2 SITE CHARACTERISTICS

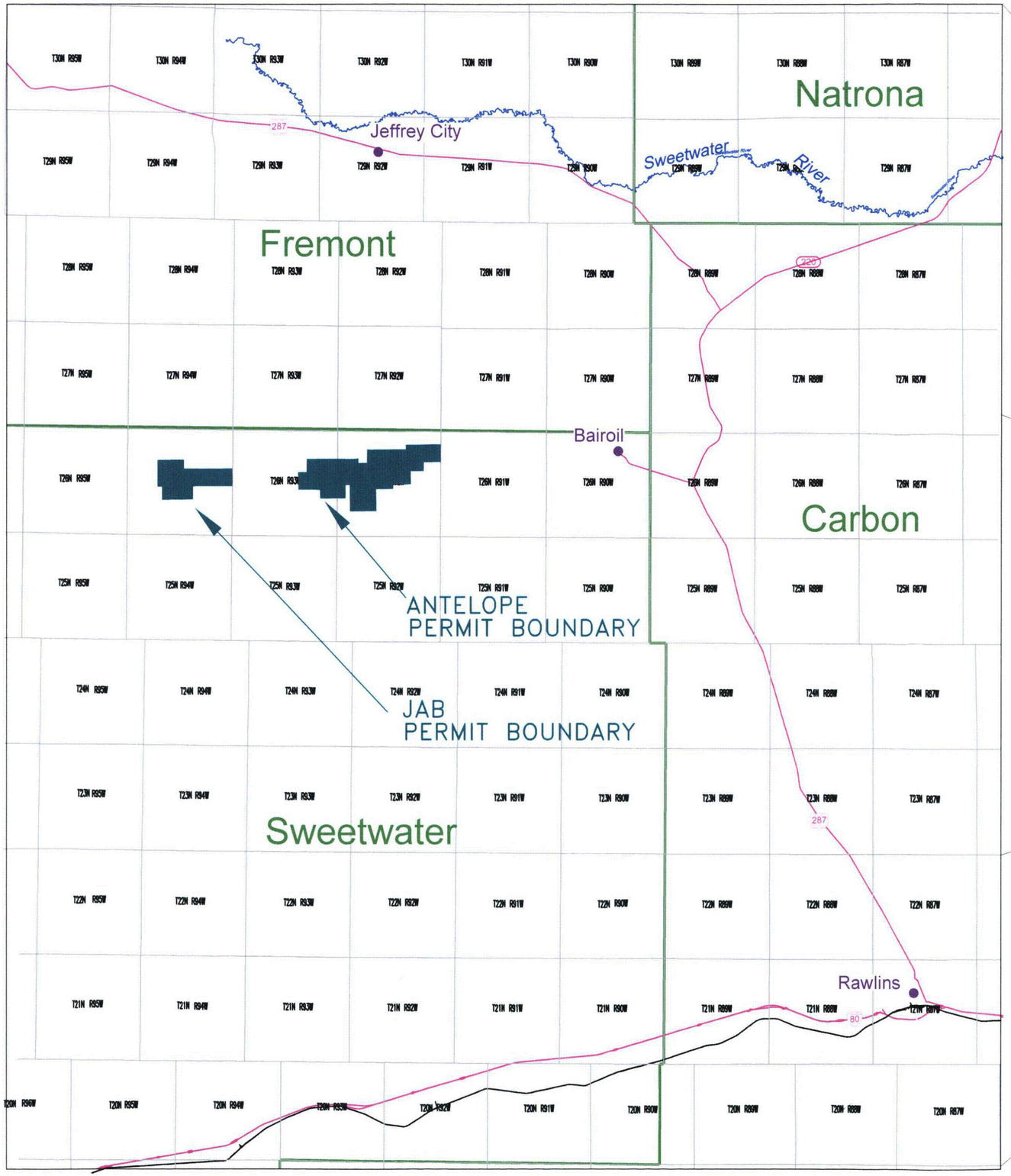
2.1 SITE LOCATION AND LAYOUT

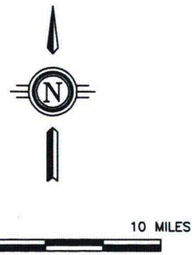
The proposed Antelope and JAB Project Area is located in Sweetwater County in south central Wyoming in Township 26 North, Range 94 West, in all or portions of Sections 8, 9, 10, 13, 14, 15, 16, 17, 20, 21, 22, 23 and 24; Township 26 North, Range 93 West, in all or portions of Sections 11, 12, 13, 14, 15, 22, 23 and 24 and Township 26 North, Range 92 West, in all or portions of Sections 1, 2, 7, 8, 9, 10, 11, 12, 14, 15, 16, 17, 18, 19, 20, 21, 22, 28, 29 and 30. Figure 2.1-1 shows the general location of the site in the Great Divide Basin area in relation to surrounding population centers, interstates and highways, and County boundaries.

Access to the site from the east is on State Highway 287 at Lamont, west on State road 73 to Bairoil, west on the Bairoil road. Access from the North is on Highway 287 at Jeffery City, south on the Wamsutter-Crooks Gap road. The main access road to the central plant facilities and wellfields at the Antelope site and the satellite and wellfield at the JAB site will be on the Bairoil road and State Highway 287.

U.S. Geological Survey (USGS) 7.5 minute topographical quadrangle maps from Topo Depot® software and geo spatial data from the Wyoming Geographic Information Science Center were utilized for development of the base map. These are CAD/GIS drawings where each road, stream, and contour line are individual entities. This base map was then used for each of the figures prepared for this document with the addition of the pertinent information for that figure.

Figure 2.1-2 shows the general topography, project site layout, and Restricted Areas for the project area including the central plant facilities, Warehouse/Shop, and Office building areas at the Antelope site, the satellite facilities at the JAB site and the potential mine unit boundaries at both sites. Other site right of ways such as electrical transmission lines and pipelines are also shown on Figure 2.1-2. Drainage, surface water features, and waterways are shown on Figure 2.7-1 in Section 2.7.





0 MILES 10 MILES

WYOMING

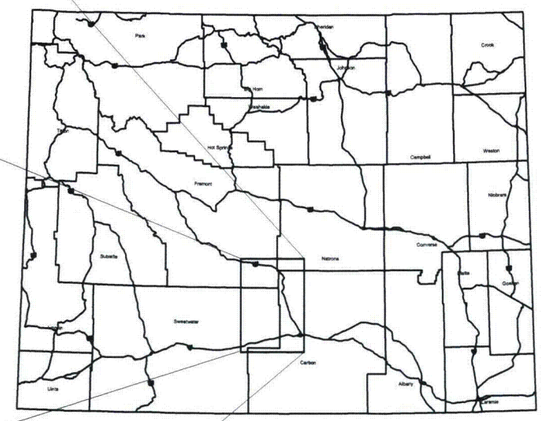


Figure 2.1-1

URANIUM ONE

907 North Poplar St. Casper, WY 82601 307-234-8235

REVISIONS		
NO.	DATE	BY

ANTELOPE & JAB

GENERAL LOCATION MAP

GEOL. BY:	DATE: 08/23/08	APPR. BY:	DATE:	SHT. NO.
ENG. BY:	DATE:	APPR. BY:	DATE:	
DRAFT. BY:	DATE:	SCALE:	FILE:	

T.27N., R.94W.

T.27N., R.93W.

T.27N., R.92W.

