particulates (TSP): TSP would be monitored at three on-site and two off-site air monitoring stations continuously. Filters on the TSP samplers would be exchanged on approximately a biweekly basis, depending on loading. The TSP filters would be composited quarterly for each site and analyzed for uranium, radium-226, thorium-230, and lead-210.

- Radon-222: Radon-222 would be sampled continuously on track-etch detectors at each of the five air monitoring stations. The detectors would be exchanged on a quarterly basis.

- Gamma: Environmental dosimeters (e.g. OSLs) are located each of the five air monitoring stations to measure environmental gamma. The detectors would be exchanged on a quarterly basis.

- Leak Collection and Recovery Systems: The tailings cells and evaporation pond cells would each have multiple liners with a dedicated leak collection and recovery system (LCRS) located below the primary liner for seepage collection. Any seepage through the primary liner would be collected in the LCRS and routed via gravity flow to an LCRS sump located in each tailings cell and evaporation cell. The LCRS sumps would be equipped with water level indicators, and portable submersible pumps, as necessary, to automatically remove any water collected in the sump to the respective tailings cell or evaporation pond cell. Additionally, the LCRS risers would be instrumented to

automatically report to the mill control and alarm system, providing continuous, online monitoring.

- Surface seepage: If observed, surface seepage would be sampled and analyzed for the same constituents as surface water.

Closure

A detailed decommissioning plan would be required prior to commencement of closure of the site and would include an Effluent Monitoring Program. The Effluent Monitoring Program would be an extension of the monitoring program conducted during operations. It would include provisions for the collection and analysis of airborne and liquid effluents, for assessing radiation exposures to members of the public, and for demonstrating compliance with applicable regulations.

Energy Fuels would demonstrate, through the mill operations and decommissioning protocols, that it has an Effluent Control Program to control radioactive material in effluents and to comply with all applicable standards and permit requirements related to the release of radioactive material in effluents, as required in applicable sections of CDPHE Part 4 and 18 (CDPHE, 2005b and 2001).

4.12 WASTE MANAGEMENT

4.12.1 Environmental Impacts

4.12.1.1 General Impacts

Activities associated with construction, operation, and closure of the Mill Facility would generate nonradiological and radiological solid and liquid waste streams. The possible waste streams are identified in the following sections as well as the controls and disposal methods for each. As provided in the sections above, to avoid and prevent waste management impacts, Energy Fuels has prepared and would implement the following plans:

4.12.1.2 Construction, Operations, and Closure Impacts

4.12.1.2.1 Construction

Waste generated during construction of the Mill Facility would be similar to waste generated at a typical construction site and would not include the generation of any radiological waste. Energy Fuels would require, through contractual provisions, that contractors involved in construction implement the appropriate plans and procedures described in this ER (e.g., SWMP and SPCC Plan) to protect the environment from waste-related impacts. An appropriate number of port-a-potties and dumpster containers would be available and would be properly maintained. Waste generated during construction would be handled as described in Section 4.12.1.2.2, Operations – Nonradiological below.

4.12.1.2.2 Operations

Nonradiological

Nonradiological waste would include any waste generated outside of the licensed area (e.g., administration building, warehouse, shop) and waste generated within the licensed area that has been scanned and verified to be below radiological screening levels. Radioactive waste materials that could not be decontaminated to meet general release criteria would be disposed

of in a tailings cell (e.g., worn out equipment such as pumps) or in appropriated off-site disposal facility. Operation of the Mill Facility would generate various types of nonradiological waste, including those discussed below.

Solid Waste. Solid waste would include items such as lunch room wastes, cardboard, paper, packing materials, empty cans, etc. The solid waste would be stored in an area inaccessible to wildlife (e.g., bears) and then sent to a landfill. Recyclable materials such as scrap metal, aluminum cans, paper, etc would be stored in separate bins for shipment to recycling facilities.

Special Waste. Special waste would include items such as batteries, tires, fluorescent light bulbs with mercury, paint, used oil, used antifreeze, etc. Recyclable batteries, tires, light bulbs, and similar materials would be stored, picked up, and recycled. Used oil and antifreeze would also be stored and recycled. Empty spray paint cans would be punctured over a 55-gallon drum and emptied of any residuals. When the paint drum fills up, it would be recycled or appropriately disposed. Oil cans, paint cans, and similar containers would be drained of their contents, crushed, and disposed of with the solid waste.

Hazardous Waste. Energy Fuels would, to the extent practicable, avoid using products that generate hazardous waste. Hazardous waste could include items such as used solvents and old pesticides. Solvent stations would typically consist of wash sinks over small drums of solvent. The solvent would be reused until it is too contaminated with oils and grit and then the drums would be recycled by a vendor and replaced with new drums of solvent. Occasionally other materials are purchased for specialized applications that may be considered hazardous waste if not totally consumed. If only partially consumed, these materials would be properly stored and used at a later time or disposed of at an appropriate hazardous waste facility. Hazardous waste would be stored and handled in accordance with RCRA regulations that are enforced by CDPHE.

Gray Water. Gray water would be used water from the showers, sinks, and laboratory. The source water for the gray water would be the potable water system, and 100 percent of the gray water would be recycled into the process water system (see Section 4.12.1.2.2) through the process water tank.

Septic Systems. Effluent from the sanitary facilities would flow by gravity to engineered leach field septic systems designed according to state and county health and sanitation requirements regarding sewage disposal. The sanitary septic system would handle waste from the urinals and commodes in the mill. The 3,475 square foot septic system was designed by Kleinfelder to handle 3,885 gallons per day (Kleinfelder 2008j). The water from the potable water system would flow to the bathrooms and then from the urinals and commodes into the septic system. The administration building would have a potable water supply that would feed through the building. All building drains, water coolers, commodes and urinals would drain to the sanitary septic system. The 544 square foot system was designed by Kleinfelder to dispose of 608 gallons per day (Kleinfelder 2008j).

Radiological

Following the extraction and recovery of the uranium and vanadium from the ore, the remaining waste products from the milling operation are disposed onsite, in engineered facilities designed to protect the environment (i.e., tailings cells and evaporation ponds). These facilities are designed to contain 40 years of waste material at a milling rate of 500 tons per day. The waste products are referred to as 11e.(2) byproduct material and are not considered hazardous waste. Section 11e.(2) of the Atomic Energy Act (as revised in 1978 and in 2005 by the Energy Policy

Act) provides the following definition for byproduct material: “the tailings or waste produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content.” The provisions in 40 CFR 261 list solid wastes that are considered hazardous waste and which are regulated under Subtitle C of the Resource Conservation and Recovery Act (RCRA). To be a hazardous waste, the material must be a solid waste. Under 40 CFR 261.4(a)(4), source, special nuclear, or byproduct material as defined by the Atomic Energy Act is not considered a solid waste and is, therefore, not a hazardous waste. The 11.e(2) byproduct materials are described below.

Tailings Slurry. The milling process includes grinding and leaching the ore with sulfuric acid to liberate uranium and vanadium from the solid matrix. These metals enter into solution and are separated from the barren solid waste in the CCD thickeners. The pregnant metal-bearing solution flows from the top of the first thickener and is directed to the next step in the processing circuit. The solid waste, consisting predominantly of a thick, low-pH slurry of fine-grained sands, is pumped from the bottom of the last thickener to the tailings box. At the tailings box, the solid waste stream is mixed with the barren process water from the SX system, called raffinate, and is then pumped to an active tailings cell.

The tailings cells would be permanent disposal facilities consisting of three liners with an LCRS system between the primary and secondary liners. In the tailings cell, the solids would settle out of solution while most of the process water would remain at the top of the tailings cell, where it would be recovered and pumped back to the mill for reuse. Although this solution is projected to have a low pH (3.3) and high dissolved solids content, it would be reusable for some applications within the mill. An underdrain on top of the primary liner would also allow for recovery of water draining from the base of the tailings. The main radioactive materials remaining in the tailings are Thorium-230 and Radium-226, which are decay products of Uranium-238 pesent in the uranium ore.

Raffinate. Once the supply water is utilized in the milling process, it is termed process water. The process water is utilized in all areas of the plant and is recycled wherever practicable. After uranium and vanadium have been recovered from the process stream in the solvent extraction building, the barren solution (i.e. raffinate) is pumped to the tailings box where it is used to dilute the tailings as described above. Excess raffinate, which has a projected pH of 4.4 and high levels of dissolved solids (typically 70,000 to 100,000 parts per million total dissolved solids) can not be recycled cost-effectively. This excess solution would be pumped to the evaporation pond where the water would be allowed to evaporate and the dissolved solids would precipitate out of solution (mostly as sulfate compounds) in the bottom of the lined ponds. Based on samples collected at other uranium milling facilities, radionuclide activity levels in the precipitated compounds would be very low compared to the activity levels in the tailings.

The evaporation ponds would be lined in a similar fashion to the tailings cells. The initial, total lined evaporation pond area would be approximately 40 acres. Evaporation of the raffinate solution is enhanced by mechanical means (i.e., the use of bubblers, fountains, or misters) within the central area of the ponds. As evaporation ponds fill with salts, new ponds would be constructed thus increasing the evaporation pond area to 80 acres over the life of the facility.

4.12.1.2.3 Closure

At the time of cessation of mill operations, some radiological and nonradiological wastes would remain in the mill systems and inventory as described in the *Mill Decommissioning Plan* (Kleinfelder, 2009b). Mill closure activities associated with and closure procedures for the

tailings cells and the evaporation ponds (radiological waste) are provided in Section 4.11.1.2.3 above. Specific nonradiological waste-handling plans would include:

- Removal of product – any remaining milling product would be removed for sale or placed in the disposal vault (vault) in Tailing Cell C (Kleinfelder, 2009b);
- Disposal of process liquids – organic and inorganic process liquids would be stripped and neutralized as necessary for either on-site disposal in the evaporation pond or off-site recycling or disposal at a licensed facility;
- Removal of circuit residues – liquid mill circuits would be flushed to the evaporation pond and solid residues would be collected for disposal in the tailings vault;
- Removal of pond solids – evaporation pond solids would be allowed to dry, then mixed with soil as needed to excavate and handle as dry solids for disposal in the vault;
- Removal of reagents – reagents that are uncontaminated would be returned to the vendor. Contaminated reagents would be handled as process liquids; and
- Oil and Lubricants – oil and lubricants that are uncontaminated would be returned to the vendor; if contaminated they would be sent to a licensed mixed waste facility for treatment and disposal.

4.12.2 Protective/Mitigation Measures

- Energy Fuels would dispose of all wastes in accordance with applicable local, state, and federal regulations.
- Waste minimization practices would be developed and implemented to the extent practicable.

4.12.3 Monitoring

Routine sampling of the raffinate solution (discharged to the evaporation ponds) and the tailings solution and sands (discharged to the tailings cells) would be conducted to provide continuous tail grade characterization of these byproduct wastes during the operational phase of the Mill Facility. Samples of the tailings slurry would be collected daily. Additionally, quarterly samples of the tailings sands and supernatant solution would be collected at the tailings cells. Samples of the raffinate and evaporitic salts would be collected at the evaporation ponds on a quarterly basis. These samples would be analyzed for the parameters listed in Table 9-2 in the *Operational Monitoring Plan* (Visus and Energy Fuels, 2009b) to characterize the materials for environmental planning purposes.

Section 5.0
Summary of Impacts

Resource	Construction	Operations	Closure
Land Use			
Regional and Local Land Use Patterns	Construction would not impact regional land use patterns. Landowners accessing surrounding lands from SH 90 would be affected by construction traffic potentially increased up to 40 percent above existing levels (see Transportation).	Operation would not impact regional land use patterns. Landowners accessing surrounding lands from SH 90 would be affected by operation traffic potentially increased up to 24 percent above existing levels.	Closure would not impact regional land use patterns. Landowners accessing surrounding lands from SH 90 would be affected by closure traffic less than during construction and operation.
Agriculture	Construction would remove 880 acres of seasonal grazing land and 90 to 124 AUMs. No commercial crop production would be affected by construction.	Seasonal grazing lands and AUMs removed during construction would continue to be removed during operations.	Closure would allow 722 acres to return as seasonal grazing land and 72 to 102 AUMs. There would be a permanent loss of 158 acres of seasonal grazing land and 16 to 22 AUMs for tailing cells.
Mineral Resources and Mining	Construction of the Mill would stimulate uranium/vanadium ore production in the region and allow reopening of some idle mines.	Operation of the Mill would stimulate uranium/vanadium ore production in the region and allow reopening of some idle mines.	Closure of the Mill could impact uranium/vanadium ore production in the region.
Recreation	Increased traffic could potentially impact Dolores River floaters en route to Bedrock launch site and bicyclists on SH 141 and SH 90. There would be 880 acres removed for hunting big game and small game within the Site during construction.	Increased traffic could potentially impact Dolores River floaters and bicyclists on SH 141 and SH 90, especially by ore trucks. Loss of 880 acres for hunting big game and small game within the Site would continue during operations.	Traffic impact to Dolores River floaters and bicyclists on SH 141 and SH 90 would be less than during construction and operation. 722 acres would potentially be returned to hunting use.
Land Use Planning Issues	The Site would become an area for commercial and industrial development, authorized by Montrose County, rather than rangeland.	The Site would continue as a commercial and industrial site.	Closure would allow 772 acres of the Site to be returned to rangeland.
Transportation			
Regional Traffic	Impact from increased traffic on SH 90 between the Site and SH 141 junction could potentially be 40 percent above 2008 levels, and 30 percent above existing levels on SH 141 between Naturita and 2 miles north of SH 90 junction.	Impact from increased traffic during operations on SH 90 between the Site and SH 141 junction could potentially be 24 percent above 2008 levels, and 18 percent above existing levels on SH 141 between Naturita and 2 miles north of SH 90 junction.	Traffic associated with closure would be less than during construction and operations. Impact would be concomitantly less as well.
Vehicular Crashes	Increased construction traffic could potentially result in 0.46 fatal and 0.7 injury highway crashes during the 630 day construction period.	The Proposed Action could potentially result in 0.06 fatal and 0.09 injury highway crashes each year of Mill operation.	The Proposed Action could potentially result in between 0.004 and 0.007 fatal, and 0.007 and 0.01 injury highway crashes during the 855 day closure period.
Geology and Soils			
Soil Productivity	Construction would result in disturbance of 414.6 acres of soil with potential for erosion and loss in productivity. Subgrade soils would be compacted in place or excavated and replaced with compacted materials required for construction of the Mill Facility.	During operations, surface disturbance outside of the Mill License Boundary and ancillary facilities would have been stabilized with vegetation and other methods. Potential impacts during construction might consist of erosion and sedimentation of surface drainages.	The primary earthwork involved in restoration would be removal of the ore pad, evaporation ponds, and mill pad, with redistribution of these contaminated soils in the final tailings cells. These areas outside the tailings cells would be regraded to original contours, topsoiled, and seeded.
Geologic Hazards	Impacts resulting from geologic hazards are not anticipated during construction. The Maximum Credible Earthquake has a probability of occurrence of 2 percent in 50 years, corresponding to a return period of 2,475 years. Liquefaction potential at the Site is negligible. Volcanism is not a threat.	All Mill Facilities would be designed in accordance with Montrose County building codes, now transitioning to the International Building Code (IBC), which includes a more comprehensive analysis of earthquakes. Under the IBC, the facility would be designed based on the Design Earthquake, which has a magnitude 4.8 at a distance of 10 miles from the Site.	Impacts resulting from geologic hazards are not anticipated during closure because the reclaimed tailings cells would have high factors of safety for earthquakes and the gradual, rock armored slopes are designed to pass the PMP storm event.
Water Resources			
Surface Water	Impacts to surface water quantity and quality are not expected during construction because Energy Fuels would obtain a Construction Stormwater Permit and follow BMPs in their Stormwater Management Plan. During construction of the stormwater control structures, there is the potential of stormwater eroding disturbed areas and contributing sediments to East Paradox Creek. Access roads and stormwater control structures would be completed before any other facility construction begins and would be in place to manage runoff and sediment through the construction of all other facilities.	Operation would result in capture of runoff from the Mill Facility in quantities up to 428 acre-feet/year under maximum annual precipitation. Impacts to surface water quality are not expected because the facility is designed as zero discharge. A large storm could possibly cause runoff erosion in diversionary channels, and add to turbidity in East Paradox Creek.	During closure, decommissioning would potentially expose some soils to possible erosion. Contaminated material from the Mill and evaporation ponds would be transported to, and placed in, the final tailings cell. There would also be potential for residual amounts of radioactive material to be spilled or blown as dust during closure activities. In post-closure, only the diversionary dike at the south end of the Site and channels bypassing the sealed tailings cells would remain, which should not measurably alter the natural hydrology.
Groundwater	Groundwater withdrawals from the bedrock aquifer would begin during construction and would be closely monitored to evaluate impacts on the aquifer. Stormwater control structures would intercept water that would otherwise have infiltrated or run off. This reduction of surface infiltration to groundwater has been claimed by Energy Fuels as a water right for industrial use.	Groundwater withdrawals from the bedrock aquifer and interception of a small amount of runoff from the facility would decrease combined groundwater discharge from the southeast portion of Paradox Valley to the river. This could potentially cause a slight decrease in groundwater flow to the river during operations, but it is unlikely this would be measurable. The water demand (224 acre-feet/year) is less than the annual average capture of rainwater by the zero-discharge area (252 acre-feet/year).	Potential impacts in closure include the gradual return of the groundwater system to its original baseline conditions with flows toward the Dolores River.
Water Use	Water use during construction would be minimal and would be mostly limited to that required for dust control and moisture conditioning of compacted soils.	There would be a consumptive use of 144 gallons per minute of water for operations. Drawdown of the aquifer could potentially impact surrounding wells.	Water use during closure would be minimal and would be mostly limited to that required for dust control and moisture conditioning of compacted soils.