FREMONT COUNTY
SWEETWATER COUNTY

JETTREY CITY ~25 MI.
CROOKS GAP ROAD

JAB
LICENSE/PERMIT BOUNDARY

ANTELOPE
LICENSE/PERMIT BOUNDARY

LICENSE/PERMIT BOUNDARY

LICENSE/PERMIT BOUNDARY

SATELLITE IX PLANT
Proposed Plant Site

CENTRAL PLANT FACILITY
Proposed Plant Site

BISON BASIN RD

BARROW ROAD

TO BARROW ~16 MI.

WAMSUTTER-CROOKS GAP RD.

Commuter Road

Pipeline

Powerline

PPL Substation

T.26N., R.94W.

T.26N., R.93W.

T.26N., R.92W.

LEGEND

PROPOSED WELLFIELD AREAS/ AFFECTED LANDS

MINERALIZED/FUTURE DEVELOPMENT AREAS/POTENTIAL FUTURE AFFECTED LANDS

NAD 27 WYOMING WEST CENTRAL ZONE

URANIUM ONE

REVISIONS

FIGURE 2.1-2

JAB & ANTELOPE
SITE PLAN

SWEETWATER COUNTY, WYOMING

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TABLE OF CONTENTS

TABLE OF FIGURES

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TABLE OF TABLES

2.2 USES OF ADJACENT LANDS AND WATERS

The information in Section 2.0 provides relevant data concerning the physical, ecological, and social characteristics of the proposed Antelope and JAB License Area (License Area), and the surrounding environs for uranium in situ mining. NUREG-1569 requires discussion of land use in the proposed License Area, and within a 2.0-mile radius surrounding the License Area. This section indicates the nature and extent of present and projected land use and trends in population or industrial patterns. Preliminary data were obtained from several sources followed by field studies to collect on-site data to check land uses. All tables discussed in section 2.2 are presented at the end of the section.

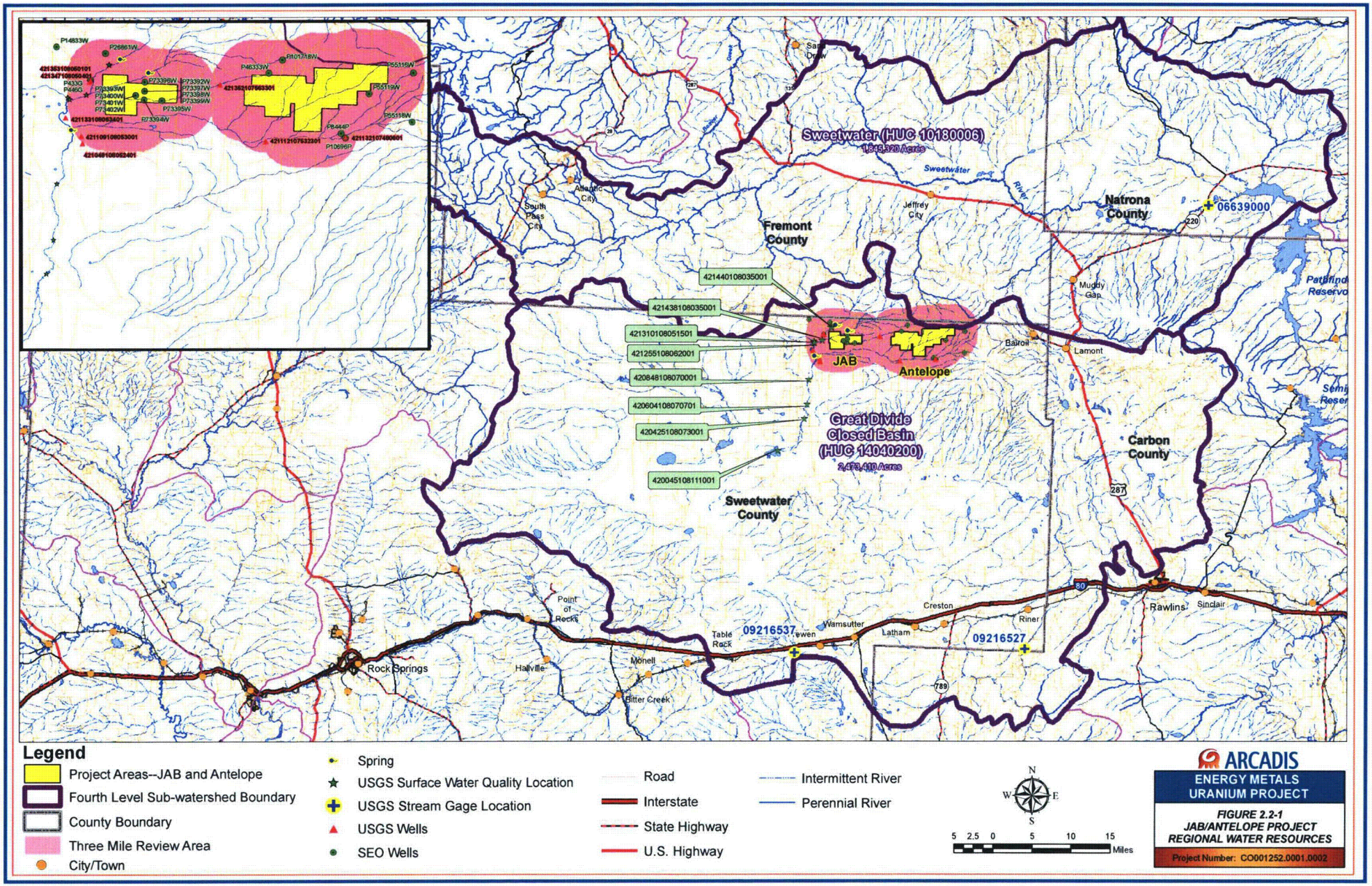
2.2.1 General Setting

The License Area (consisting of two sites) is located in south central Wyoming in the northeastern section of Sweetwater County, Wyoming (Figure 2.2-1). The License Area is located about 100 miles northeast of Rawlins, WY. The center of the Antelope site is located 15 miles west of Bairoil, WY and the center of the JAB site is located about 35 miles west of Bairoil. The License Area (both sites) may be accessed from Rawlins, Wyoming by traveling about 30 miles north on State Highway 287 to Lamont, WY. From Lamont, the License Area is accessed by traveling west on State Road 73 (Bairoil Road) for about 15 miles to reach the eastern boundary of the Antelope site. The Bairoil Road continues through the entire Antelope site, which is 6.5 miles across and continues west/northwest for another 6 miles to where Bairoil Road intersects with Arapahoe Creek. At this point, access to the JAB site is by a service four-wheel-drive road for about 0.5 miles.

The License Area is located within the Great Divide Basin, a large intermontane topographic and structural basin that is part of the Wyoming Basin Physiographic Province. The terrain is flat to rolling hills, and slopes downward along ephemeral draws (BLM 2007). Elevations in the basin range from 6,900 to 7,400 feet above mean sea level (USGS 1995). Average annual precipitation for the License Area ranges from 8 to 12 inches per year (SWWRC 2001).