Resource	Construction	Operations	Closure
Ecological Resources			
Vegetation	Construction would cause long-term removal of 236.5 acres of big sagebrush shrubland and 71.3 acres of mixed grassland within the Mill License Boundary; long-term removal of 8.8 acres of big sagebrush shrubland and 37.3 acres of mixed grassland outside of the Mill License Boundary; short-term removal of 2.3 acres of big sagebrush shrubland and 58.4 acres of mixed grassland outside of the Mill License Boundary.	Operation of the Proposed Action would displace native and domestic herbivores, causing browsing and/or grazing on vegetation resources that would otherwise not occur. Surface disturbance, increased vehicle traffic, equipment placement and operation, foot traffic, and other activities associated with operation may promote the spread of invasive plants and noxious weeds and affect native vegetation.	The majority of the Site would be returned to rangeland use, with the exception of the tailings cells, which would be capped with an engineered soil cover and revegetated. Revegetation would include spreading the salvaged topsoil over disturbed areas, seeding with a native seed mix, and mulching. Closure monitoring would include repair of eroded areas, implementation of weed-control measures, and reseeding areas with sparse vegetation.
Wetlands	No direct or indirect impacts are expected during construction.	No direct or indirect impacts are expected during operations.	No direct or indirect impacts are expected during closure.
Invasive, Non-native Species	Infestations of non-native species are already present. Additional noxious weed growth is possible in disturbed areas following surface disturbance, primarily along roads and areas of development; however, the spread of noxious weeds would be controlled through implementation of Energy Fuels' weed control program.	Additional noxious and invasive weed species could potentially be introduced by ore trucks entering the Site from mines outside the county or state, including invasive species not currently located at or within the vicinity of the Site; however, the spread of noxious weeds would be controlled through implementation of Energy Fuels' weed control program.	The potential for invasive, non-native species to become established, as during construction, would continue during closure; however, the spread of noxious weeds would be controlled through implementation of Energy Fuels' weed control program.
Federally Listed Threatened and Endangered Species	Increased traffic would increase the potential for mortality of Canada lynx Noise generated during construction could exceed 70 dBA in pinyon-juniper habitat and could disturb Mexican spotted owls if they are present. Accidental spills of petroleum products into the Dolores or San Miguel rivers could impact the four Colorado River endangered fish; however, the risk of a spill to the rivers is negligible. A spill would not be toxic 65 miles downstream where the fish species occur.	Increased traffic would increase the potential for mortality of Canada lynx. Restriction of most traffic to daylight hours would reduce but not eliminate risks of collisions of project-related vehicles with lynx. Noise generated during construction could exceed 57 dBA in pinyon-juniper habitat and could cause alert behaviors in Mexican spotted owls if they are present. Water depletions within the Upper Colorado River Basin could potentially affect the four endangered fish species and their designated critical habitats. Operation of the Mill Facility would withdraw water at an average annual depletion of 227 acre-feet. During operations, an accidental spill of ore, yellowcake, chemical reagents, or petroleum products could temporarily impact a short section of the river. The risk to endangered species is negligible because they are located 65 miles from potential spills.	The potential for vehicle collisions with lynx would be less than during construction or operation. Noise generated during construction could exceed 70 dBA in pinyon-juniper habitat and could disturb Mexican spotted owls if they are present. No impacts to the four endangered fish species due to closure are anticipated. Impacts from potential spills would be the same as described for construction.
Candidate Species	Soil disturbance during construction of the Mill Facility could provide habitat suitable for colonization by Gunnison's prairie dogs during or following construction. If they do colonize, they could be susceptible to direct mortality by construction equipment. Construction could potentially interfere with attempted movements by Gunnison Sage-grouse between occupied habitat in Dry Creek Basin and potentially suitable habitat in the East Paradox Valley.	Gunnison's prairie dogs could be impacted they access the evaporation ponds or tailings cells. The Mill Facility could potentially hinder re-establishment of Gunnison Sage-grouse populations in East Paradox Valley during operations because sage-grouse are sensitive to disturbance from roads and noise during breeding and females avoid nesting and utilizing brood-rearing habitats in areas with high levels of human presence.	No impact to Gunnison's prairie dogs is expected during closure. Site demolition and earthwork activities would tend to limit sage-grouse migration into the area because of the associated noise and traffic.
BLM Sensitive Species and State of Colorado Species of Special Concern	Noise from traffic and other sources during construction could potentially interfere with bats' echolocation of insect prey; however, most construction activity would occur during daylight hours when bats are not active. Removal of foraging habitat, or alteration in vegetation cover and vegetation composition from introduced, invasive species may negatively affect pocket gophers, if present. Accidental spills of petroleum products into the Dolores or San Miguel rivers could occur and affect Northern river otters, if present. The risk of a spill into the rivers is negligible. Increased traffic would increase the potential for bald eagles to be killed while feeding on roadside carrion.	Night lighting could potentially act as barriers to bat movements, reduce bat activity in the immediate vicinity or have an opposite effect, depending on light sources, by attracting nocturnal insects. Pocket gophers, if present, could potentially be impacted by passing through chain-link fencing to the evaporation ponds and the tailings cells. During operations, an accidental spill of ore, yellowcake, chemical reagents, or petroleum products could spill into the rivers potentially impacting river otters. The risk of a spill into the rivers is negligible. Increased traffic would increase the potential for bald eagles to be killed while feeding on roadside carrion.	Potential effects to bats during closure would be similar to those expected during construction. Pocket gophers would be effectively excluded from the tailings cells by the bio-intrusion barrier. An accidental spill of petroleum products into the Dolores or San Miguel rivers could affect otters, if present. The risk of a spill into the rivers is negligible. Increased traffic would increase the potential for bald eagles to be killed while feeding on roadside carrion.

Resource	Construction	Operations	Closure
	Western burrowing owls could be indirectly impacted during their breeding season from noise and vibration associated with construction and increased human presence, habitat loss including destruction or degradation of foraging habitat adjacent to occupied or potentially occupied burrows, and decrease in prey species. Midget faded rattlesnake could be impacted during construction if cover or hibernacula are removed, or if traffic associated with the Proposed Action increases road mortality. An accidental spill of petroleum products into the Dolores or San Miguel rivers could affect fish. The risk of a spill into the rivers is negligible.	Burrowing owls might not re-colonize the abandoned prairie dog burrows located west of the Site in the vicinity of the soil stockpiles because of increased human activity. Midget faded rattlesnake could be adversely impacted during operation if cover or hibernacula are removed, or if traffic associated with the Proposed Action increases road mortality. During operations, an accidental spill of ore, yellowcake, chemical reagents, or petroleum products could spill into the rivers potentially impacting fish. The risk of a spill into the rivers is negligible.	Impacts to burrowing owls during construction would be similar to those during closure but the presence of burrowing owls cannot be predicted. Midget faded rattlesnake could be adversely impacted during closure if cover or hibernacula are removed, or if traffic associated with the Proposed Action increases road mortality. An accidental spill of petroleum products into the Dolores or San Miguel rivers could affect fish. The risk of a spill into the rivers is negligible.
Terrestrial Wildlife	Construction of fencing along the Property Boundary could potentially cause mule deer and elk mortality. Habitat supporting mule deer and elk would be removed during construction potentially causing displacement of other animals from adjacent winter range and severe winter range. Functions of habitat could diminish. Increased poaching of big game could occur with increased population. Increased traffic would increase the potential vehicle collisions with big game, small game, and non-game species. Construction during the migratory bird nesting season between May 15 and July 15 could potentially result in a take of nesting migratory birds. Increased noise could cause birds to abandon nests.	Construction of fencing along the Property Boundary could potentially cause mule deer and elk mortality. Habitat supporting mule deer and elk would be removed during construction potentially causing displacement of other animals from adjacent winter range and severe winter range. Functions of habitat could diminish. Increased poaching of big game could occur with increased population. Increased traffic would increase the potential vehicle collisions with big game, small game, and non-game species. Most migratory bird species would be excluded from evaporation ponds and tailings cells by the use of bird netting and bird balls; however, there could potentially be impact to smaller non-game wildlife if they are not effectively excluded from the evaporation ponds or tailings cells.	Risk of vehicle collisions with big game, small game, and non-game species would be less than that during construction and operations. The presence of and effects to migratory birds, small game, and non-game species during closure cannot be predicted.
Aquatic Species	Potential impact to aquatic species could occur from an accidental spill of petroleum products into the Dolores or San Miguel rivers. The risk of a spill into the rivers is negligible.	During operations, impacts to aquatics species could potentially occur from spills of ore, chemical reagents, petroleum products, or yellowcake into the Dolores or San Miguel rivers. The risk of a spill into the rivers is negligible.	An accidental spill of petroleum products into the Dolores River or San Miguel Rivers could potentially affect aquatic species. The risk of a spill into the rivers is negligible.
Air Quality			
Emissions	Emissions during construction would be limited to fugitive dust emission associated with construction equipment and emissions from the diesel engines. There would be no exceedance of either National Ambient Air Quality Standards or Colorado Ambient Air Quality Standards.	Emissions during operations would include both fugitive and non-fugitive emissions, primarily PM_{10} and VOC emissions. There would be no exceedance of either National Ambient Air Quality Standards or Colorado Ambient Air Quality Standards.	Emissions during closure would be similar to those during construction. There would be no exceedance of either National Ambient Air Quality Standards or Colorado Ambient Air Quality Standards.
Noise			
Mill Site	Maximum estimated noise generated by construction equipment within the Site would attenuate to background levels (40 dBA) 5,000 feet away.	Maximum estimated noise generated by operation equipment (87 dBA at 50 feet) within the Mill Facility would attenuate to background levels (40 dBA) 2,600 feet away.	Maximum noise due to construction equipment during closure would be the same as noise generated during construction.
Traffic	Project related traffic during construction, added to existing (2008) traffic volumes, would generate noise on SH 90 attenuating to background levels 1,590 feet away east of the Mill Site and 1,290 feet away on SH 90 west of the Site.	Project related traffic during operation, added to existing (2008) traffic volumes, would generate noise on SH 90 attenuating to background levels 1,470 feet away east of the Mill Facility and 1,340 feet away on SH 90 west of the Mill Facility.	Traffic volumes would be less than during construction and operation and are expected to generate less noise on SH 90.
Historic and Cultural Resources			
Archeological Sites	NRHP-eligible sites would be avoided during construction. If previously unidentified cultural resources are encountered during construction, Energy Fuels would implement *the Unanticipated Discovery Plan* and confer with SHPO, as appropriate.	NRHP-eligible sites would be avoided during operations. If previously unidentified cultural resources are encountered during operations, Energy Fuels would implement the *Unanticipated Discovery Plan* and confer with SHPO, as appropriate.	NRHP-eligible sites would be avoided during closure. If previously unidentified cultural resources are encountered during closure, Energy Fuels would implement the *Unanticipated Discovery Plan* and confer with SHPO, as appropriate.
Visual and Scenic Resources			
Visibility	Large vehicles and construction equipment could be seen from Key Observation Points on SH 90. Areas stripped of vegetation and soil stockpiles would also be visible during the construction period.	Visual resources observed from Key Observation Points on SH 90 are not expected to be substantially impacted. However, middle and background viewsheds would be altered for the 40 year life of the Mill Facility. The administration building and associated parking area would be 675 feet from SH 90 and would be clearly visible to observers using the road. Outdoor lighting at the Mill Facility would change the nighttime viewshed in a place where no lights previously existed.	Large vehicles and construction equipment could be seen from Key Observation Points on SH 90.

Resource	Construction	Operations	Closure
Socioeconomic Resources			
Environmental Justice	No construction-related impact to minority populations, low income population, or Indian Tribes is expected.	No operation-related impact to minority populations, low income population, or Indian Tribes is expected.	No closure-related impact to minority populations, low income population, or Indian Tribes is expected.
Workforce	Construction workforce would increase from 25 workers in the 1st quarter to 200 workers in the 4th and 5th quarters, and fall to 10 workers during the 7th (final) quarter of construction. Local workers are expected to comprise 20 percent of the construction workforce. Additional indirect employment impacts of 126 workers.	Operational workforce would include 85 workers. Local workers are expected to comprise 80 percent of the operational workforce. Additional indirect employment impacts of 230 workers, mostly related to mining-activities.	Closure will cause the loss of 85 operational jobs. Closure workforce would include 10 workers. Local workers are expected to comprise the entire closure workforce. Minimal indirect employment impacts.
Economic Benefits	$14.3 million in regional labor income and $35.5 million in regional business sales during 21 month construction period.	$18.7 million in annual regional labor income and $140 million in regional business sales every year the Mill Facility is in operation	$662,857 in regional labor income and $1.65 million in regional business sales during 33 month closure period.
Population	Construction of the Mill Facility is expected to attract construction workers from across western Colorado and eastern Utah. Construction workers are transient workers who would typically not relocate permanently to communities near the job site and would not impact regional population trends.	No impact on regional population distributions because fewer than 20 mill workers would be expected to relocate to Paradox Valley. Some population gains in local communities of Naturita, Nucla, Bedrock, and Paradox.	No impact on regional or local population distributions is expected during closure although Mill closure could lead to population losses in local communities.
Housing	The Mill's peak construction workforce would be likely to fully occupy available short-term rentals in the local area, causing upward pressure on short-term housing prices, including motels and RV sites.	Because of the small influx of new residents, the Mill's operational workforce is not expected to face severe housing constraints or a rapid increase in prices in the local area.	Mill closure could result in falling housing prices regardless of out-migration of workers and population loss.
Land Values	Initial public perceptions could impact land values in the Paradox Valley.	The Proposed Action is not expected to have a long-term impact on agricultural and residential land values in the Paradox Valley.	Closure would have no impact on agricultural and residential land values in the Paradox Valley.
Community Services	The Mill's peak construction workforce could place increased demands on local medical services, volunteer fire departments, and public safety officers.	Mill operations would not impact local public safety services. Likely increase in insured patients using local medical services.	Mill closure could result in falling school enrollments. Mill closure would not be expected to have an adverse impact on medical service providers and public safety officials, nor on local water and wastewater treatment facilities.
Sales Tax Revenues	During 21 month construction period, sales and use tax revenues are estimated at $2.48 million to State of Colorado, $288,118 to Montrose County, and $286,118 to Montrose County, and $33,769 to each of the towns of Naturita and Nucla.	During Mill operations, annual sales and use tax revenues are estimated at $241,516 to the State of Colorado, $120,000 to Montrose County, and $58,841 to each of the towns of Naturita and Nucla.	During 33 month closure period, sales and use tax revenues are estimated at $194,868 to the State of Colorado, $116,678 to Montrose County, and $2,612 to each of the towns of Naturita and Nucla. Final Mill closure would result in the loss of sales tax revenue associated with Mill expenditures and household spending of income derived from mill operations.
Property Tax Revenues	Construction would generate approximately $37,796 in property taxes, derived by multiplying the unimproved land value of the Mill Site by a 29 percent assessment rate and then by the 2008 mill levy.	Property taxes are estimated to range between $1.9 in Year 1 and $1.1 million in Year 10 over the first 10 years of Mill operations.	Final Mill closure would result the loss of property tax revenue based on real and personal property values at the Mill Facility.
Public and Occupational Health			
Nonradiological	Potential nonradiological impacts associated with construction (i.e., trips and falls, strains, electrocution, crushing, pinching, fuel spills or releases, etc.) would be similar to those at any industrial construction site and would be prevented or mitigated by Energy Fuels' adherence to the applicable plans and reports described in Section 4.11.	The Mill Facility would be operated in compliance with MSHA regulations to protect workers and the public. During operations, potential nonradiological impacts include spills and releases of chemical reagents, fuels, feedstock and waste streams that could impact workers. Energy Fuels would implement the applicable plans and reports to protect workers from possible risks.	During closure, potential nonradiological impacts would be the same as operation but to a lesser extent.
Radiological	Potential radiological impacts during construction would be limited to the possible delivery of ore near the end of the construction period. Radiological controls would be implemented in the ore delivery area as identified in Section 4.11.	Potential radiological impacts would be present throughout most of the mill processes. The Mill Facility would be operated in compliance with CDPHE regulations to protect workers and the public. Energy Fuels must maintain radiation levels, to which workers are exposed, below regulatory limits. To protect the public, Energy Fuels must maintain radiation levels to 100 mrem/year (or less) above background at the Property Boundary. Energy Fuels would comply with the applicable plans and reports prepared for the Mill Facility (see Section 4.11).	During closure, potential impacts would be associated with residual radioactivity above background remaining on equipment, structures, and in soils. Energy Fuels would implement the radiological protection procedures applicable plans and reports to protect workers and the public. Post closure, the Site would be surveyed and monitored in accordance with state and federal regulations.
Waste Management			
Nonradiological	Waste generated during construction would be typical of any industrial building site and would be disposed of in compliance with applicable local and state regulations.	Waste resulting from operation of the Mill Facility would be recycled where possible; disposed of in compliance with local and state regulations; and in the case of potential hazardous waste generation, Energy Fuels would abide by RCRA regulations, which are enforced by CDPHE. The septic system would be designed according to state and county requirements.	Waste generated during closure would be disposed of in compliance with local and state regulations.
Radiological	Construction would not generate radiological waste.	The radiological waste generated during operation (i.e., 11e.(2) byproduct material) would be disposed of in the tailings cells and evaporation pond and would be in compliance with state and federal regulations.	At the time of closure, remaining radiological waste would be disposed of in Tailing Cell C, and the tailings cell area would be covered and monitored in compliance with state and federal regulations.

Section 6.0
Cumulative Impacts

6.1 INTRODUCTION

NRC Environmental Review Guidance for Licensing Actions Associated with NMSS Programs (NUREG-1748) requires the evaluation of any past, present or reasonably foreseeable future actions that could result in cumulative impacts when combined with the proposed action (NRC, 2003). NRC guidance does not specify an appropriate geographic scope over which to evaluate cumulative impacts. Guidance issued by the Council on Environmental Quality (CEQ) states that, "It is not practical to analyze the cumulative effects of an action on the universe; the list of environmental effects must focus on those that are truly meaningful." To be meaningful, "cumulative effects analysis should be conducted on the scale of human communities, watersheds or airsheds using the concept of project impact zone" (CEQ, 1997). In other words, the cumulative impact analysis should address the area that might be affected by the Proposed Action.

Consistent with NRC and CEQ Guidance, the cumulative impact analysis considers the effects of past, present, and reasonably foreseeable actions along with the Proposed Action within a project impact zone (Cumulative Impact Area). The Cumulative Impact Area is identified as being bounded to the north by the Gateway community in Mesa County, to the south by U.S. Highway 491 in Dolores County, to the east by the Uncompahgre Plateau, and to the west by U.S. Highway 191 in San Juan County, Utah. This region contains the airsheds, watersheds, and transportation routes that would be most affected by the Proposed Action. The resources that could be affected by existing and future activities within this vicinity are discussed in the sections below.

6.2 PAST ACTIONS IN THE VICINITY OF THE PIÑON RIDGE MILL SITE

The Site and Cumulative Impact Area are centered in a zone of uranium and vanadium deposits known as the Uravan Mineral Belt. This mineralized zone contains a substantial portion of the nation's known reserves of uranium ore, and is the oldest uranium mining region in the United States (DOE, 2007). Historically, almost 1,200 mines were located within the Uravan Mineral Belt, which produced over 63 million pounds of uranium and 330 million pounds of vanadium between 1948 and 1978 (CDNR, 2009b). The Cumulative Impact Area also includes the La Sal and Big Indian Mining Districts in southeastern Utah. Due to falling uranium prices, uranium production fell dramatically across the area in the mid-1980s, and ultimately came to a halt throughout the Cumulative Impact Area. The uranium mines in the Cumulative Impact Area either went on standby or were reclaimed. As discussed in Section 1.0, with the exception of the White Mesa Mill in Blanding, Utah, mills in the area were closed and reclaimed. Improving market conditions in the early 2000s resulted in the resumption of limited mining operations, the reopening of some reclaimed mines (e.g., the Whirlwind Mine) and extensive exploration activity throughout the area (CDNR, 2009a).

According to the CDNR, as of September 2009 there were 33 actively permitted uranium mining projects, including four producing mines, in Colorado's Uravan Mineral Belt. The four producing mines – Sunday, West Sunday, St. Jude, and Topaz mines– are in San Miguel County and are operated by Denison (CDNR, 2009a). These mines ship their ore to Denison's White Mesa Mill.

Denison also operates another three mines within the Cumulative Impact Area – Beaver, Pandora, and Rim mines–in the La Sal region of San Juan County that also ship ore to the White Mesa Mill. Not all of Denison's mines are operating at this time, as they are currently milling alternate feeds and stockpiling ore for resumption of ore milling operations in early 2010. Several smaller mines in both Colorado and Utah have also shipped ore to the White Mesa Mill during the past several years, but are currently inactive because current uranium spot prices (upon which Denison bases its purchasing schedules) are relatively low. Energy Fuels placed its Whirlwind Mine near Gateway on standby in November 2008 after failing to secure a contract with Denison. Energy Fuels continues to move forward with the rehabilitation of the Energy Queen Mine near La Sal, Utah. Uranium exploration activity, although still occurring throughout the region, has cooled significantly over the past two years in response to lower uranium prices.

In addition to uranium mining, mineral development within the vicinity of the Site has included oil and natural gas development. To date, most of this activity has been in San Miguel County, Colorado and San Juan County, Utah. The pace of oil and natural gas development is also highly dependent on market conditions. Periods of active drilling occurred in the mid-1970s to early- 1980s and most recently in the early- to mid- 2000s. The pace of drilling fell dramatically in 2008 due to falling oil and gas prices and the downturn in national economic activity.

Ranching activity has remained stable within the Cumulative Impact Area, although some loss of farm and ranch land has occurred over the past two decades. As discussed in Section 3.0, with the exception of the Gateway Canyons Resort in Gateway, recreation activity in the area is not intensive and only supports a small portion of the population on a seasonal basis. The economy within the Cumulative Impact Area, as represented by Nucla, Naturita, and other small rural towns, was depressed economically prior to the current recession and remains in that state.

6.3 PRESENT AND REASONABLY FORESEEABLE ACTIONS

To evaluate present and reasonably foreseeable actions that may occur within the Cumulative Impact Area that, when combined with the impacts of the Proposed Action, could potentially contribute to cumulate effects, a review of the BLM National Environmental Policy Act (NEPA) registers for the Grand Junction and Uncompahgre field offices in Colorado and for the Utah State Office was completed. Mining applications under review by the Colorado Division of Reclamation, Mining and Safety (DRMS) and Utah Division of Oil, Gas and Mining (DOGM) were also reviewed. Finally, the Montrose Economic Development Corporation (EDC) and towns of Naturita and Nucla were contacted to determine if there were any economic development projects underway.

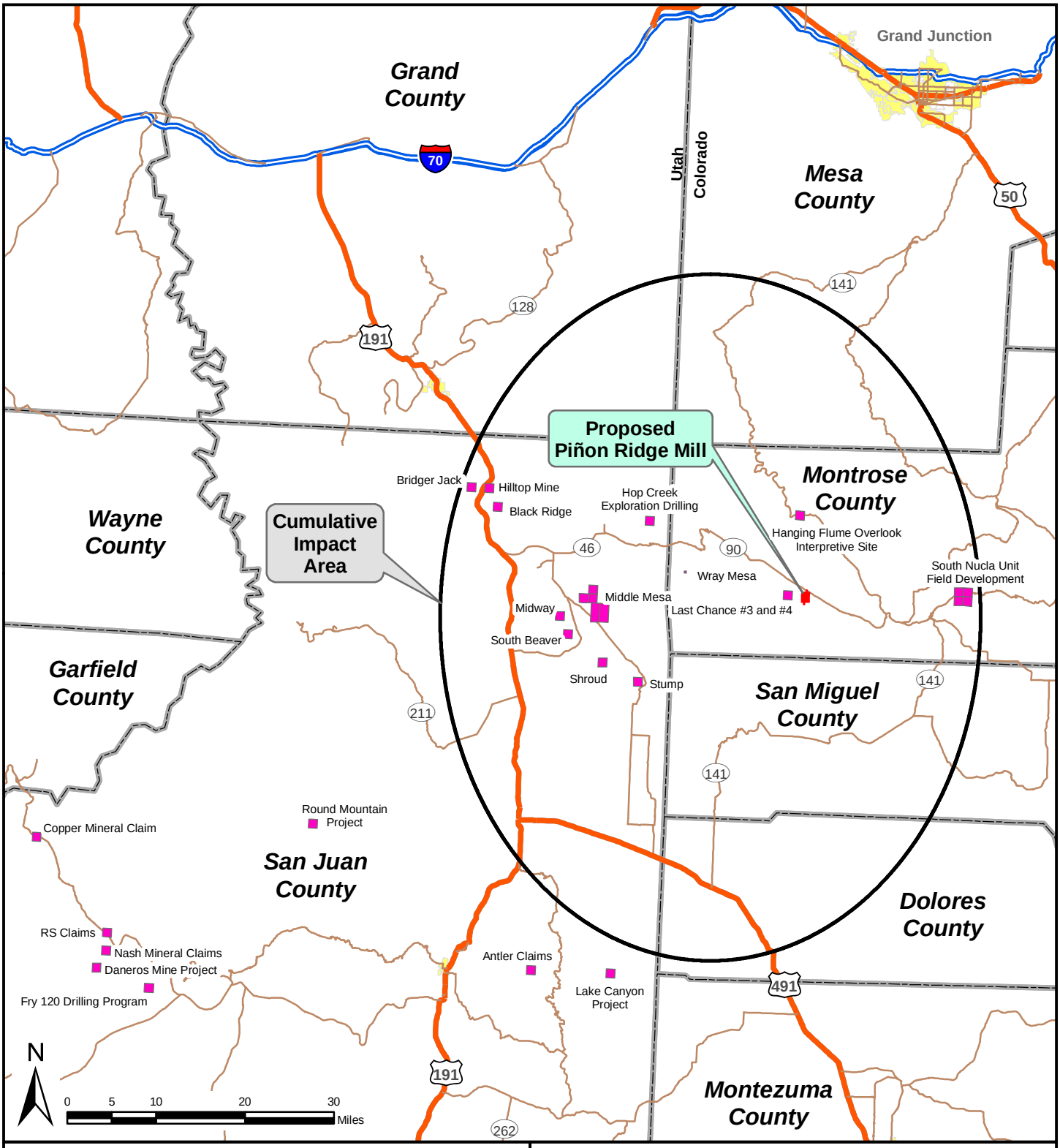
Based on the review of NEPA registers and mining applications, it was determined that 18 uranium exploration projects, three oil and gas projects, and one building construction project (an interpretive site at the Hanging Flume Overlook Historic Site in the Unaweep Canyon) were within the vicinity of the Proposed Action and could potentially cause future impacts that might be additive or cumulative with those associated with the Proposed Action. According to the Montrose EDC, there are no anticipated new industrial or commercial projects in Montrose County (Head, 2009). A restaurant (steakhouse) in Nucla is the only anticipated new business in either Naturita or Nucla (Lear, 2009 and Smith, 2009b). The projects that could contribute to cumulative impacts when combined with the Proposed Action are shown in Table 6.3-1 and on Figure 6.3-1.

Table 6.3-1
Potential Projects in the Vicinity of the Site

Site Name and Operator	County	Project Type
Uranium/Vanadium Exploration Projects		
Antler Claims – Vern Shumway[1]	San Juan, UT	Uranium Exploration
Black Ridge Mine – Mitch Shumway[1]	San Juan, UT	Uranium/Vanadium Exploration
Bridger Jack Mine – South American Minerals[1]	San Juan, UT	Uranium/Vanadium Exploration
Copper Mineral Claim – John Rud[1]	San Juan, UT	Uranium/Vanadium Exploration
Daneros Mine – Utah Energy Corp. [2]	San Juan, UT	Uranium/Vanadium Mine
Fry 120 Drilling Program – John Rud[1]	San Juan, UT	Uranium/Vanadium Exploration
Hilltop Mine – South American Minerals[1]	San Juan, UT	Uranium/Vanadium Exploration
Hop Creek Exploration Drilling – CO Plateau Partners[1]	San Juan, UT	Uranium/Vanadium Exploration
Lake Canyon Project – Uranium Energy Corp[1]	San Juan, UT	Uranium/Vanadium Exploration
Lark Royal Claims – Utah Energy Corp.[1]	San Juan, UT	Uranium/Vanadium Exploration
Last Chance #3 & #4 Mines – Nuvemco LLC[1]	Montrose, CO	Uranium/Vanadium Exploration
Midway Mine – Uranium One Exploration[1]	San Juan, UT	Uranium/Vanadium Exploration
Nash Mineral Claim – John Rud[1]	San Juan, UT	Uranium/Vanadium Exploration
Round Mountain Project – Global Uranium Corp[1]	San Juan, UT	Uranium Exploration
RS Claims – John Rud[1]	San Juan, UT	Uranium/Vanadium Exploration
Shroud Mine – Uranium One Exploration[1]	San Juan, UT	Uranium/Vanadium Exploration
South Beaver Mine – Uranium One Exploration[1]	San Juan, UT	Uranium/Vanadium Exploration
Stump Mine – Uranium One Exploration[1]	San Juan, UT	Uranium/Vanadium Exploration
Oil and Natural Gas Development Projects		
Middle Mesa Gas Wells (15 wells) – EnCana[4]	San Juan, UT	Natural Gas Wells
South Nucla Unit Field Development (20 gas wells) – Redwine Resources[4]	Montrose, CO	Natural Gas Wells
Wray Mesa Natural Gas Well Pad – EnCana[4]	Montrose, CO	Natural Gas Well
Other projects		
Hanging Flume Overlook Interpretive Site	Montrose, CO	Historic Center Interpretive Center

[1] Source: UDNR-DOGM, 2009.
[2] Source: BLM, 2009c.
[3] Source: Colorado DRMS, 2009.
[4] Source: BLM, 2009d.

Ultimately, the cumulative impacts associated with the Proposed Action are dependant on the future price of uranium. Most forecasters predict a gradual rise in the price of uranium, based on the increasing development of nuclear power plants throughout the world and the 2013 expiration of the Russian disarmament program that has, to date, created a substantial quantity of low enriched uranium for nuclear fuel in the United States and abroad. The following reasonably foreseeable actions are based on this scenario. If uranium prices were to remain at their current levels, impacts associated with the Proposed Action would be lower. If uranium prices increased dramatically, exploration activities would also be likely to increase; however, a dramatic increase in uranium mining within the Cumulative Impact Area is unlikely due to constraints in present and reasonably foreseeable mill capacity as discussed in Section 6.4.



Proposed Projects

Figure 6.3-1

Proposed Projects in the Vicinity of the Piñon Ridge Mill Site

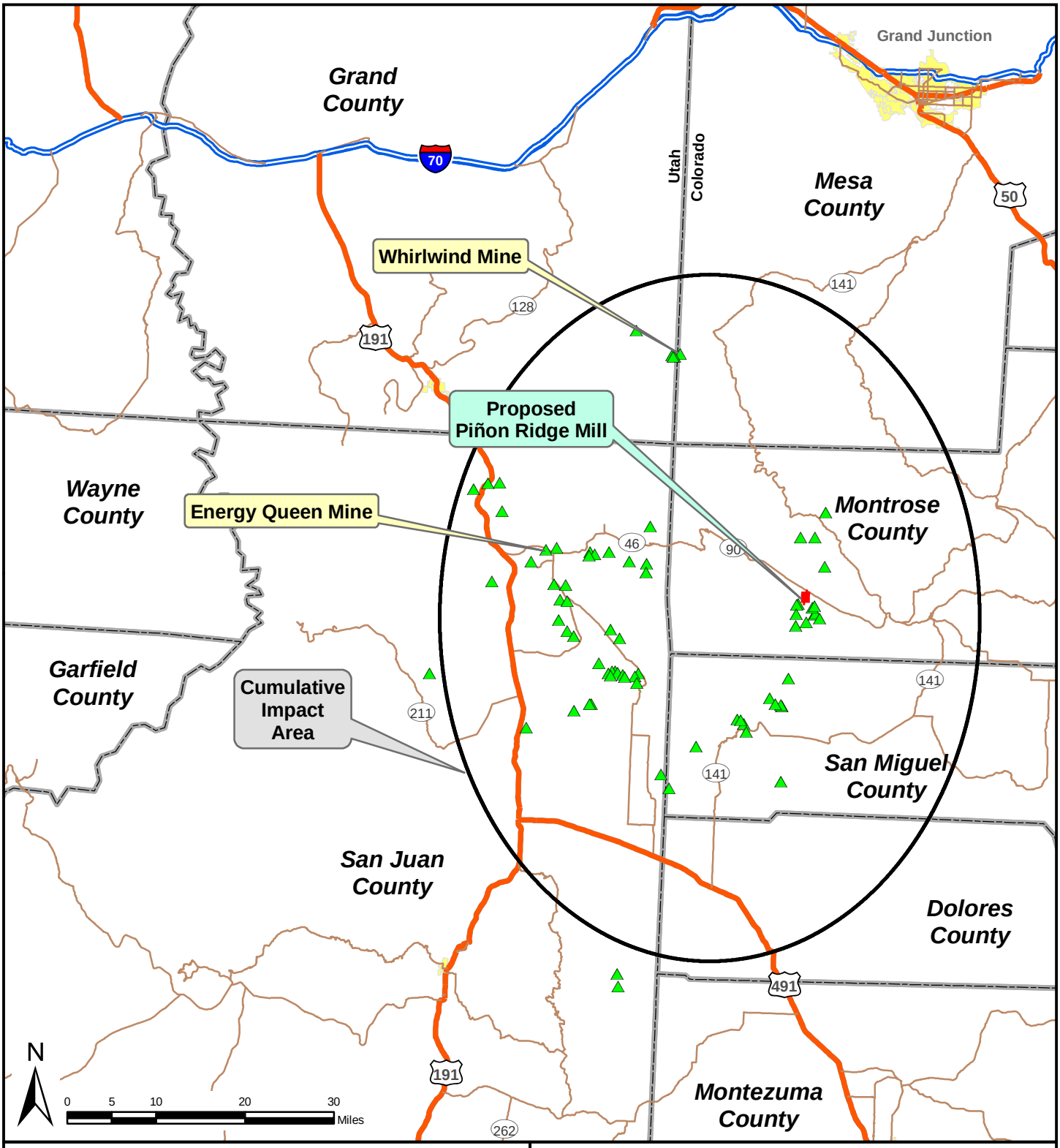
6.3.1 Uranium Mining Projects

Construction and operation of the proposed Piñon Ridge Mill would allow Energy Fuels to commence mining operations at its Whirlwind and Energy Queen Mines. It would also allow for permitting and development of additional uranium/vanadium deposits controlled by Energy Fuels, as well the resumption of mining at some of the permitted mines within the Cumulative Impact Area controlled by mining companies other than Energy Fuels and Denison. The locations of permitted uranium mines relative to the Site are shown in Figure 6.3-2. As discussed in the *Mine Operations Plan* (Energy Fuels, 2009d), the Mill is expected to be able to process ore from five to nine mines in the area at any one time. These mines are primarily located in western Montrose, Mesa, and San Miguel counties in Colorado and eastern San Juan County in Utah. Some feeder mines could also be located in Grand and Emery counties in Utah. The mines feeding the Mill are expected to change over the course of the 40-year mill life as projects are mined out and reclaimed and other projects come on line.