2.2.2 Land Use

Current and historic (within the last 20 years) land uses within the License Area and a 2.0-mile review area around the License Area are Grazingland, Fish and Wildlife Habitat, and Industrial, as defined by State of Wyoming regulations in Wyoming Statutes § 35-11-103 (e) (xxvi) (Wyoming Legislative Service Office 2007). Dispersed recreation such as hunting may also occur in the License Area and review area. These land uses occur on a land cover type generally known as rangeland. Grazing and


Sweetwater (HUC 10180006)
1,845,320 Acres
Great Divide Closed Basin (HUC 14040200)
2,473,410 Acres
Fremont County
Natrona County
Carbon County
Sweetwater County
JAB
Antelope
421440108035001
421438108035001
421310108051501
421255108062001
420848108070001
420604108070701
420425108073001
420045108111001
06639000
09216537
09216527
Rock Springs
Green River
Rawlins
Sinclair
Creston
Riner
Wamsutter
Latham
Table Rock
Point of Rocks
Hallville
Monell
Bitter Creek
Atlantic City
South Pass City
Jeffrey City
Muddy Gap
Bairoil
Lamont
Legend
Project Areas--JAB and Antelope
Fourth Level Sub-watershed Boundary
County Boundary
Three Mile Review Area
City/Town
Spring
USGS Surface Water Quality Location
USGS Stream Gage Location
USGS Wells
SEO Wells
Road
Interstate
State Highway
U.S. Highway
Intermittent River
Perennial River
N
W
E
S
5 2.5 0 5 10 15
Miles
ARCADIS
ENERGY METALS URANIUM PROJECT
FIGURE 2.2-1
JAB/ANTELOPE PROJECT
REGIONAL WATER RESOURCES
Project Number: CO001252.0001.0002

industrial uses (oil and gas development) are described below. Fish and Wildlife Habitat are discussed in the appropriate wildlife descriptions in Section 2.7 of this Technical Report. These land uses coexist within the same land area and cannot be mapped or described with calculated acreages.

2.2.2.1 Grazing

Livestock grazing is the primary land use of the rangeland in the License Area, which are in the Green Mountain Common Allotment of the Lander Office region. The allotment includes 517,240 acres, of which 468,379 acres are administered by the Bureau of Land Management (BLM), 14,842 acres are private land, and 34,019 acres are administered by the state of Wyoming. The allotment is permitted for 47,361 Animal Unit Months (AUMs), which includes 35,910 AUMs for cattle and 11,451 AUMs for sheep. An additional 3,550 AUMs are allowed for wild horses, which range across much of this area, including the License Area. The average stocking rate is 9 acres per AUM. Permitted seasons for cattle are May 1 through October 31 and May 15 through November 15 and for sheep is March 1 through February 28 (BLM 1986, 2007a).

In 2006, an average of 25,000 head of livestock was reported for Sweetwater County (NASS 2007). Table 2.2-1 provides additional detail on the livestock inventory for Sweetwater County. The inventory of cattle decreased from 20,000 head in 2000 to 15,000 head in 2006. The inventory of sheep has fluctuated between 2000 and 2005, but has remained relatively stable. In 2005, cash receipts for livestock marketing totaled $99.8 million in Sweetwater County. The inventory value of livestock was $17.4 million, which was calculated by multiplying the state average price by the county inventory.

2.2.2.2 Industrial

Industrial development consists of oil and gas production, which occurs throughout BLM lands in the general area. Primary mineral resources that occur within the License Area and the 2.0-mile review area are uranium, natural gas and oil. The Great Divide Basin has been explored and developed for oil and gas resources at least since 1978, the earliest date that well information is maintained by the Wyoming Oil and Gas Conservation Commission. Currently, 19 leases are partially or wholly within the Antelope License Area and eight oil and gas leases are located partially or wholly within the JAB License Area. Table 2.2-2 lists the leases that are located partially or entirely within the License Area.

2.2.2.3 Recreation

Recreational opportunities provided by federal and state lands in the four-county (Sweetwater, Carbon, Natrona & Fremont) region have become an increasingly important component of local economies. No developed recreational sites, facilities, or special recreational management area exist in the License Area or the surrounding 2.0-mile review area.

The regional setting of the License Area contains broad, panoramic prairie landscapes, which provide a setting for a variety of outdoor recreational activities. For BLM lands in the License Area, the management objective is to provide a range of opportunities for recreational experiences now and in the future. For land use planning purposes, BLM lands are designated into Resource Opportunity Spectrum (ROS) classes based on the mix of activities, settings, and probable outdoor recreational experience opportunities. The designated ROS class for the License Area is semi-primitive motorized (BLM 1986).

The recreational industry is a large part of the local economies. Dispersed recreational opportunities in the License Area include hunting, camping, hiking, horseback riding, rock collecting, bicycling, motorcycling, and off-road vehicle (ORV) use (BLM 1986). The Continental Divide National Scenic Trail runs north and east of the License Area and comes within 2 miles of the northeast boundary of the Antelope site. No specific data on recreational use of the License Area are available; however, use is likely low because of the relatively small local population, long drives from major population centers, and lack of well-known natural attractions. Hunting is the most important recreational activity in the License Area. Hunting occurs primarily during the fall hunting seasons, specifically during September and October. Species hunted include antelope, mule deer, and sage grouse, as well as rabbits and some predators such as coyotes (BLM 1986). The region within the 50-mile radius includes several special recreation management areas on public and private lands. Recreation sites on public lands are summarized in Table 2.2-3.

NUREG-1569 requires a table summarizing the distance to each residence within 2 miles (3.3 km) from the center of the License Area for each of the 22.5-degree sectors centered on each of the 16 compass points from the center of the License Area. However, the Antelope and JAB License Area and the surrounding 2-mile buffer for each License Area contains BLM lands and state lands, and small parcels of private land located within or in very close proximity to the 2-mile buffer. Based on a site reconnaissance conducted in May 2007 and review of a 2006 aerial photo of the License Area, no occupied housing units have been identified in the License Area. The nearest residences are located in the communities of Bairoil and Jeffrey City. Table 2.2-4 shows the distance to the nearest site boundary from the center of each site for each 22.5 degree sector centered on each compass point for the proposed License Area.

Industrial and Mining land use within the License Area and the surrounding 2.0-mile review area is a subcategory of the dominant Grazingland land use, and consists of ongoing oil and natural gas production facilities located throughout rangeland that is also used for grazing.

2.2.2.4 Aesthetics

The License Area is located on flat to rolling grasslands that are typical of the characteristic landscapes in the Great Divide Basin. The landscapes in the License Area are rural in character, with a minor industrial component from oil and gas extraction

activities. The landscape colors are dominated by tan, gold, and green vegetation and tan soils. As the License Area has been used historically for grazing and oil development, it is unlikely that any undisturbed area exists within the proposed License Area boundaries. Human influence is evidenced by existing grazing activities and facilities (stock tanks, fences), oil production facilities, natural gas production facilities, and infrastructures that support these activities. Oil and gas field infrastructure in the License Area and the surrounding 2.0-mile review area includes access roads, overhead electric distribution lines, and cleared rights-of-way for underground utilities, generally located along access roads.

2.2.2.5 Transportation and Utilities

The regional transportation system that serves the License Area includes an established network of interstate and state highways, county roads, and BLM roads. The primary existing roads that provide access to the License Area are Interstate 80 (I-80), U.S. Highway 287/Wyoming State Highway (WY) 789, Sweetwater County Road 73 (Bairoil Road), and Wamsutter-Crooks Gap Road. The Wyoming Department of Transportation (WYDOT) measures annual average daily traffic volume (AADT) on federal and state highways. AADTs for highways and major collector roads that provide access to the License Area are shown in Table 2.2-5.

Improved and unimproved BLM roads provide access for local traffic on federal land. BLM roads are maintained by the BLM. Construction and maintenance of access roads for the proposed project must be in accordance with road standards outlined in BLM Manual 9113 and other applicable measures described in Section 3.0. The BLM has completed off-road vehicle (ORV) designations for the Lander Field Office. The ORV designation for the License Area is limited, meaning that ORV use is limited to existing roads and trails (BLM 1986).