The mines that would feed the Mill are predominantly existing underground mines with relatively small disturbance footprints, typically encompassing between 5 and 30 acres of surface disturbance depending on the size of the mine. Although some new disturbance would occur as the mines develop further, most of the surface disturbance associated with the mines (*i.e.*, roads, portals, mine buildings, ore pads, and waste dumps) already exists. Section 4.0 evaluated the potential traffic-related impacts of ore haulage from mines to the Mill, and the potential employment impacts of mining personnel associated with Mill operations. An estimated 228 mining workers (miners, support personnel, and truckers) would be required to provide the 175,000 tons of ore consumed annually (500 tpd) by the Proposed Action (Energy Fuels, 2009d). Section 4.0 did not evaluate the mines' socioeconomic impacts. The text addresses the socioeconomic impacts of the Proposed Action – which consists of the Mill only. Section 4.0 discusses indirect employment associated with mining (miners and truckers only), and the fiscal analysis includes the spending of mining-income associated with the Mill. The fiscal analysis does not include direct spending by mines, indirect spending associated with the mines, or any taxes paid by the mines.

6.3.2 Uranium Exploration Projects

According to the Colorado DRMS and Utah DOGM, there are several proposed uranium exploration projects, most of which are located in San Juan County. In Montrose County, the BLM Uncompahgre Field Office is evaluating exploration data concerning underground mining at the Last Chance #3 and #4 mines. Activities limited to exploration are not likely to contribute to cumulative impacts as exploration typically involves few workers, low traffic volumes, and no emissions. If any of the exploration projects noted in Table 6.3-1 lead to new or renewed mining activity, there could be additional land use and biological impacts within the vicinity of the Site, as well as cumulative impacts due to increased traffic, particularly ore-haul trucks, and surface disturbance. Air emissions from underground uranium mining operations are regulated, and the potential for fugitive dust and combustion emissions is low (40 CFR, Part 61, Subpart b). Mine developers would be required to obtain air permits from the CDPHE APCD or the Utah Department of Environmental Quality – Division of Air Quality, which would minimize the potential for cumulative air quality impacts. Potential cumulative socioeconomic impacts associated with an expanded mining and ore-haul workforce, such as increasing populations and potential increases in school enrollments and housing demand could occur.



Permitted Mines

Uranium, Vanadium, and Zinc
(Mines shown designated as "Active" in source data)

NOTE:
Source data obtained from;
Utah Division of Oil, Gas and Mining and
Colorado Division of Reclamation, Mining and Safety

Figure 6.3-2

Permitted Uranium Mines
in the Vicinity of the Piñon Ridge Mill Site

6.3.3 Oil and Gas Development Projects

According to the BLM Uncompahgre Field Office, three oil and gas projects, with a total of 36 proposed wells on BLM land, are currently under NEPA review. Oil and gas development typically requires 7 to 10 weeks for construction, drilling and completion (BLM, 2008). During this time, assorted heavy equipment and pickup trucks would add to traffic in the vicinity of the Site. Workers would travel daily to a well location; however, the heavy equipment needs would not result in daily transit during well development. There would be brief periods of highly intensive heavy equipment travel (*e.g.* 4 to 10 trucks for a few days). Depending on the number of wells developed at any one time, localized traffic increases would likely be experienced in the region. The proposed oil and gas development would result in additional land use and biological impacts in the region; however, as with uranium mining, oil and gas drill rig impacts are limited to the localized area of a drill pad, which typically covers 5 to 10 acres. The cumulative effects on land use and biota in the region would be an increase in the acreage of public lands that would be affected by mineral exploration. The three oil and gas projects under consideration could result in additional surface disturbance of 180 to 360 acres.

6.3.4 Other Projects

The Hanging Flume is a historic structure situated above the San Miguel and Dolores rivers that supplied water for placer gold mining in the late 1800s. The Hanging Flume Site is listed on the National Register of Historic Places and is accessed via a 0.5-mile graveled road leading west from SH 141. In September 2009, the BLM Uncompahgre Field Office approved construction of the Hanging Flume Overlook Interpretive Site to replace the existing graveled parking area that is situated above the Unaweep Canyon rim. Phase One of the project, which includes a graveled vehicle parking area to accommodate six to eight vehicles, two interpretive kiosks, and two to three picnic tables, is scheduled for completion in early 2010. Phase Two includes the construction of a concrete or hardened trail to the river overlook, and is scheduled for construction in the fall of 2010. During late 2010 and early 2011, when construction activities at the Piñon Ridge Site and the Interpretive Site are scheduled to occur, the cumulative impact of increased traffic along SH 141 could result. In particular, a high volume of trucks hauling gravel and other construction materials would be expected along SH 141 through the Unaweep Canyon. Short-term traffic impacts would be mitigated through speed control, dust control, appropriate signage, employee training, and scheduling. Over the long term, the Hanging Flume Interpretive Site will mitigate traffic concerns in the Unaweep Canyon as the BLM considers the current pullout to the Hanging Flume Site to be poorly situated for highway safety (BLM, 2009x).

6.4 POTENTIAL CUMULATIVE IMPACTS ASSOCIATED WITH INCREASED URANIUM MINING IN THE VICINITY OF THE PIÑON RIDGE MILL SITE

The potential cumulative impacts from development of uranium resources within the region depends largely on the number of mining claims and DOE leases that are brought into production. Mine development is constrained by actual and potential milling capacity in the foreseeable future. Table 6.4-1 shows the estimated capacity (tpd) and operational status of uranium mills that have been announced, are in the permitting process, or are already permitted. Figure 6.4-1 shows the location of these mills in relation to the Cumulative Impact Area.

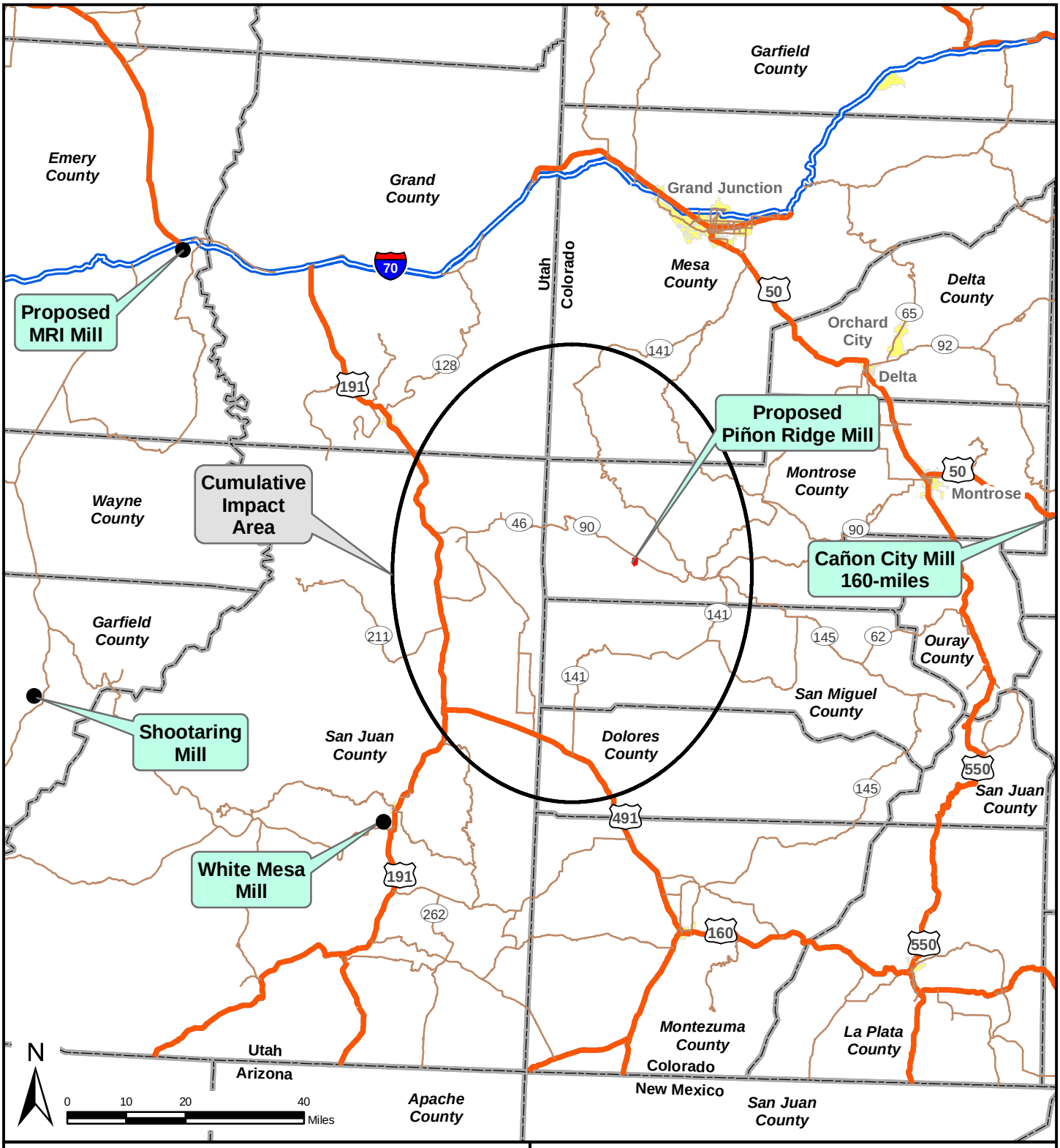


Figure 6.4-1

Existing and Proposed Mills
in the Vicinity of the Piñon Ridge Mill Site

Table 6.4-1
Status of Potential Uranium Mills[1]

Mill	Location	Owner	Estimated Milling Capacity	Estimated Operational Status
White Mesa Mill	Blanding, UT	Denison Mines (USA) Corp.	1,500 tpd[1]	Operating
Piñon Ridge Mill	Bedrock, CO	Energy Fuels Resources Corporation.	500 tpd	Projected 2012 start date
Cañon City Mill	Cañon City, CO	Cotter Corpation	1,500 tpd[2]	Inactive
Shootaring Mill	Ticaboo, UT	Uranium One, Inc.	750 tpd[2]	Inactive
MRI Mill	Green River, UT	Mancos Resources, Ltd.	1,200 tpd[2]	Baseline investigation phase initiated
		Total	**5,450 tpd**	

[1] Source: Denison, 2009.
[2] Source: BLM, 2008.

If all the uranium mills shown in Table 6.4-1 were operational and processing ore at the full capacity of 5,450 tpd, this would result in approximately 227 ore-truck round trips per day (454 total trips) based on 24 tons per shipment. Approximately 28 acres of surface disturbance is likely to be associated with every 100 tpd of production (BLM, 2008). This equates to 1,526 acres of cumulative surface disturbance to supply ore to 5,450 tpd of milling capacity. Energy Fuels estimates that cumulative employment associated with this production rate would include approximately 2,000 workers, including mill workers, miners, mining support personnel and truckers (Filas, 2009).

Cumulative impacts in the vicinity of the Mill Site are likely to be lower than this because not all of the mills plan to process ore from mines in western Colorado and eastern Utah. Cotter intends to process ore shipped from the Mount Taylor Mine at its Cañon City Mill (Cotter, 2009). The Mount Taylor Mine, which is owned by Rio Grande Resources Corporation, an affiliate of Cotter, is located near Grants, New Mexico. Ore would most likely be transported from the mine to Cañon City by train, well outside the Cumulative Impact Area. Denison recently announced its intention to supply the White Mesa Mill with ore from its Arizona 1 deposit in north central Arizona. Denison intends to start production at the Arizona 1 deposit in 2010, and to haul ore by truck to the White Mesa Mill (Denison, 2009). Ore would most likely be transported from the mine to the mill along US Highway 191, south of the Cumulative Impact Area. This ore would be in addition to the ore currently produced at its La Sal, Utah and San Miguel County, Colorado mines, which are located at the east and south edges of the Cumulative Impact Area, respectively. With the addition of the ore feed from its Arizona Mines, White Mesa's potential need for additional ore from mines within the Cumulative Impact Area is significantly reduced.

Excluding the Cañon City and White Mesa mills, the remaining mills have a processing capacity of 2,450 tpd. If the Piñon Ridge, Shootaring and MRI mills were all operational and processing ore at their full capacities, this would result in approximately 102 ore-truck round-trips per day (204 total trips) based on 24 tons per shipment. Supplying ore to 2,450 tpd of mill capacity would result in approximately 686 acres of cumulative surface disturbance and a workforce of about 1,000 mill workers, miners, mine support workers, and truckers (Filas, 2009). However, both the inactive Shootaring Mill and the proposed MRI Mill are outside of the Cumulative Impact Area. Although they could draw uranium ore from the western portion of the Cumulative Impact Area, they would likely rely more heavily on ore produced from uranium mining districts in closer proximity. These include the Yellow Cat, San Rafael, Temple Mountain, and Henry

Mountain Mining Districts, all of which are outside of the Cumulative Impact Area. Accordingly, impacts associated with these activities would be spread over a much greater area.

Based on the cumulative analysis in this Section and the impact analysis in Section 4.0, it is unlikely that the cumulative impacts that could potentially occur as a result of the Proposed Action and past, present and reasonably foreseeable future actions could not be mitigated.

Section 7.0
Cost Benefit Analysis

7.1 ECONOMIC AND SOCIAL EFFECTS OF THE PROPOSED PIÑON RIDGE MILL

This section of the ER builds upon the analysis of potential impacts presented in Section 4.0 to evaluate the potential economic and social effects of the Proposed Action. There are limitations on the extent to which the economic and social benefits and costs of the Proposed Action can be evaluated. Some of the project's benefits and costs are measurable, such as product sales, capital costs, operating and maintenance costs, decommissioning costs, regulatory compliance costs, labor income, tax revenues, and regional output. On the other hand, some potential environmental costs of the Proposed Action and their potential economic and social consequences are not readily quantifiable. Pursuant to NRC Regulatory Guide 3.8 (NRC, 1982a) and NUREG 1748 (NRC, 2003a), this section compares the value of the costs and benefits that can be quantified through a cost-benefit analysis, and discusses qualitatively the costs and benefits that cannot be measured monetarily.

7.1.1 Benefits

The Proposed Action would be a private venture and, as such, would not have a direct public purpose. However, because the Proposed Action would support the expansion of domestic uranium sources, much of which would eventually be used in nuclear reactors to generate electricity, it would have a public benefit. Existing statues obligate the U.S. Secretary of Energy to have a "continuing responsibility" for the domestic uranium mining industry "to encourage use of domestic uranium" (42 USC §§2201b and 22966b-3). The NRC recognizes that the viability of the industry is a federal concern and that there is a public interest in the domestic uranium supply. Between 1996 and 2008, annual uranium production decreased by 38 percent in the United States (EIA, 2009b). In 2008, 14 percent of the 53 million pounds of uranium oxide (U_3O_8) purchased by U.S. civilian nuclear power plants was supplied by domestic sources, and 86 percent was supplied by foreign sources. Australian-origin and Canadian-origin uranium together accounted for 42 percent of the 53 million pounds. Uranium originating in Kazakhstan, Russia and Uzbekistan accounted for 33 percent, and the remaining 11 percent originated from Brazil, Czech Republic, Namibia, Niger, South Africa, and the United Kingdom (EIA, 2009b).

Potential benefits associated with the Proposed Action would include the value of the Mill's products: uranium oxide (U_3O_8), also known as yellowcake, and processed vanadium. Yellowcake is the raw material for nuclear fuel that, after conversion and enrichment, is processed into fuel rods. When placed in a reactor, the fuel rods provide the heat to produce steam to generate electricity. With the exception of hydropower (which accounts for 3 percent of the U.S. supply of electricity), nuclear power is the only source of carbon emissions-free, reliable baseload electricity. Worldwide, there are currently 436 nuclear power plants producing 15 percent of the global electrical power supply. In the United States, 104 nuclear power plants are producing 20 percent of the domestic supply of electricity (World Nuclear Association, 2009a). The EIA forecasts that the annual demand for electricity in the United States will increase by 26 percent between 2007 and 2030 (EIA, 2009c). Meeting this increase in demand through domestically supplied uranium has the potential to increase national energy independence and address climate change concerns.

Yellowcake is also used in small nuclear reactors to produce isotopes for medical, industrial and research purposes around the world. The primary use of vanadium oxide, or black-flake, is as an alloying agent in the manufacture of high strength, low-alloy steels, which are known for their increased strength and durability. Vanadium is used in several applications, including surgical

instruments, tool and die steels, engineering alloy steels used in axles, crankshafts and gears, stainless steels, rail steels, and titanium alloys. Additionally, vanadium serves as a catalyst in numerous industrial processes. Work is currently underway to develop a new, large-scale battery technology known as vanadium redox battery, which would enhance the benefits of renewable energy sources. This newly proposed vanadium battery will have the ability to store large quantities of electrical energy with minimum storage losses and can quickly discharge energy to the electrical grid.

Thus, the potential benefits of the output associated with the Proposed Action are spread across the national and global economies. The major potential benefits to the state and local communities would include tax revenues, employment income, and regional output that would be generated by the Mill. Property tax revenues would accrue to Montrose County, the RE-2 West End School District, Montrose Library District, Southwest Water Conservation District, and San Miguel Water Conservancy District throughout Mill Facility construction, operations, and closure. During all of these phases, the State of Colorado, Montrose County, the towns of Naturita and Nucla, and numerous other localities across the region and state would receive sales tax revenue from the sale of taxable goods to the Mill Facility, its employees and other workers whose jobs are supported by the Mill Facility. The potential employment benefits of the Proposed Action include the income derived from the estimated 326 jobs that would be created during Mill construction, the 315 jobs that would be generated by the Mill's annual operations, and the 15 jobs related to Mill closure.

The potential benefits of the Mill's products, its fiscal and employment impacts, and the increase in income and regional productivity can be quantified monetarily and are included in the cost-benefit analyses shown in Tables 7.1-1 and 7.1-2.

7.1.2 Costs

The primary internal costs associated with the Proposed Action include the capital costs of land acquisition and improvement, and facility construction; operating and maintenance costs; plant decommissioning, closure, and site reclamation costs; and regulatory costs associated with permitting and oversight.

The Proposed Action would also have external costs that would not be borne directly by Energy Fuels. Some of these costs can be estimated quantitatively. For example, the Site's transition from grazing land to industrial use would result in the long-term loss of 722 acres of seasonal grazing land. This loss would continue throughout Mill construction, operations and closure. The restricted tailings area, which includes approximately 158 acres, would be permanently lost as seasonal grazing land. The grazing losses can be estimated by considering the Site's livestock carrying capacity, grazing fees and lost grazing acreage. Similarly, there is an opportunity cost to the surrounding community of the Mill's consumptive use of 227 acre feet of water per year. From an economic perspective, the opportunity cost of this water use is the amount that would have been paid for water withdrawn from the supply system by the next (or marginal) user. Along with the internal costs noted above, these external costs are quantified and included in the cost benefit analyses presented in Tables 7.1-1 and 7.1-2.

There are several potential external costs associated with the Proposed Action that are not amenable to monetary quantification. These costs, which would be widely disbursed among members of surrounding and extended communities, are summarized in Section 5.0 and discussed below.

- Increased truck traffic on rural county highways. Potential traffic impacts to surrounding landowners and recreationists during construction and operations.

- Displacement of native species and herbivores, and the potential spread of invasive plants and noxious weeds due to long-term surface disturbance and heavy truck traffic into the Site.

- Potential drawdown of groundwater in off-site wells in the vicinity of the Proposed Action.

- Potential impacts on endangered fish species due to water withdrawals (227 acre feet per year) from the Upper Colorado River Basin.

- Wildlife losses associated with habitat disturbance and loss and increased traffic would be likely to include burrowing owls, sage grouse, prairie dogs, pocket gophers, mule deer, elk, pronghorn, turkeys, waterfowl and migratory birds.

- Fugitive dust emissions from equipment and diesel engine emissions during construction. Fugitive and non-fugitive air emissions (primarily PM_{10} and VOC) during operations.

- Potential increases in the price and limited availability of short-term housing during Mill construction.

Building upon the potential costs to environmental resources noted above, it is widely recognized that there are some values for natural resources that are not amenable to monetary quantification, and thereby excluded from cost-benefit analyses of activities that impact environmental resources. For example, some people may derive benefits from knowing that undeveloped open space and wildlife habitat exist in the Paradox Valley, or from knowing that these amenities would be available for future generations to enjoy. Although survey techniques (known as contingent valuation methodology) have been developed to estimate non-use and other values for natural resources that are not expressed in monetary terms, their use in government agency cost-benefit analyses has been limited. Although they are not included in the cost-benefit analysis for the Proposed Action, some non-market values for natural resources would be likely to be affected to a limited extent.

7.1.3 Cost-Benefit Analysis

NRC guidance recommends that the benefits and costs of a proposed action that can be expressed monetarily should be discounted to present values (NRC, 1982). Based on Office of Management and Budget (OMB) guidance, the NRC recommends that present value calculations be presented using real discount rates of 3 percent and 7 percent (NRC, 2004). The 3 percent rate approximates the real rate of return on long-term government debt, which serves as a proxy for the real rate of return on savings. This rate is appropriate when the primary effect of a regulation is on private consumption. Alternatively, the 7 percent rate approximates the marginal pretax real rate of return on an average investment in the private sector, and is the appropriate discount rate whenever the main effect of a regulation is to displace or alter the use of capital in the private sector.

Table 7.1-1 compares the present value of the Proposed Action's costs and benefits at a 3 percent discount rate, and Table 7.1-2 compares the project's costs and benefits at a 7 percent discount rate. The project's benefit-cost ratio is 5 to 1 at a 3 percent discount rate, and 6 to 1 at a 7 percent discount rate.

Table 7.1-1
Cost Benefit Analysis for the Piñon Ridge Mill – 3 percent discount rate

Benefits	Present Value	Costs	Present Value
		Internal Costs	
Mill Output (sales)[1]	$2,331,925,894	Land Acquisition, Facility Construction[4]	$130,167,485
		Operating and Maintenance Costs[4]	$551,033,049
Tax Revenues:	$34,046,386	Decommissioning and Closure Costs[4]	$3,268,461
State of Colorado[2]	$7,813,734	Regulatory Costs[5]	$3,459,294
Montrose County[2,3]	$10,701,863	Permitting Fees	$388,350
Town of Naturita[2]	$1,353,024	Regulatory Oversight	$3,070,944
Town of Nucla[2]	$1,353,024	**Total Internal Costs**	**$687,928,289**
RE-2 West End School District[2]	$11,073,815		
Montrose Library District[2]	$1,636,419	**External Costs**	
Southwest Water Conservation District[2]	$92,289	Loss of Grazing Land[6]	$8,371
San Miguel Water Conservancy District[2]	$22,218	Consumptive Water Use[7]	$58,545
		Total External Costs	**$66,916**
Labor Income[1]	$432,635,820		
Regional Output (sales)[1]	$840,621,472		
Total Benefits	**$3,639,229,572**	**Total Costs**	**$687,995,205**
Benefit Cost Ratio:5.3:1			

[1] Based on IMPLAN modeling results.
[2] Based on annual Mill property values provided by Energy Fuels (Vigil, 2009) and property tax rates provided by the Montrose County Assessor's Office (Montrose County, 2009d).
[3] Based on annual sales tax revenue estimated in Section 4.0.
[4] Based on information in the *Mill Decommissioning and Reclamation Cost Estimate* (Energy Fuels, 2009h).
[5] Based on permitting and oversight cost information provided by Energy Fuels (Filas, 2009).
[6] Based on grazing lease information provided by BLM (Stindt, 2009).
[7] Based on water rate information provided by Town of Naturita (Carver, 2009).

Table 7.1-2
Cost Benefit Analysis for the Piñon Ridge Mill – 7 percent discount rate

Benefits	Present Value	Costs	Present Value
		Internal Costs	
Mill Output (sales)[1]	$1,294,685,842	Land acquisition, facility construction[4]	$125,301,411
		Operating and maintenance costs[4]	$317,814,607
Tax Revenues:	$21,818,758	Decommissioning and closure costs[4]	$611,357
State of Colorado[2]	$5,188,044	Regulatory Costs[5]	$2,031,613
Montrose County[2,3]	$6,763,927	Permitting Fees	$373,832
Town of Naturita[2]	$762,760	Regulatory Oversight	$1,657,781
Town of Nucla[2]	$762,760	**Total Internal Costs**	**$445,758,988**
RE-2 West End School District[2]	$7,202,458		
Montrose Library District[2]	$1,064,334	**External Costs**	
Southwest Water Conservation District[2]	$60,025	Loss of grazing land[6]	$4,566
San Miguel Water Conservancy District[2]	$14,450	Consumptive Water Use[7]	$33,766
		Total External Costs	**$38,332**
Labor Income[1]	$245,233,657		
Regional output (sales)[1]	$479,224,412		
Total Benefits	**$2,040,962,669**	**Total Costs**	**$445,797,320**
Benefit Cost Ratio: 4.6:1			

[1] Based on IMPLAN modeling results.
[2] Based on annual Mill property values provided by Energy Fuels (Vigil, 2009) and property tax rates provided by the Montrose County Assessor's Office (Montrose County, 2009d).
[3] Based on annual sales tax revenue estimated in Section 4.0.
[4] Based on information provided in the Mill *Decommissioning and Reclamation Cost Estimate* (Energy Fuels, 2009h)
[5] Based on permitting and oversight cost information provided by Energy Fuels (Filas, 2009).
[6] Based on grazing lease information provided by BLM (Stindt, 2009).
[7] Based on water rate information provided by Town of Naturita (Carver, 2009).

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Section 8.0
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Section 9.0
Consultation and Coordination

List of Preparers – Edge Environmental, Inc.

Name	Environmental Report Responsibility
Bloomstran, M.	Project Management, Air Quality, Project Description, Document Review
Buseck, R.	Vegetation, Invasive Non-Native Species, Wetlands
Duce, D.	Soils, Prime and Unique Farmlands
Gagnon, N.	Hydrology, Water Quality, Transportation, Alternatives
Goodman, S.[1]	Land Use, Transportation, Socioeconomics, Environmental Justice, Cumulative, Cost-Benefit
Gulliver, T.[2]	Geology, Water Resources
Last, C.	Alternatives, Public and Occupational Health, Waste Management, Document Review
Moro, J.	Cultural Resources, Native American Religious Concerns, Visual Resources
Reeve, A.	Terrestrial and Aquatic Wildlife, Special Status Species, Noise
Thomas, J.	GIS Coordinator, Mapping

[1] SLG Consulting, Inc.
[2] Norwest Corporation

List of Persons Contacted during Preparation of the Environmental Report

Name	Title	Affiliation
Adams, D.	Senior Professional	Kleinfelder
Albee, J.	Statistical Analyst	Colorado State Patrol
Allen, K.	Air Quality Task Manager	Kleinfelder
Baker, P.	Minerals Program Manager	Utah Department of Natural Resources, Division of Oil, Gas and Mining
Barnett, S.	Project Manager	Montrose County
Bridges, L.	Principal Professional	Kleinfelder
Brown, S.	Certified Health Physicist	SENES Consultants Limited
Butterfield, T.	Research Analyst	Utah Department of Transportation Systems Planning and Programming
Cannon, S.	Postmaster	La Sal Post Office
Carter, J.	Manager	Mustang Water Authority
Croll, K.	Archaeologist	ERO Resources Corporation
Davis, N.	Realtor	Vista Realty
Doyle, S.	Project Environmental Scientist	Golder Associates, Inc.
Egidi, P.	Environmental Protection Specialist	CDPHE, Hazardous Materials & Waste Management Division
Elliot, J.	Staff Geotechnical Engineer	Golder Associates, Inc.
Esker, J.	Staff Meteorologist	Kleinfelder
Ethington, E.	Geologist	CDPHE, Hazardous Materials & Waste Management Division
Ferguson, J.	Retired Wildlife Biologist	BLM Uncompahgre Field Office
Filas, F.	Environmental Manager	Energy Fuels Resources Corporation
Fonze, E.	River Recreation Manager	BLM Uncompahgre Field Office
Fransioli, P.	Quality Assurance Manager	Kleinfelder
Fulbright, J.	Air Monitoring Team Leader	Energy Fuels Resources Corporation
Gjerapic, G.	Senior Project Engineer	Golder Associates, Inc.
Haag, S.	Director	Basin Clinic

Name	Title	Affiliation
Ham, C.	Supervisory Outdoor Recreation Planner	BLM Grand Junction Field Office
Head, S.	Executive Director	Montrose Economic Development Corporation
Janney, D.	Geoscience Lead	Kleinfelder
Johansen, S.	Records Department	Montrose County West End Sheriff's Substation
Johnson, J.	Principal and Project Director	Golder Associates, Inc.
Johnson, T.	Office Technician	Montrose County Assessor's Office
Keckler, R.	Coordinator	Colorado Enterprise Zone Region 10
Kluthe, T.	Staff Professional	Kleinfelder
Kuhn, A.	Project Manager	Kleinfelder
LaBondy, S.	Engineer	WestWater Engineering
Lafrenz, E.	Senior Air Quality Professional	Kleinfelder
Larmore, S.	Principal Investigator	ERO Resources Corporation
Larson, C.	Principal Professional	Kleinfelder
Lear, D.	Town Clerk	Town of Naturita
Leon, C.	Employment Specialist	Colorado Rural Workforce Consortium, Delta Workforce Office
Little, C.	Owner	TwoLines, Inc.
McKinney, R.	Senior Program Manager	Kleinfelder
Meyer, J.	Staff Professional I	Kleinfelder
Monnig, N.	Staff Hydrologist	Golder Associates, Inc.
Monok, B.	Mill Operations Consultant	Energy Fuels Resources Corporation
Montoya, M.	President	Visus Consulting Group, Inc.
Morrison, K.F.	Senior Project Manager	Golder Associates, Inc.
Oliver, C.	President	Board of Directors, Paradox Pipeline Company
Osborne, J.	Engineering Manager	Energy Fuels Resources Corporation
Popielak, R.	Senior Consultant	Golder Associates, Inc.
Rogers, Z.	Environmental Engineer and Air Monitoring Manager	Energy Fuels Resources Corporation
Ryan. R.	River Recreation Manager	BLM Durango Field Office
Savignac, N.	Consulting Engineer	Kleinfelder
Schierman, M.	Senior Health Physicist	Environmental Restoration Group, Inc.
Smith, D.	GIS Analyst	Utah Department of Natural Resources, Division of Oil, Gas and Mining
Smith, E.	Town Clerk	Town of Nucla
Spangler, C.	Human Resources Director	San Miguel Power Association
Steele, G.	Vice President – Corporate Marketing	Energy Fuels Resources Corporation
Steyskal, M.	Air Quality Professional	Kleinfelder
Stindt, D.	Rangeland Management Specialist	U.S. Forest Service, Norwood Field Office
Sullivan, S.	Maintenance and Operations Superintendent	Tri-State Generation's Nucla Station
Tarlton, S.	Unit Leader	CDPHE, Hazardous Materials & Waste Management Division
Tschida, A.	Geotechnical Manager	Kleinfelder
Vigil, J.	Chief Financial Officer	Energy Fuels Resources Corporation
Waller, S.	Appraiser	Montrose County Assessor's Office
Whicker, F.	Professor Emeritus	Colorado State University, Department of Environmental & radiological Health Sciences
White, S.	Planning Director	Montrose County
Whitfield, A.	Archaeologist	ERO Resources Corporation

Appendix A

U.S. Regulatory History of Uranium Mills

U.S. Regulatory History of Uranium Mills

Because of the military importance of uranium during the cold war, the federal government encouraged and supported the development of a domestic uranium industry starting in 1946 with the passage of the Atomic Energy Act (AEA). The federal programs, which were initiated by the Atomic Energy Commission (AEC), included guaranteed prices for uranium ore production and guaranteed cost recovery and return on investment for mills. The AEC's programs gradually phased out in the late 1960s and ended in December 1970. The uranium industry contracted substantially in size during this phase-out period; however, the industry grew rapidly in the mid- to late-1970s to supply uranium for the expanding nuclear power plant market.