2.2.2.6 Fuel Cycle Facilities

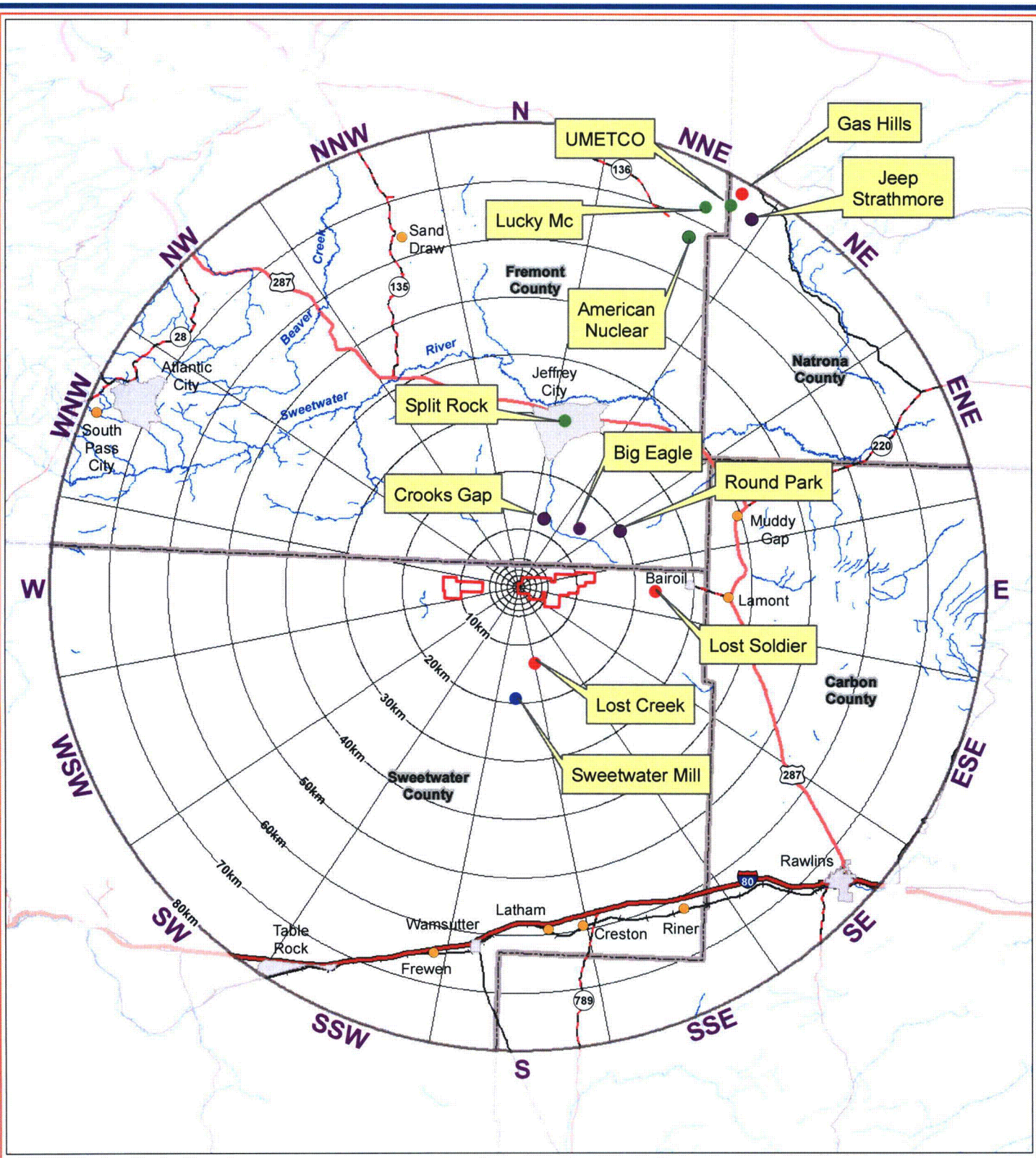
The United States Nuclear Regulatory Commission website (NRC 2007) provides the locations of all source material facilities in the United States, including fuel cycle facilities and uranium mills. The website was reviewed to identify the location of fuel cycle facilities and uranium mills within 50 miles (80-km) of the proposed Antelope and JAB Project Area. The nearest uranium fuel fabrication facility is located in Richland, Washington (U.S. NRC 2007). Several Source Material Licenses for proposed situ uranium projects occur within a fifty mile radius of the Antelope and JAB Project as shown on Figure 2.2-2. These sites are listed below:

- Cameco Resources Gass Hills Project.
- Ur Energy Lost Creek Project
- Ur Energy Lost Soldier Project

Other resources such as Underground Uranium resources, Reclaimed Conventional Uranium Mills or existing Conventional Uranium Mills include:

- Kenecott Uranium - Sweetwater Mill

The nearest operational in-situ plant is the Smith Ranch facility, which is the only currently producing ISR facility in Wyoming. The facility is in Converse County approximately 50 miles north east of Casper Wyoming.



Legend

- JAB and Antelope Project Areas
- Approximate Location
- Uranium Surface/Underground Resource
- Existing Conventional Uranium Mill
- Proposed In-Situ Uranium Recovery Operation
- Reclaimed Conventional Uranium Mill

0 5 10 20 Miles

ARCADIS

ENERGY METALS CORP.

FIGURE 2.2-2
JAB AND ANTELOPE PROJECT
URANIUM OPERATIONS
WITHIN 80 KILOMETERS

Project Number: CO001252.0001.0002

I:\CO001252\GIS\ArcMap_MXD\Uranium_JAB.mxd - 5/28/2008 @ 1:51:35 PM

2.2.3 Uses of Adjacent Waters

This section examines the nature and extent of present and projected water use in the License Area. Preliminary data were obtained from several sources followed by field studies to collect on-site data. NUREG 1569 requires review and discussion of water use in the License Area and within a 2-mile radius surrounding the License Area. In addition, the WYDEQ requires review and discussion on groundwater rights within a 3.0-mile radius and surface water rights within 0.5 mile radius surrounding the License Area. Water use within the review area is illustrated on Figures 2.2-3 and 2.2-4.

2.2.3.1 Surface Water

The License Area, as well as most of the 3.0-mile review area surrounding the sites, is located in the northern central part of Great Divide Closed Basin, Hydrologic Unit Code (HUC) Number 14040200, which is situated in south central Wyoming in Sweetwater and Fremont Counties (Figure 2.2-1). The Great Divide Basin is a high desert watershed that forms a bowl-like depression located along the Continental Divide. The Great Divide Basin is a closed watershed, or terminal basin, meaning all surface water drainage is internal. Surface water bodies within the Great Divide Basin are unconnected from any jurisdictional waters of the United States. Streamflow in the Great Divide Basin is mostly a response to spring snowmelt and direct runoff from summer thunderstorm events (USGS 1976). The total drainage area of the Great Divide Basin is approximately 3,865 square miles.

The north/northeastern portion of the 3-mile review area of the Antelope site boundary drains to the Sweetwater Basin, HUC Number 10180006, via Crooks Creek (Figure 2.2-1). The Sweetwater Basin is a headwater basin, i.e. there are no upstream basins, and it drains to the North Platte River Basin. As in the Great Divide Basin, streamflows peak in the late spring as a product of snowmelt. Late summer and fall thunderstorms also influence hydrograph rises. In total, the Sweetwater Basin drains 2,883 square miles.

The Antelope site is drained by several unnamed ephemeral drainages that flow southwest to Osborne Draw, an ephemeral creek that flows west to its confluence with Lost Creek (Figures 2.2-1 and 2.2-2). One unnamed drainage originating in the northwestern portion of the Antelope site flows westerly toward the JAB site where it joins with Arapahoe Creek. Lost Creek is a perennial stream that flows southwest/south from its confluence with Arapahoe Creek just west of the JAB site, to its termination point at Lost Creek Lake within the Great Divide Closed Basin. To the north/northeast of the Antelope site within the 3.0-mile review area, Bare Ring Slough, Crooks Creek and several unnamed ephemeral streams drain into the Sweetwater River and Sweetwater Basin located to the north of the property sites (USGS 1995).

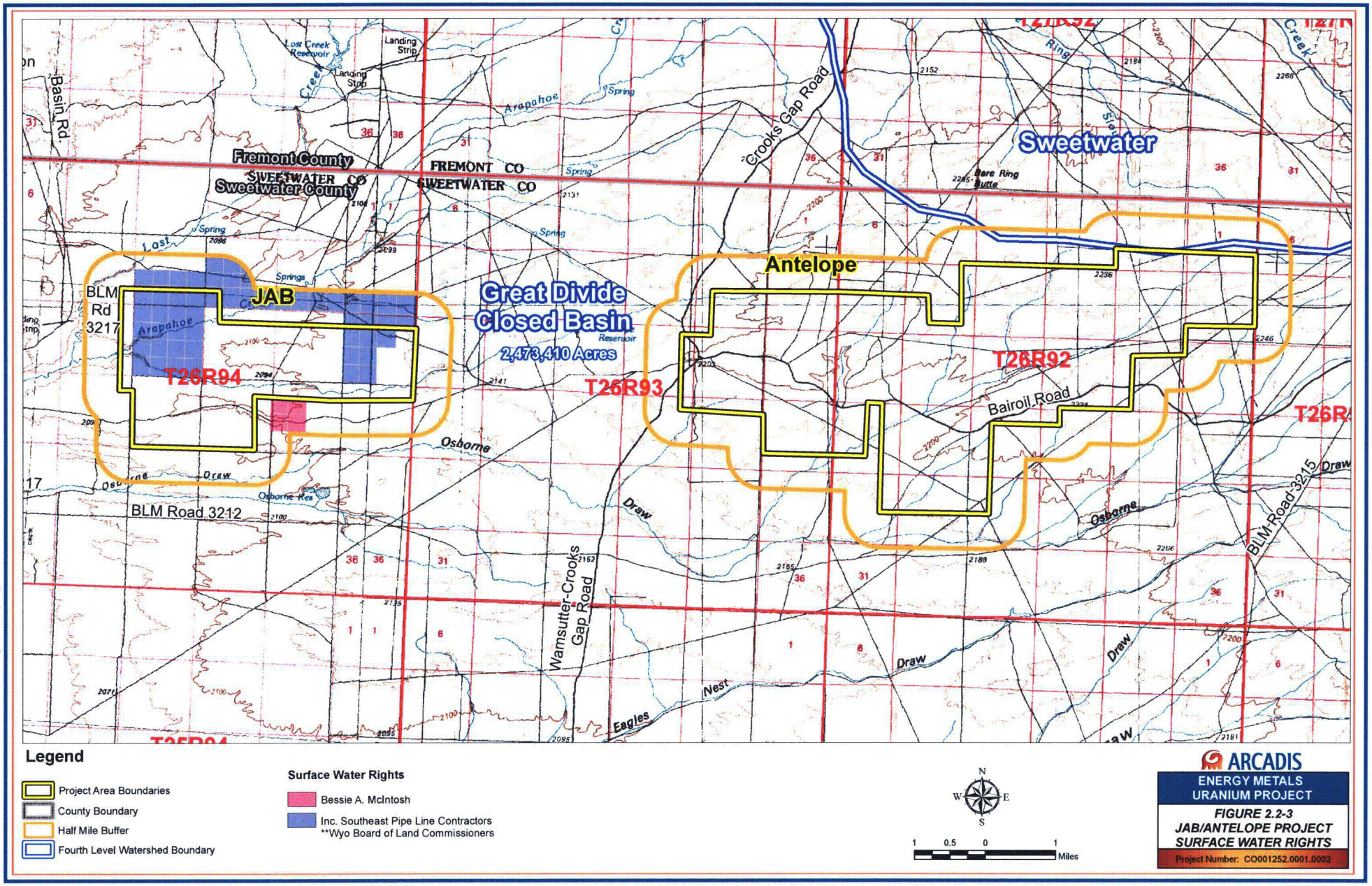
The JAB site is drained by Arapahoe Creek, which is an ephemeral drainage that flows through the property from the north central area, southwest to its confluence with Lost Creek just west of the JAB site boundary within the 3.0-mile review area. From its confluence with Arapahoe Creek, Lost Creek flows south past Big Bend to an area of unnamed springs where it is joined by Osborne Draw from the east. In addition to the springs located at the confluence of Osborne Draw with Lost Creek, four unnamed springs located upstream of the JAB site on tributaries of Arapahoe Creek provide input to Arapahoe Creek (Figures 2.2-1 and 2.2-3).

A small reservoir, Antelope Reservoir, is located on an unnamed tributary of Arapahoe Creek located in between the proposed Antelope and JAB License Area. A larger reservoir, Osborne Reservoir, is located about 1.5 miles south of the eastern portion of the JAB site on an ephemeral tributary to Osborne Draw.

2.2.3.1.1 Surface Water Quantity

Streamflow data for drainages in the Great Divide Closed Basin are extremely limited. Two gages within the basin were historically operated by the United States Geological Survey (USGS). These historic gages include Separation Creek near Riner, Wyoming (USGS 09216527) and Delaney Draw near Red Desert, Wyoming (USGS 09216537) (Figure 2.2-1) (USGS 2007). Daily mean discharges were recorded for Separation Creek near Riner, Wyoming from October 1, 1975 to September 30, 1981 (Figure 2.2-5) (USGS 2007). Analysis of daily mean discharge data for the Separation Creek gage revealed an average flow of 1.8 cubic feet per second (cfs) or 3.6 acre-feet/day and a maximum flow of 76 cfs recorded on April 20, 1980. The Separation Creek annual hydrograph peaks in April or May, coinciding with peak snowmelt, and typically reaches magnitudes of 15 to 20 cfs. Annual instantaneous peak discharge data were available for the Delaney Draw gage from September 22, 1961 to July 31, 1984 (Figure 2.2-6) (USGS 2007). Analysis of instantaneous peak streamflow for the Delaney Draw gage produced an average of 180 cfs or 357 acre-feet/day.

Flood frequency analysis was performed for the Delaney Draw peak streamflow record using the USGS standard method, in which a log-Pearson Type III frequency distribution is fit to the logarithms of the peak flow cumulative distribution. Parameters of the log-Pearson Type III were estimated from the logarithmic peak flows (mean, standard deviation, and coefficient of skewness) with adjustments for low and high outliers, historic peaks and generalized skew (Riggs 1968). Log-Pearson III flood frequency analysis revealed a 10-year flood, i.e. a flood that has the probability of occurring once every 10 years, magnitude of about 260 cfs and a 100-year flood of about 1,400 cfs (Figure 2.2-7).