In response to increasing health and safety concerns regarding uranium milling, the Energy Reorganization Act (ERA) was passed in 1974, which resulted in the creation of the Nuclear Regulatory Commission (NRC or Commission). This was followed in 1978, with the Uranium Mill Tailings Radiation Control Act (UMTRCA), which established NRC as the lead agency for regulating the production containment and monitoring of uranium and thorium mill tailings, which are defined in the AEA under section 11e.(2) as byproduct material. The U.S. Department of Energy (DOE) was required, under UMTRCA, to remediate inactive mill sites and conduct long-term surveillance and monitoring of mill sites after reclamation. The U.S. Environmental Protection Agency (EPA) also played an important role as they issued standards for the control of uranium mill tailings in 1983, which were then integrated into NRC's regulations. NRC implements and enforces those regulations through its licensing process. Colorado is one of five Agreement States that have since been authorized by the NRC to license AEA section 11e.(2) byproduct material under state regulations that are as strict or stricter than the federal regulations.

Since its inception in the mid-1970s, the statutory and regulatory program associated with the uranium industry has undergone massive development with the assistance of federal/state governmental entities, regulators, industry members, and interested stakeholders. There were many "lessons learned' as all of the uranium mills, to date, were built and began operating prior to the development of the current regulations. This has resulted in substantial monitoring, cleanup, and closure costs for older mill facilities, which had little or no controls in place for disposal of byproduct material. The regulatory program implemented by NRC and the Agreement States for uranium recovery facilities is now a mature and comprehensive program that ensures adequate protection of public health and safety and the environment. A detailed regulatory history of uranium mills, also commonly referred to as uranium recovery facilities, is provided below.

Atomic Energy Commission. Prior to World War II, the most important use for ores containing radioactive constituents such as uranium was for medical purposes.[1] In 1939, the splitting of the atom created a viable military use for uranium and, after World War II, the United States Congress enacted the AEA[2] in recognition of the strategic value of possessing significant and secure supplies of uranium for military purposes. The AEA created the AEC and Congress empowered the AEC to procure and control uranium supplies, as well as to create a domestic uranium recovery industry, to build nuclear weapons and to develop and regulate a nuclear power industry.

[1] Earle Gray, *The Great Uranium Cartel* at 16 (McClelland & Stewart) (1982).
[2] Atomic Energy Act of 1946, Pub. L. No. 79-585, 60 Stat. 755 (1946).

Initially, the AEC recognized that the United States was primarily dependent on uranium ores from the Belgian Congo and, to a lesser extent, Canada for such materials. In order to alleviate this dependency, the AEC sought to stimulate creation of a domestic uranium recovery industry by enacting policies that encouraged private companies and individuals to explore for uranium reserves and to fully develop such reserves. The AEC's biggest obstacle was the lack of a market for domestically-produced uranium in light of the significant exploration, extraction, and processing costs associated with the recovery of such uranium reserves. As a result, the AEC developed a program that guaranteed prices for uranium ore production, that provided bonuses for the initial production at new mines, and that reimbursed producers for transportation and other costs.[3] These incentives were provided through a series of "Domestic Uranium Production Circulars" issued by the AEC. The AEC also established a number of ore-buying stations in areas of anticipated ore production.

In addition to the need for exploration, location, and mining of uranium ores, the AEC recognized that it needed to encourage the development of a domestic uranium milling industry. Accordingly, the AEC set out to encourage the private development of milling facilities by creating an incentive system in the form of agreement by the AEC to purchase processed uranium on terms that allowed private companies to recover the cost of constructing and operating a mill during the life of a particular contract.[4] Under this program, uranium mills were privately constructed and operated pursuant to AEC contracts which guaranteed cost recovery and a reasonable return on investment.[5]

By 1951, the AEC was able to announce that the United States was second among the free nations in uranium mining and processing; by 1955 that the United States was the single largest producer of uranium ore in the world; by 1957 that its emphasis was no longer on expanding production but in maintaining and developing ore reserves for future needs; and by 1963, in a report to the President, that the United States was now self-sufficient in uranium mining and milling and need not depend on foreign sources.[6]

In an announcement issued May 24, 1956, the AEC established a new domestic procurement program for the period from April 1, 1962 through December 31, 1966. This action was taken "in recognition of the need for a continuing Government market in order to maintain a high rate of exploration and development." One of the main purposes of this program was to provide assurances of a uranium market during the 1962-1966 timeframe, and, thus, assure the continued development of a domestic mining and processing industry until a commercial market developed that could support this industry.

The new program established a minimum price of $8 per pound for concentrate purchased by the AEC subsequent to March 31, 1962. According to the AEC, "[t]he $8 price was determined on the basis of a study of existing contracts, known sources of supply and estimated costs of production."[7] The program guaranteed a Government market for all uranium concentrates produced by domestic mills from domestic ores, subject to a limitation of 500 tons per year from

[3] Gray *supra* note 1 at 42-43.
[4] United States Nuclear Regulatory Commission, *Final Generic Environmental Impact Statement*, NUREG-0706, Volume 1, at 2-1 (September 1980) (hereinafter "GEIS").
[5] *See generally American Mining Congress, Commingled Uranium Mill Tailings-A Historical Perspective,* (March 4, 1985).
[6] Civilian Nuclear Power—A Report to the President, p. 58.
[7] AEC Release No. 150.

any one mining property or mining operation. The AEC ore purchase and price guarantees were to be discontinued after March 31, 1962.

The last major change in the AEC procurement policy was announced on November 17, 1962. The announcement established a new program—the “stretch-out” program—for the period of January 1, 1967 through December 31, 1970. AEC requirements through 1970, as then currently estimated, were significantly below the amounts which it had committed to purchase. To effect a better balance between AEC receipts and requirements and to assure an ongoing, operating industry capable of supplying the anticipated (but still non-existent) commercial market, the AEC offered mill operators the option of deferring a portion of the concentrate contracted for delivery to the AEC in 1963-1966, and delivering it in 1967 and 1968. In return, in 1969 and 1970, the AEC would purchase an additional quantity of concentrate equal to the amount deferred. The price to be paid for the deferred material in 1967 and 1968 was to be $8 per pound, the same as in the 1962-1966 contracts. The price to be paid in 1969 and 1970 for concentrates produced from ore mined from properties controlled by the mill contractor would be calculated by use of a formula based on average allowable costs of production during the 1963-1968 period, as determined by an audit of mining and milling costs. The price per pound would be eighty-five (85) percent of the allowable production cost per pound plus $1.60, subject to a maximum price of $6.70 per pound. The price for all concentrates produced from ores purchased from independent producers would be $6.70 per pound of concentrate. The contracts permitted mill operators to cease deliveries to the AEC upon a showing that continued production at the 1969-1970 contract price would result in a net loss. Many of the older mills, mines, and buying stations closed.

Nuclear Regulatory Commission. As discussed above, amidst growing concern by congress regarding the health and safety aspects of the uranium industry, the ERA was passed and resulted in the creation of the NRC in January 1975, which assumed the regulatory control of uranium milling as well as enrichment operations and nuclear power generation. Other non-regulatory functions of the AEC, such as the promotion of atomic energy, were transferred to the Energy Research and Development Administration (ERDA), which, in 1977, became the DOE.

In 1978, Congress enacted the Uranium Mill Tailings Radiation Control Act of 1978 (UMTRCA) to provide the express statutory authority to regulate the production, containment, and monitoring of uranium and thorium mill tailings. UMTRCA was based upon a finding that uranium and thorium mill tailings located at active (i.e., licensed) and inactive (i.e., abandoned) mill sites may pose a significant, potential radiation health hazard to members of the public. In Section 11e.(2) of UMTRCA, tailings or wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content were defined as byproduct material, which is now commonly referred to as section 11e.(2) byproduct material. In the implementing regulations, contaminated mill equipment and other materials generated during cleanup and decommissioning were also included in the definition of byproduct material.

In Title I of UMTRCA, Congress established a program to identify and remediate so-called “inactive” sites; that is, sites at which uranium milling operations had occurred in the past or that contained tailings and other wastes produced during such operations and that were not covered by an existing license. Under the program set out in Title I of UMTRCA, DOE is authorized to enter into “cooperative agreements” with States containing inactive sites for the purpose of remediating those sites. Remedial actions undertaken by DOE under Title I are required to have the NRC’s concurrence and to conform with generally applicable standards developed by the EPA for the protection of public health and safety and the environment from potential

radiological and non-radiological hazards associated with tailings and other uranium milling wastes.[8] Following remediation of these inactive sites, title to the tailings and wastes from the sites and to the land used for their disposal resides with DOE, and the sites are to be maintained by DOE in perpetuity pursuant to license issued by the NRC.[9] In addition, the NRC is authorized to require that DOE, as the custodian of remediated inactive sites, undertake such monitoring, maintenance, and emergency measures as the NRC may deem necessary to protect public health and safety.[10] The NRC can also require DOE to take other actions that the NRC deems necessary to comply with EPA's generally applicable standards for protection against potential radiological and non-radiological hazards associated with uranium mill tailings and related wastes.[11]

In parallel with the Title I program is Title II, wherein Congress granted EPA and NRC expansive authority to regulate directly all aspects of the management and disposition of uranium mill tailings and related wastes generated at "active" (i.e., licensed) uranium mill tailings sites.[12] Like Title I, Title II establishes a tripartite jurisdictional scheme involving EPA, NRC, and DOE,[13] each of which have a defined role, which for NRC and DOE are similar yet different. Under Title II, NRC has the lead on addressing regulation and closure of sites, and DOE has only the long-term surveillance and monitoring responsibility that it also has under Title I. EPA's responsibilities are essentially the same under both Titles I and II.

Pursuant to Section 275 of the AEA, Congress assigned EPA the authority to promulgate generally applicable standards for the protection of public health and safety and the environment from the potential radiological and non-radiological hazards associated with the possession, transfer, and disposal of 11e.(2) byproduct material.[14] For the non-radiological hazards associated with 11e.(2) byproduct material, these generally applicable standards are to provide equivalent protection to that provided by EPA's Resource Conservation and Recovery Act (RCRA) standards.[15] As a result, 11e.(2) byproduct material is specifically exempted from EPA regulation under RCRA[16] and permitting authority over such material is deliberately withheld from EPA.

Implementing UMTRCA's mandate, EPA issued its first set of generally applicable standards in 1983 which applied only to "inactive" mill tailings sites (i.e., sites regulated under Title I of UMTRCA that were no longer operated under an active license).[17] This occurred 3 years after

[8] 42 U.S.C. § 7918 (1994).
[9] 42 U.S.C. § 7914 (1994); *see also* 10 CFR § 40.28.
[10] 42 U.S.C. § 2113(b)(5).
[11] In many respects, the role assigned to DOE under Title of UMTRCA is akin to that of a super "potentially responsible party" or (PRP) under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S.C. §§ 9601 *et seq*., since DOE is responsible for remediating Title I sites and maintaining them in perpetuity, and the agency is responsible for most of the costs associated with those efforts. Indeed, because of the unique role performed by DOE at Title I sites, Congress deemed it appropriate to specifically exclude those sites from the reach of CERCLA. *See* 42 U.S.C. § 9601(22).
[12] Under Section 274 of the AEA, States can enter into agreements with NRC under which the States assume the authority of the NRC with respect to the regulation of uranium mill tailings and related wastes.
[13] In 1974, the AEC was terminated and divided into a promotional and a regulatory agency. The Energy Research and Development Administration, the precursor to the current DOE, was the promotional agency. The new regulatory agency was NRC.
[14] 42 U.S.C. § 2022(b).
[15] 42 U.S.C. § 2114(a)(3).
[16] *See* 40 CFR § 261.4.
[17] 48 Fed. Reg. 590 (January 5, 1983).

NRC issued its Generic Environmental Impact Statement (GEIS) and its initial regulations for uranium milling. EPA established 20 picocuries per meter squared per second (20 pCi/m²/s) radon standard for emissions from reclaimed tailings facilities. EPA's inactive site regulations also established what has come to be known as the "5/15" clean-up standard for radium-226 in soil, primarily due to "windblown" tailings or tailings spills. Under this standard, radium concentrations in soil are to be reduced to levels of no more than 5 pCi/g above background levels in the first 15 cm of soil and no more than 15 pCi/g above background levels in each descending 15 cm soil horizon averaged over 100 square meter segments. In addition, EPA required that disposal systems be designed to provide "reasonable assurance" of achieving the radon emission standard for 1,000 years, but no less than 200 years and to do so without the need for "active" maintenance.

Under UMTRCA, Congress specifically designated NRC as the lead agency for implementing and enforcing EPA's generally applicable standards through licensing.[18] Section 275(d) of the AEA provides that "[i]mplementation and enforcement of the standards promulgated [by EPA] pursuant to subsection (b) of this section shall be the responsibility of the NRC in the conduct of its licensing activities under this Act."[19] In addition, Congress expanded NRC's regulatory authority under Section 84 of the AEA to develop its own requirements for the management of 11e.(2) byproduct material.

The NRC's regulations providing for the safe disposal, containment, and long-term oversight of 11e.(2) byproduct material are contained in Criteria set forth in 10 CFR Part 40, Appendix A. Appendix A sets forth broad, performance-oriented criteria governing uranium recovery activities and waste disposal. At a time when emerging environmental regulations were typically extremely prescriptive (e.g., EPA), Appendix A may be classified as somewhat "ahead of its time" because NRC sought to develop performance-oriented Criteria rather than prescriptive regulations so that uranium recovery licensees could address site-specific circumstances effectively.[20] In total, Appendix A contains thirteen Criteria designed to require licensees to properly locate, manage, and decontaminate and decommission their sites. These Criteria have been adopted in total by the State of Colorado.

In 1983, in response to discontent among licensees seeking to propose site-specific alternatives, Congress amended Section 84 of the AEA to allow NRC to approve licensee-proposed alternatives to the NRC's requirements if the licensee-proposed alternatives provide a level of protection that is "equivalent to, to the extent practicable, or more stringent than" the level of protection afforded by NRC standards.[21] Congress' 1983 amendments also clarified NRC's responsibilities under Section 84(a) of the AEA by specifically requiring that EPA/NRC consider environmental and economic costs and balance those costs against potential risks when developing standards and requirements for the management of 11e.(2) byproduct material.[22]

Agreement States. Under the AEA, Congress sought to create a pervasive, comprehensive statutory and regulatory regime in which the AEC/NRC would have the primary authority for

[18] 42 U.S.C. § 2022(d).
[19] *Id.*
[20] NRC Staff developed these Appendix A Criteria "mindful of the fact that the problem of mill tailings management is highly site-specific. The precise details of a program can be worked out only when the unique conditions of a site are known." Indeed, the word "requirements" in the Introduction to "Appendix A" was replaced with the word "criteria", NUREG 0706, Volume II A-81, 82.
[21] 52 Fed. Reg. 43, 553 (1987).
[22] Pub. L. No. 97-415 § 22 (1983).

implementation and enforcement of AEA requirements for the licensing of source, special nuclear,[23] and byproduct material. However, Congress also empowered NRC to withdraw its regulatory authority over AEA materials and to enter into an "agreement" permitting State regulatory authorities to regulate such materials in accordance with the AEA.

Congress enumerated the requirements for States to assume such authority in Section 274 of the AEA entitled *Cooperation With States*.[24] Under Section 274, Congress authorized the NRC to enter into agreements with State regulatory authorities "providing for discontinuance of the regulatory authority of the Commission …with respect to any one or more of the following materials within the State:

(1) byproduct materials as defined in section 11e.(1);
(2) byproduct materials as defined in section 11e.(2);
(3) source materials;
(4) special nuclear materials in quantities not sufficient to form a critical mass."[25]

With respect to 11e.(2) byproduct material, Congress noted that "[t]he NRC shall also retain authority under any such agreement to make a determination that all applicable standards and requirements have been met prior to termination of a license for byproduct material, as defined in section 11e.(2)."[26] Thus, 11e.(2) byproduct material facilities require final "sign-off" by the NRC of a State-approved closure prior to final site closure and license termination.