Legend

- Project Area Boundaries
- County Boundary
- Half Mile Buffer
- Fourth Level Watershed Boundary

Surface Water Rights

- Bessie A. McIntosh
- Inc. Southeast Pipe Line Contractors
  **Wyo Board of Land Commissioners

N W E S

1 0.5 0 1 Miles

ARCADIS

ENERGY METALS
URANIUM PROJECT

FIGURE 2.2-3
JAB/ANTELOPE PROJECT
SURFACE WATER RIGHTS

Project Number: CO001252.0001.0002

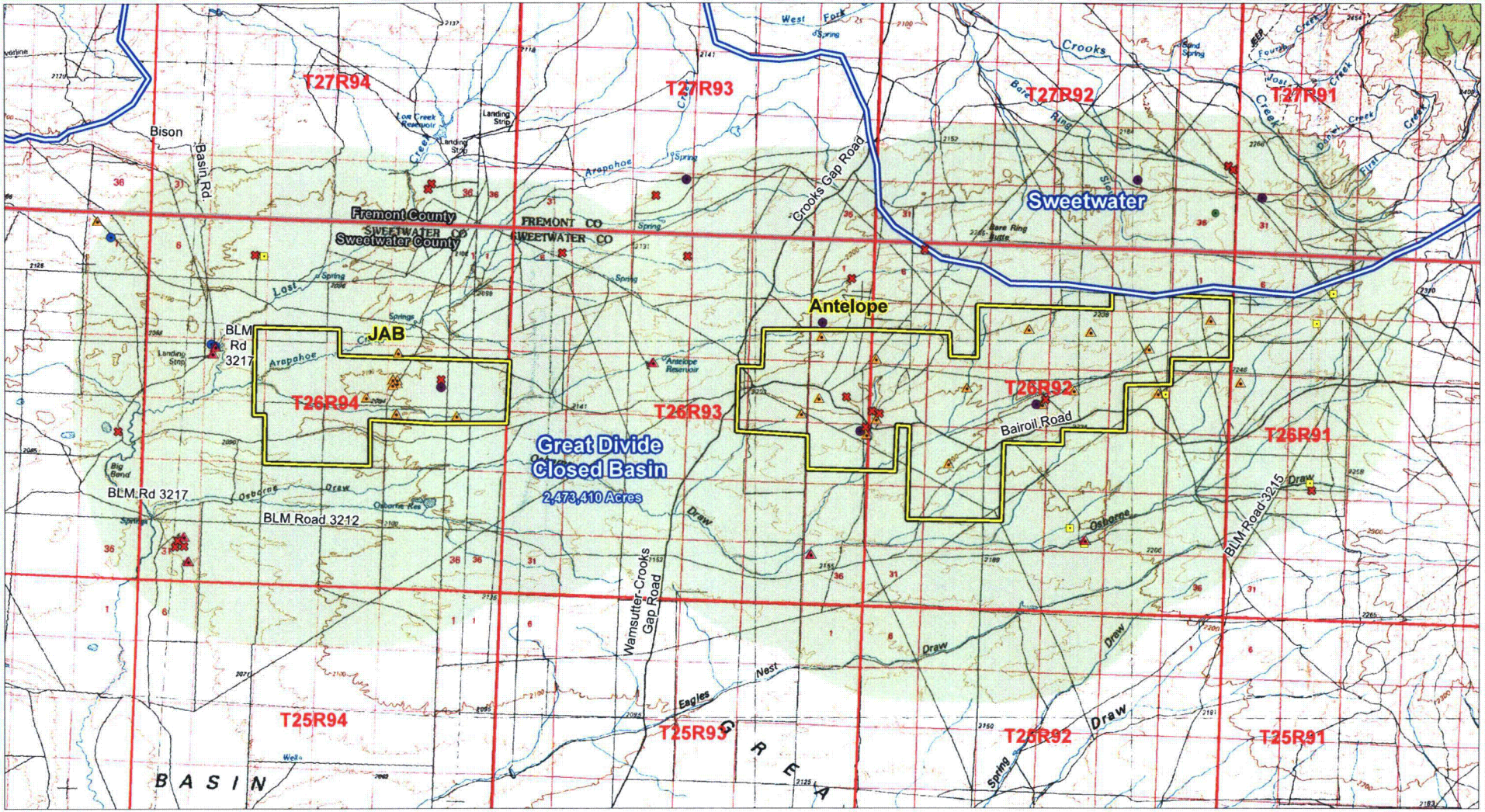

T27R94
T27R93
T27R92
T27R91
Bison
Basin Rd.
Fremont County
Sweetwater County
FREMONT CO
SWEETWATER CO
Crooks Gap Road
Sweetwater
Antelope
JAB
BLM Rd 3217
T26R94
T26R93
T26R92
T26R91
Great Divide Closed Basin
2,473,410 Acres
Bairoil Road
BLM Road 3212
Wamsutter-Crooks Gap Road
BLM Road 3215
T25R94
T25R93
T25R92
T25R91
BASIN
AREA
Legend
Project Area Boundaries
County Boundary
3 Mile Buffer
Fourth Level Watershed Boundary
Wells
Domestic
Industrial
Miscellaneous
USGS Monitoring
Monitoring
Stock
Non Active
N
W
E
S
1 0.5 0 1
Miles
ARCADIS
ENERGY METALS URANIUM PROJECT
FIGURE 2.2-4
JAB/ANTELOPE PROJECT
GROUND WATER USE
Project Number: CO001252.0001.0002

Figure 2.2-5

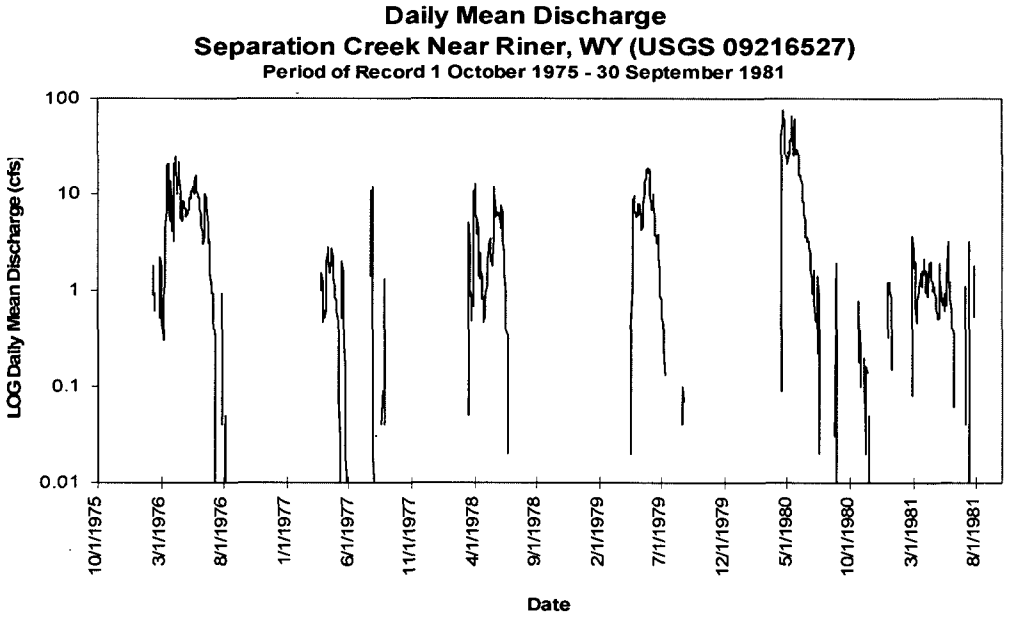


Figure 2.2- 6

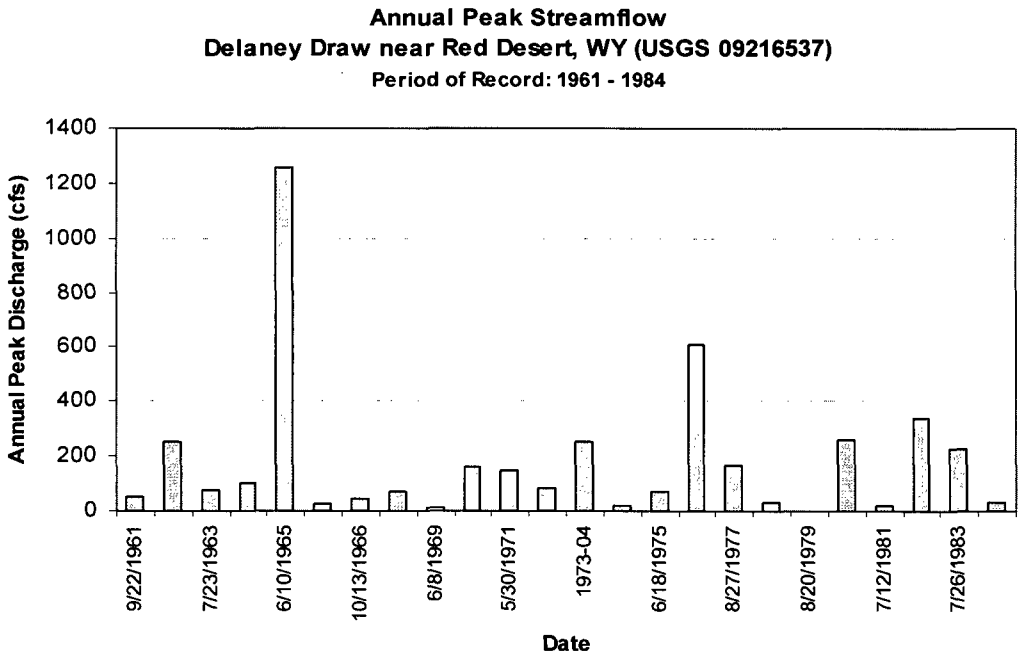
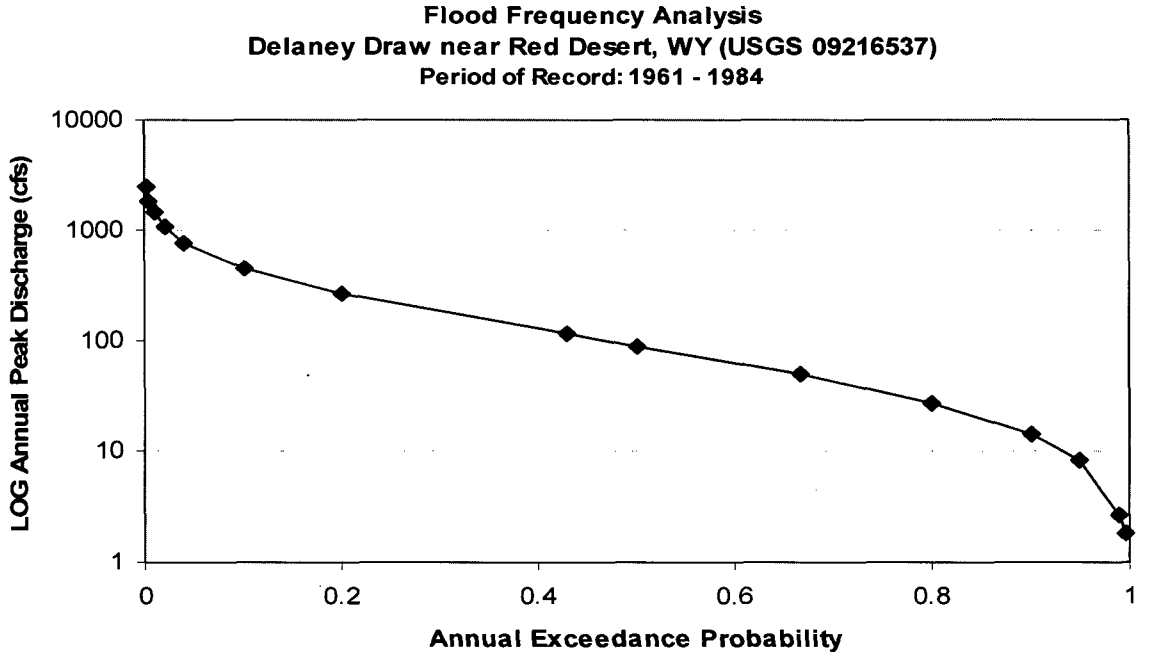


Figure 2.2-7



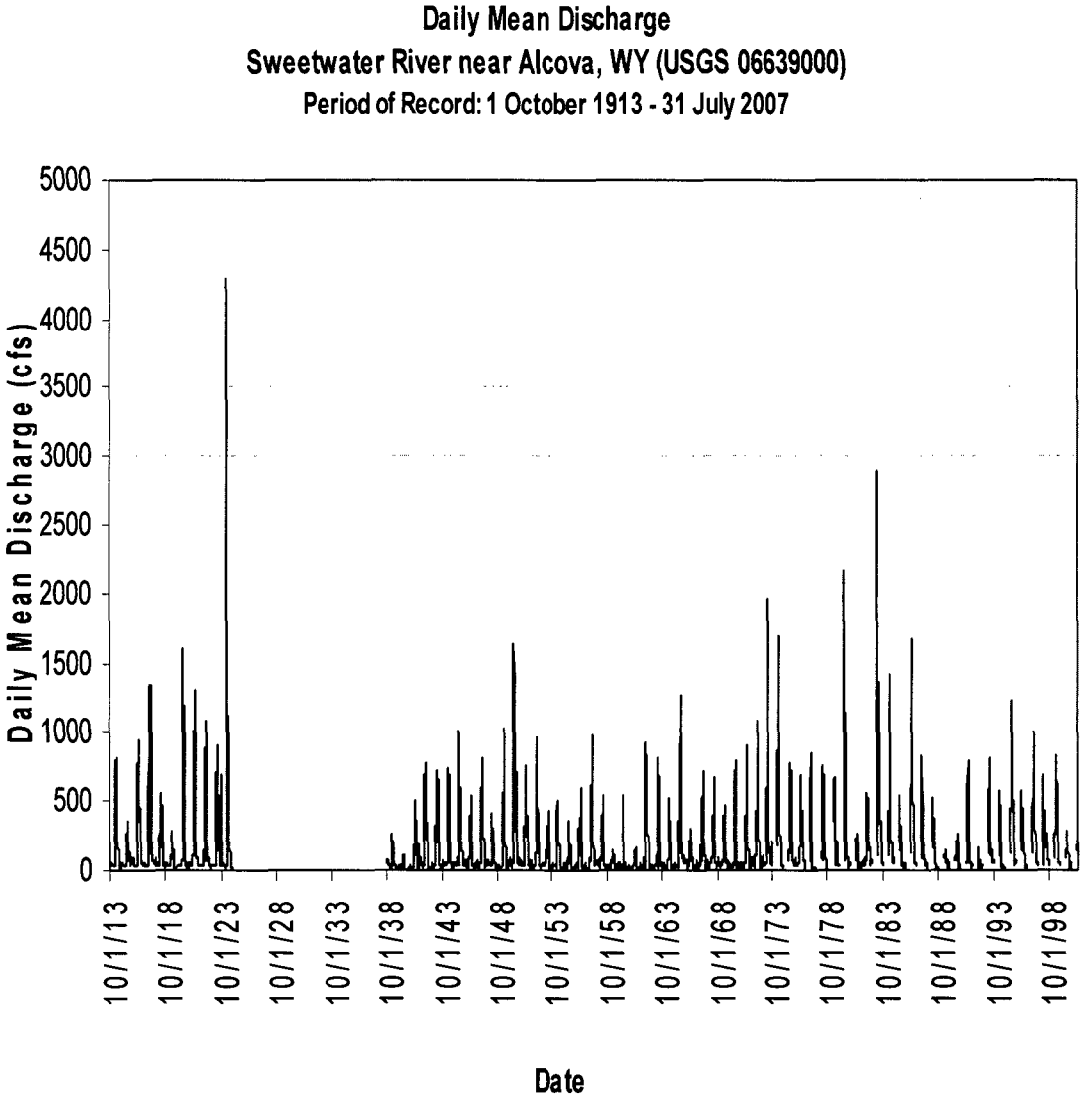
Results of the log-Pearson III flood frequency analysis for the Delaney Draw peak streamflow were compared to flood frequency results for a similar ephemeral stream in a nearby area as a quality control measure. A previous flood frequency study of the ephemeral streams in the Rock Springs, Wyoming area was carried out by Western Water Consultants, WWC, in 1995 using the Soil Conservation Service's Triangular Hydrograph Method. Within the Bridger drainage in the Rock Springs area, the flood frequency results for ephemeral stream reaches with a similar drainage area to the Delaney Draw gage were used for comparison. Flood frequency results for the Bridger drainage indicate that the 10-year flood was found to be about 450 cfs and the 100-yr flood was found to be about 1,200 cfs (WWC 1995). Comparing the results of the Delaney Draw and the Bridger drainage, our flood estimates seem reasonable.