In June of 1981, representatives of Agreement States complained that NRC was not permitting those States to develop their own site-specific requirements for uranium mill tailings to operate in lieu of the requirements promulgated by NRC, even if those State alternatives provided levels of protection equivalent to those afforded by NRC regulations. Indeed, Senator Pete Domenici summarized the testimony succinctly:

> "NRC is saying that regardless of what the law says with reference to an equivalent, to the extent practicable, or more stringent than, that their interpretation now is since they have no EPA standard, it will be [the NRC standards] or nothing else."[27]

Similar problems were reported by a number of licensees, who found NRC unwilling to accept any licensee-proposed alternatives to the standards promulgated by the NRC. In response, Congress amended the AEA to modify certain sections previously added by UMTRCA.[28] In particular, Section 274 of the AEA was amended to provide Agreement States with explicit authority to adopt "alternatives (including, where appropriate, site-specific alternatives) to the requirements adopted and enforced by the Commission" provided they achieve a level of

[23] States under Section 274 of the AEA are only permitted to regulate special nuclear material in quantities not sufficient to form a critical mass. Regulation of special nuclear material in quantities sufficient to form a critical mass is expressly reserved to the NRC.
[24] 42 U.S.C. § 2021.
[25] 42 U.S.C. § 2021(b)(1-4) (emphasis added).
[26] 42 U.S.C. § 2021(c).
[27] Implementation of the Uranium Mill Tailings Radiation Control Act of 1978: Hearings Before the Subcomm. On Nuclear Regulation of the Senate Comm. on Environment and Public Works, 97th Cong. 17 (1981).
[28] Pub. L. No. 97-415, 96 Stat. 2067 (1983).

protection "equivalent to, to the extent practicable, or more stringent than" the level of protection afforded by NRC's standards.[29]

As the Agreement State program is currently constituted, in order for the NRC to withdraw its regulatory authority over one or more AEA materials listed in Section 274(b), the petitioning State must demonstrate to the NRC the following:

(1) that the State desires to assume regulatory responsibility for the relevant AEA material(s); and
(2) that the State has a radiation control program adequate to protect public health and safety from the potential hazards of the relevant AEA material(s)[30]

Further, the relevant State must adequately demonstrate to the NRC that its radiation safety program for AEA materials is compatible with AEA/NRC requirements.[31] When the NRC determines that the proposed agreement with the relevant State should become effective, the AEA requires that such agreement be published once a week for four consecutive weeks so that the public may submit comments.[32] After such comments are reviewed, the NRC will determine whether or not the agreement should be executed or whether revisions to such agreement are required.

Pursuant to the AEA, the NRC retains the authority to suspend or cancel a State's Section 274 Agreement if it determines that such program is either insufficient to protect public health and safety or is incompatible with the AEA and the NRC's regulatory program. With respect to ongoing review of Agreement State programs, NRC has developed a system of compatibility categories into which all aspects of a State radiation control program, including its statutory and regulatory sources of authority, are classified. STP (Office of State and Tribal Programs) Procedure SA-200 defines the relevant compatibility categories for Agreement States to follow when creating radiation safety program regulations:

(1) Category A is defined as "[b]asic radiation protection standard or related definitions, signs, labels or terms necessary for a common understanding of radiation protection principles. *The State program element should be essentially identical to that of NRC*;"
(2) Category B is defined as "[p]rogram element with significant direct transboundary implications. *The State program element should be essentially identical to that of NRC*;"
(3) Category C is defined as "[p]rogram element, the essential objectives of which should be adopted by the State to avoid conflicts, duplications or gaps. *The manner in which the essential objectives are addressed need not be the same as NRC, provided the essential objectives are met*;"[33]

These compatibility requirements serve as a primary basis for NRC's STP's Integrated Materials Performance Evaluation Program (IMPEP). Under the IMPEP reviews of Agreement State

[29] *Id. codified* at 42 U.S.C. § 2021(o).
[30] 42 U.S.C. § 2021(d).
[31] 42 U.S.C. § 2021(d)(2).
[32] 42 U.S.C. § 2021(e)(1).
[33] United States Nuclear Regulatory Commission, Office of State and Tribal Programs, *Compatibility Categories and Health and Safety Identification for NRC regulations and Other Program Elements,* STP Procedure SA-200 (October 8, 2004). Previously, Category A compatibility regulations required identical language to that of NRC.

radiation safety programs are conducted to ensure that such programs are adequately protective of public health and safety and are compatible with AEA/NRC requirements.

Long-Term Surveillance and Monitoring Program. Under UMTRCA, DOE is designated as the primary responsible party for long-term surveillance and monitoring of all 11e.(2) byproduct material and the land(s) on which such material is deposited. Under Section 83 of the AEA, as amended, as stated above, Congress mandated that title to all 11e.(2) byproduct material and the land(s) on which such material is deposited be transferred to either (1) the United States or (2) the State in which such material is deposited.[34] In each case where a mill tailings site has been transferred for long-term surveillance and monitoring, the site has been transferred to DOE as States generally do not wish to avail themselves of the opportunity to take title to such sites.

As a result, in January of 1998, DOE, in conjunction with NRC, generated a protocol for the transfer and licensing of mill tailings sites to DOE for long-term surveillance and monitoring following site closure and license termination. This *Working Protocol of Long-Term Licensing of Commercial Uranium Mills* sets forth a number of principles for NRC and DOE to follow in affecting the transfer of these sites. For example, the Protocol specifies that NRC will require current licensees to demonstrate that all applicable NRC requirements have been met before the NRC will terminate current licenses. In addition, the Protocol provides that NRC "will not terminate any site-specific license until the site licensee has demonstrated that all issues with state regulatory authorities have been resolved."[35] This provision of the Protocol was consistent with NRC's interpretation of "concurrent jurisdiction" at the time.

As a general proposition, regardless of whether a mill tailings facility is located in an Agreement or non-Agreement State, the NRC has the final "sign-off" on whether site closure and license termination is proper.[36] As a result, the NRC has generally required that DOE be informed of the status of mill tailings sites destined for site closure and license termination and that DOE concur with all proposed site-specific issues such as groundwater containment and monitoring, institutional controls, and engineered barriers. Licensees have maintained, however, that this "concurrence" requirement is merely inter-agency courtesy, as any final NRC decision regarding final site closure is binding on DOE.

When an 11e.(2) byproduct material site has satisfied its NRC-approved reclamation plan, pursuant to 10 CFR § 40.51, the licensee is then required to transfer title to all 11e.(2) byproduct material and the lands within the long-term surveillance site boundary to DOE or the State in which the site is located. [37] This transfer must be completed at no cost to the government (i.e., federal or state government) and must be accompanied by a transfer of funds equal to the amount prescribed in Appendix A, Criterion 10 or to another amount designated by NRC. At the time of transfer, as required by 10 CFR § 40.51(c), DOE or the State will possess the site as a licensee of NRC in perpetuity and subject to all appropriate site-specific license conditions, as imposed by the NRC.[38]

[34] 42 U.S.C. § 2113(b)(1)(A).
[35] *See* United State Nuclear Regulatory Commission, *License Termination/Site Transfer Protocol Between the U.S. Department of Energy and the U.S. Nuclear Regulatory Commission* (1998).
[36] *Id*.
[37] 10 CFR § 40.51((b).
[38] 10 CFR § 40.51(c).

Appendix B

Population Distribution Data

Population Distribution Data

Current and future populations within an 80 km radius of the proposed Piñon Ridge Mill site were estimated for 16 compass sectors, by concentric circles of 0.1, 0.5, 1.0, 2.0, 3.0, 4.0, 5.0, 10.0, 20.0, 30.0, 40.0, 50.0, 60.0, 70.0, and 80.0 km from the center of the mill site, for a total of 240 sectors. Population estimates for each sector were derived using county population forecasts from the Colorado Department of Local Affairs (CDOLA), Demography Office, and Utah Governor's Office of Planning and Budget. Population subtotals by sector and compass point, as well as the total population for the expected first year of mill operation (2012), census years through the anticipated life of the mill (2020 and 2030), and the final year of CDOLA population forecasts are shown in Tables B1 through B4. Graphic representations of these population distributions are shown in Figures B1 through B4.

Sectoral populations were estimated by combining county-level population forecasts with the most recent available population data for Census Tract Block Groups. in the United States. ArcInfo and Xcel were used to extract data from U.S. Census 2008 population distribution estimates for Census Tract Block Groups located wholly or partially within the 80 km radius of the center of the proposed mill site. Urban areas within each county were generally assigned their own block group. To assign a population to each sector, a percentage area of each sector within one or more block groups was calculated for all the block groups.

Sectoral population estimates calculated using the percentage Block Group approach were modified to account for public land within the 80 km radius that does not contain residents. These areas, which include BLM, and U.S. Forest Service administered lands, were assigned a zero population. Population estimates for sectors containing federal lands were recalculated to account for the portion of acreage comprised of federal lands and distributed across the remaining area.

References

Utah Governor's Office of Planning and Budget. 2009. County Population Estimates and Projections. Department of Economic Analysis. Available at: http://governor.utah.gov/dea/upec.html.

U.S. Census Bureau. 2009. 2008 Census Tract Block Group population estimates obtained through ArcInfo and Xcel.

Table B-1
2012 Population within 50 mile (80 km) Radius of the Site

Sector	Radium in km															
	0.1	**0.5**	**1.0**	**2.0**	**3.0**	**4.0**	**5.0**	**10.0**	**20.0**	**30.0**	**40.0**	**50.0**	**60.0**	**70.0**	**80.0**	**Total**
N-NNE	0.02	0.44	1.37	3	0	0	0	0	0	0	0	0	266	1,232	2,132	3,634
NNE-NE	0.02	0.44	1.37	5	0	0	0	0	0	25	0	6	45	719	3,736	4,537
NE – ENE	0.02	0.44	1.37	5	6	1	0	0	124	50	0	66	1,537	928	13,223	15,943
ENE-E	0.02	0.44	1.37	5	9	13	2	0	318	405	5	0	2,876	6,446	22,429	32,511
E-ESE	0.02	0.44	1.37	5	4	2	26	78	458	607	2,479	316	72	2,426	3,433	9,908
ESE – SE	0.02	0.44	1.37	5	6	0	5	78	37	499	491	471	547	2,868	1,761	6,770
SE – SSE	0.02	0.44	1.37	5	1	0	0	0	33	127	728	409	682	451	119	2,555
SSE –S	0.02	0.44	1.37	3	0	0	0	0	12	174	459	7	67	363	799	1,887
S – SSW	0.02	0.44	1.37	3	0	0	0	0	15	164	41	174	696	461	787	2,343
SSW – SW	0.02	0.44	1.37	3	0	0	0	0	25	5	232	320	391	923	1,732	3,632
SW – WSW	0.02	0.44	1.37	0	0	0	0	0	3	3	661	754	1,011	1,135	96	3,664
WSW – W	0.02	0.44	1.37	0	0	0	0	0	0	24	406	813	1,255	770	875	4,144
W – WNW	0.02	0.44	1.37	0	0	0	0	0	0	28	342	420	670	882	970	3,315
WNW – NW	0.02	0.44	1.37	0	1	0	0	6	217	125	114	167	47	1,371	8,508	10,559
NW – NNW	0.02	0.44	1.37	6	9	7	0	89	195	68	89	420	629	929	1,644	4,086
NNW – N	0.02	0.44	1.37	3	2	1	0	3	0	0	0	102	381	680	2,163	3,337
Total	0.3	7	21	54	38	24	32	254	1,437	2,303	6,048	4,447	11,170	22,583	64,407	112,826

Sources: CDOLA, 2009; Utah Governor's Office of Planning & Budget, 2009 and U.S. Census Bureau, 2009c.

Table B-2
2020 Population within 50 mile (80 km) Radius of the Site

Sector	Radius in km															
	0.1	**0.5**	**1.0**	**2.0**	**3.0**	**4.0**	**5.0**	**10.0**	**20.0**	**30.0**	**40.0**	**50.0**	**60.0**	**70.0**	**80.0**	**Total**
N-NNE	0.02	0.55	1.71	4	0	0	0	0	0	0	0	0	313	1,452	2,513	4,284
NNE-NE	0.02	0.55	1.71	6	0	0	0	0	0	31	0	7	53	899	4,664	5,662
NE – ENE	0.02	0.55	1.71	7	7	2	0	0	154	62	0	83	1,914	1,156	16,516	19,902
ENE-E	0.02	0.55	1.71	7	11	16	3	0	397	504	7	0	3,581	8,027	27,932	40,486
E-ESE	0.02	0.55	1.71	7	6	2	32	98	570	756	3,087	395	90	3,042	4,301	12,388
ESE – SE	0.02	0.55	1.71	7	7	0	6	97	47	623	617	591	687	3,601	2,211	8,498
SE – SSE	0.02	0.55	1.71	6	1	0	0	0	42	160	914	509	793	521	137	3,084
SSE –S	0.02	0.55	1.71	4	0	0	0	0	15	219	577	8	77	420	932	2,255
S – SSW	0.02	0.55	1.71	4	0	0	0	0	19	205	51	205	804	533	915	2,739
SSW – SW	0.02	0.55	1.71	4	0	0	0	0	31	6	287	363	418	964	1,798	3,874
SW – WSW	0.02	0.55	1.71	0	0	0	0	0	3	3	686	783	1,049	1,178	99	3,804
WSW – W	0.02	0.55	1.71	0	0	0	0	0	0	25	421	844	1,302	799	908	4,301
W – WNW	0.02	0.55	1.71	0	0	0	0	0	0	29	355	436	696	916	1,006	3,440
WNW – NW	0.02	0.55	1.71	0	2	0	0	7	270	156	118	177	51	1,495	9,327	11,606
NW – NNW	0.02	0.55	1.71	7	11	9	0	111	243	85	104	475	689	1,018	1,802	4,556
NNW – N	0.02	0.55	1.71	4	2	2	0	3	0	0	0	120	449	802	2,547	3,931
Total	0.36	9	26	67	48	30	40	316	1,790	2,864	7,225	4,997	12,967	26,824	77,608	134,811

Sources: CDOLA, 2009; Utah Governor's Office of Planning & Budget, 2009; U.S. Census Bureau, 2009c

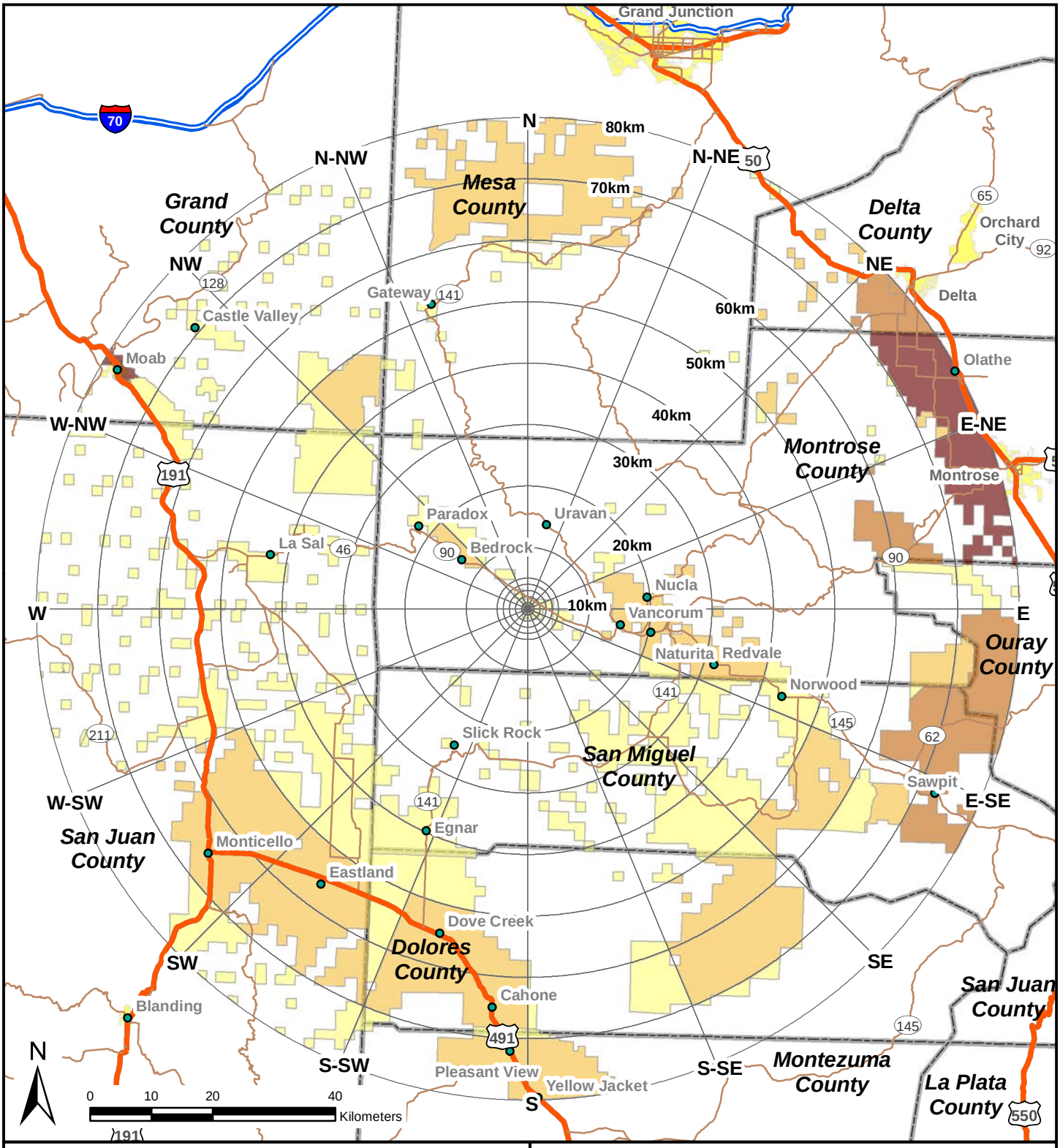
Table B-3
2030 Population within 50 mile (80-km) Radius of the Site

Sector	Radius in km															
	0.1	**0.5**	**1.0**	**2.0**	**3.0**	**4.0**	**5.0**	**10.0**	**20.0**	**30.0**	**40.0**	**50.0**	**60.0**	**70.0**	**80.0**	**Total**
N-NNE	0.03	0.68	2.13	5	0	0	0	0	0	0	0	0	382	1,773	3,068	5,231
NNE-NE	0.03	0.68	2.13	7	0	0	0	0	0	38	0	9	65	1,140	5,912	7,174
NE – ENE	0.03	0.68	2.13	9	9	2	0	0	192	77	0	103	2,383	1,439	20,841	25,058
ENE-E	0.03	0.68	2.13	9	14	20	4	0	494	628	8	0	4,458	9,968	34,651	50,255
E-ESE	0.03	0.68	2.13	9	7	2	40	122	710	941	3,844	495	114	3,829	5,172	15,286
ESE – SE	0.03	0.68	2.13	9	9	0	7	121	58	781	778	745	867	4,541	2,788	10,707
SE – SSE	0.03	0.68	2.13	8	1	0	0	0	53	202	1,152	639	946	618	163	3,785
SSE –S	0.03	0.68	2.13	5	0	0	0	0	19	276	727	10	92	499	1,112	2,744
S – SSW	0.03	0.68	2.13	5	0	0	0	0	24	259	65	246	955	634	1,090	3,281
SSW – SW	0.03	0.68	2.13	5	0	0	0	0	39	8	359	426	467	1,055	1,954	4,315
SW – WSW	0.03	0.68	2.11	1	0	0	0	0	4	3	746	851	1,140	1,280	108	4,136
WSW – W	0.03	0.68	1.62	0	0	0	0	0	0	27	458	917	1,415	868	987	4,675
W – WNW	0.03	0.68	1.55	0	0	0	0	0	0	31	386	474	756	995	1,094	3,740
WNW – NW	0.03	0.68	2.05	0	2	0	0	9	336	194	128	191	55	1,608	10,017	12,544
NW – NNW	0.03	0.68	2.13	9	13	11	0	138	303	105	125	541	740	1,094	1,936	5,017
NNW – N	0.03	0.68	2.13	5	3	2	0	4	0	0	0	147	548	979	3,104	4,794
Total	0.45	11	33	83	59	37	50	393	2,230	3,571	8,777	5,795	15,384	32,322	93,996	162,743

Sources: CDOLA, 2009; Utah Governor's Office of Planning & Budget, 2009; U.S. Census Bureau, 2009c

Table B-4
2035 Population within 50 mile (80-km) Radius of the Site

Sector	Radius in km															
	0.1	**0.5**	**1.0**	**2.0**	**3.0**	**4.0**	**5.0**	**10.0**	**20.0**	**30.0**	**40.0**	**50.0**	**60.0**	**70.0**	**80.0**	**Total**
N-NNE	0.03	0.74	2.30	5	0	0	0	0	0	0	0	0	415	1,926	3,332	5,681
NNE-NE	0.03	0.74	2.30	8	0	0	0	0	0	41	0	9	71	1,228	6,369	7,729
NE – ENE	0.03	0.74	2.30	9	10	2	0	0	207	83	0	111	2,576	1,556	22,470	27,028
ENE-E	0.03	0.74	2.30	9	15	21	4	0	534	678	9	0	4,819	10,765	37,412	54,270
E-ESE	0.03	0.74	2.30	9	8	3	43	131	767	1,017	4,156	539	124	4,181	5,551	16,532
ESE – SE	0.03	0.74	2.30	9	10	0	8	131	63	849	852	815	948	4,968	3,051	11,706
SE – SSE	0.03	0.74	2.30	9	1	0	0	0	57	221	1,260	698	1,023	668	176	4,117
SSE –S	0.03	0.74	2.30	6	0	0	0	0	21	302	795	11	99	539	1,196	2,972
S – SSW	0.03	0.74	2.30	6	0	0	0	0	26	283	71	266	1,032	684	1,170	3,542
SSW – SW	0.03	0.74	2.30	5	0	0	0	0	43	9	392	456	492	1,101	2,034	4,535
SW – WSW	0.03	0.74	2.28	1	0	0	0	0	5	3	777	886	1,187	1,333	112	4,306
WSW – W	0.03	0.74	1.75	0	0	0	0	0	0	28	477	955	1,473	904	1,028	4,867
W – WNW	0.03	0.74	1.68	0	0	0	0	0	0	33	402	494	787	1,036	1,139	3,893
WNW – NW	0.03	0.74	2.22	0	2	0	0	9	363	210	134	198	56	1,653	10,288	12,919
NW – NNW	0.03	0.74	2.30	9	15	12	0	149	237	114	134	571	760	1,123	1,988	5,204
NNW – N	0.03	0.74	2.30	5	3	2	0	5	0	0	0	159	596	1,063	3,368	5,204
Total	0.5	12	36	90	64	40	54	425	2,413	3,872	9,458	6,169	16,459	34,729	100,683	174,505
Sources: CDOLA, 2009; Utah Governor's Office of Planning & Budget, 2009; U.S. Census Bureau, 2009c																

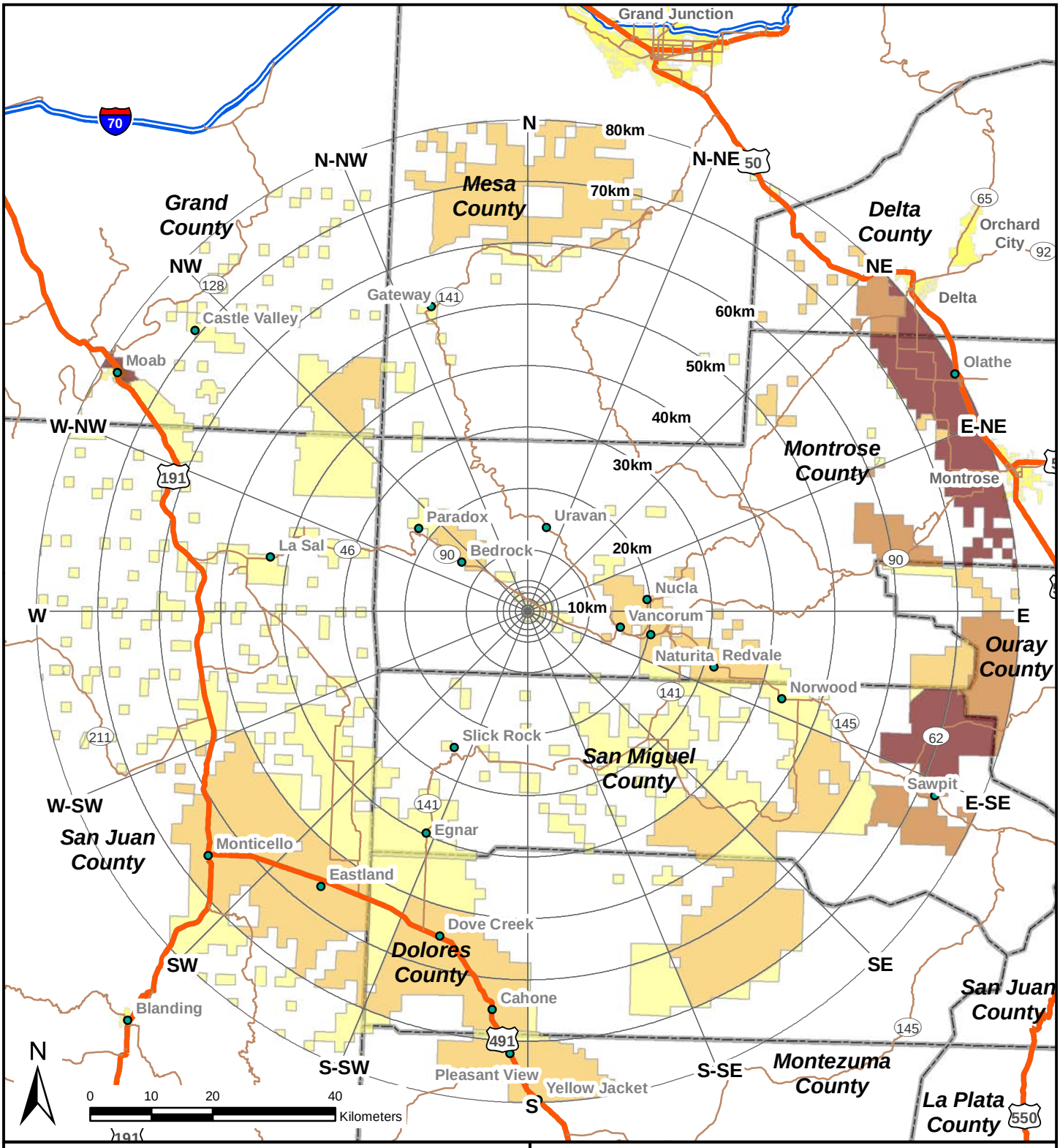


Population

- 0 - 200
- 201 - 1000
- 1001 - 2500
- 2501 - UP

Figure B-1

Population Distribution within 50 miles (80 km) of the Site 2012

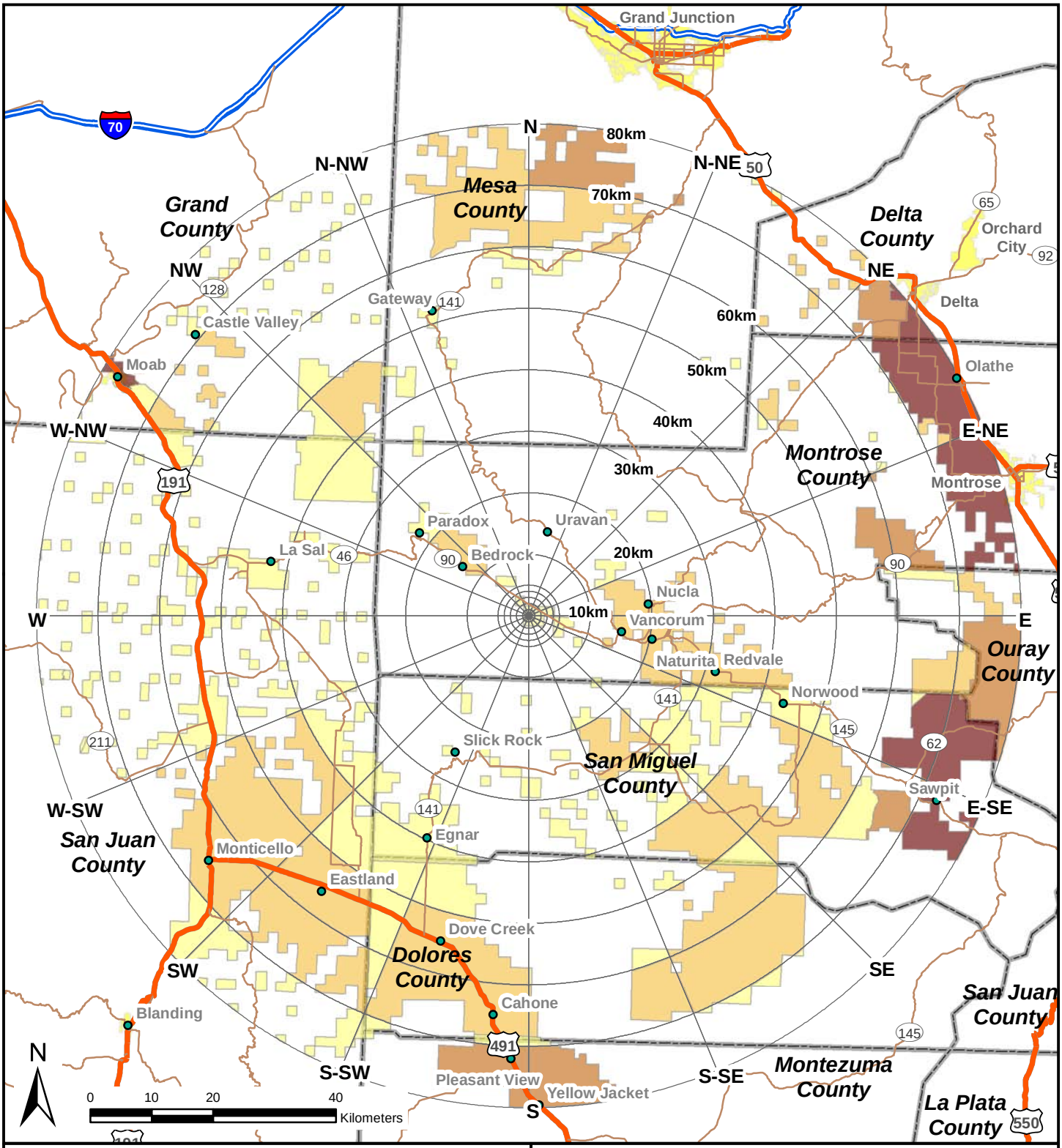


Population

- 0 - 200
- 201 - 1000
- 1001 - 2500
- 2501 - UP

Figure B-2

Population Distribution within 50 miles (80 km) of the Site 2020

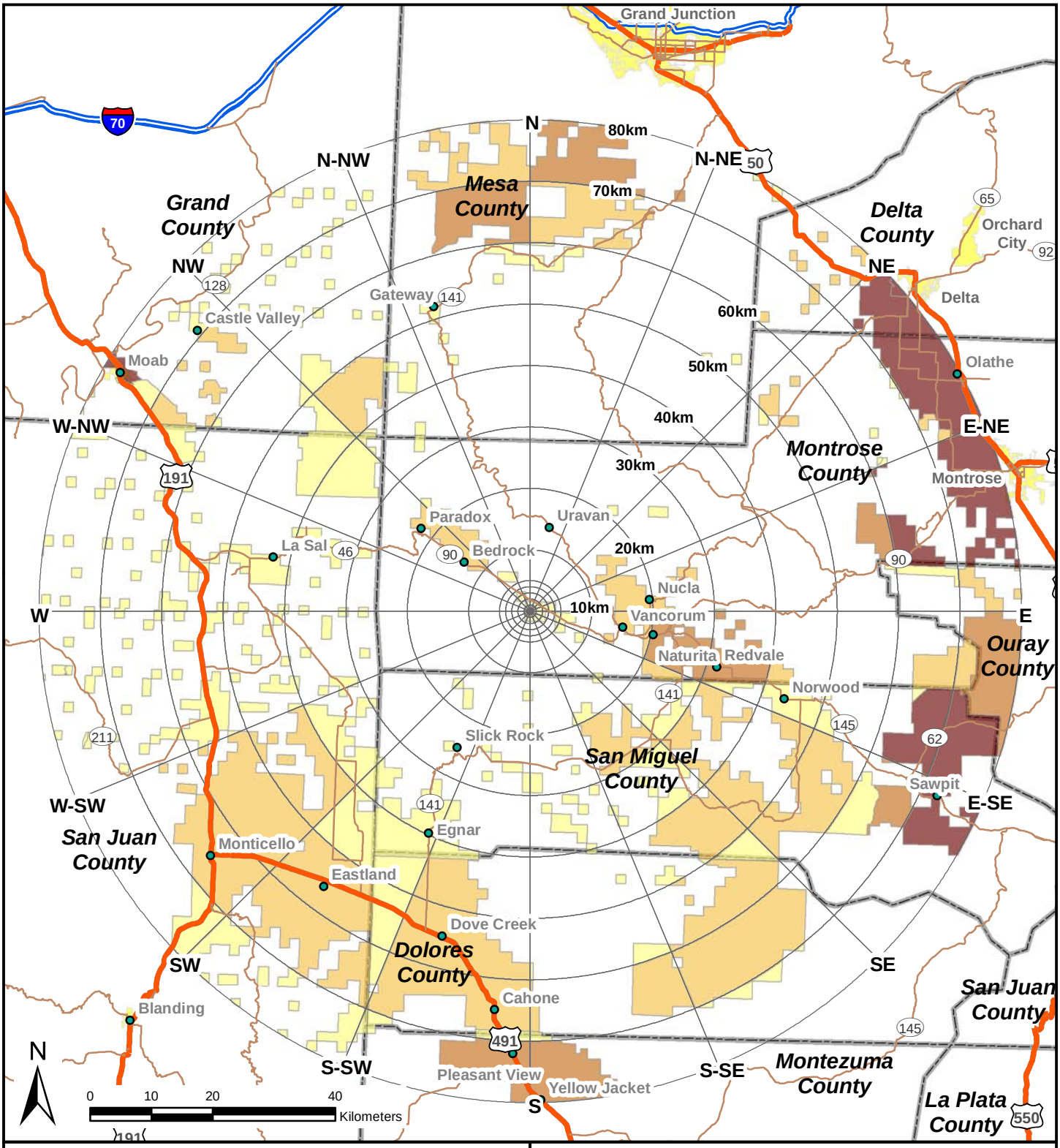


Population

- 0 - 200
- 201 - 1000
- 1001 - 2500
- 2501 - UP

Figure B-3

Population Distribution within 50 miles (80 km) of the Site 2030



Population

- 0 - 200
- 201 - 1000
- 1001 - 2500
- 2501 - UP

Figure B-4

Population Distribution within 50 miles (80 km) of the Site 2035