No data were available to quantify discharges from springs and reservoir surface water levels located around the JAB site within the Great Divide Basin.

Because the Sweetwater River receives drainage from the northern 3.0-mile review area surrounding the Antelope site, daily mean streamflow data for the Sweetwater River near Alcova, Wyoming (USGS 06639000) were obtained for October 1, 1913 through June 27, 2007 and analyzed (Figure 2.2-8). The drainage area for the Sweetwater River near Alcova is 2,245 square miles (USGS 2007). Analysis of daily mean discharge of the Sweetwater River averaged 140 cfs and ranged from 1 to nearly 4,300 cfs. The maximum daily mean streamflow of 4,290 cfs was recorded on April 13, 1924. Flood

frequency analysis using the log-Pearson III method described earlier was also carried out for annual peak instantaneous discharge records from 1914 to 2005 for the Sweetwater River near Alcova. The 10-year flood was found to be about 4,000 cfs and the 100-year flood was about 22,000 cfs (Figure 2.2-9).

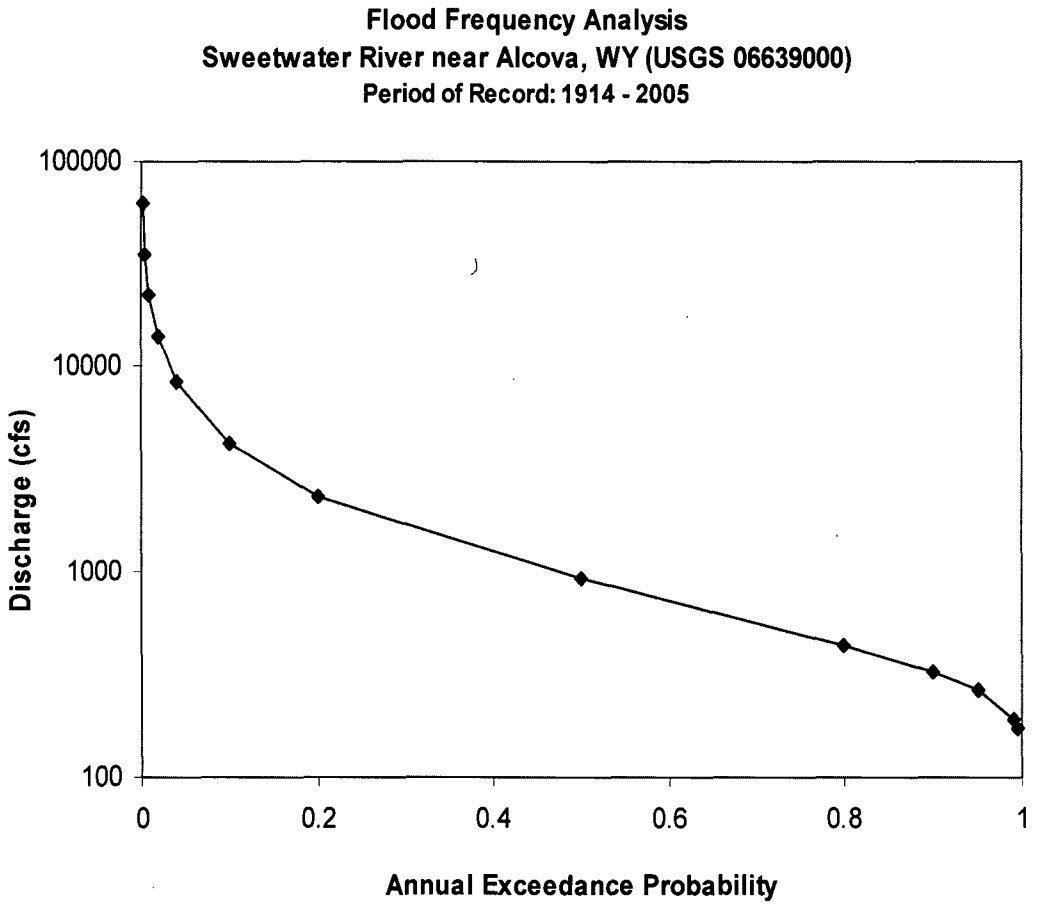
Figure 2.2-8



Surface water rights located within and surrounding the JAB and Antelope project areas within the 0.5-mile radius review area are displayed in Figure 2.2-2 (WYSEO 2008). According to the Wyoming State Engineer's Office (WYSEO) there are no permitted surface water rights within the Antelope License Area and the 0.5-mile Review Area.

WYSEO (2008) records indicate that permitted surface water rights within the JAB License Area have been appropriated to the Southeast Pipe Line Contractors and are used for industrial purposes (Figure 2.2-3). Surface water rights within the 0.5-mile review area are owned by Southeast Pipeline Contractors and Bessie Macintosh. Southeast Pipeline Contractors surface water rights are associated with industrial use and Bessie Macintosh water rights are associated with stock water use. Detailed information on the permitted surface water rights is located in Addendum 2.7-E.

Figure 2.2-9



2.2.3.1.2 Surface Water Quality

Water quality data exist for eight historical USGS sampling sites along Lost Creek within the Great Divide Basin (Table 2.2-7) (USGS 2007). The water quality monitoring sites are located on Lost Creek, beginning upstream of its confluence with Arapahoe Creek and continuing downstream to Lost Creek Lake (Figure 2.2-1). Although no data are being collected currently, water quality samples were collected at these locations from 1976 to 1978 (USGS 2007).

Water quality data for Lost Creek suggest that upstream surface water is of neutral pH and changes to slightly alkaline further downstream toward Lost Lake. In addition to pH, other water quality parameters that tend to increase in a downstream direction include specific conductance, bicarbonate, hardness, calcium, magnesium, sodium, sulfate, boron, and total dissolved solids. Sodium adsorption ratio (SAR), which represents the proportion of sodium ions to calcium and magnesium ions in the water, range from one to six. SAR is an important parameter to measure in water to be used for irrigation because the application of irrigation water with high SAR values causes a disproportionate concentration of sodium adsorbed by the soil and causes soil structure to break down (BLM 2007). Measurement of iron is noteworthy because iron concentrations narrowly exceeded the secondary drinking water standards of 0.3 milligrams per liter (mg/L) in a sample from one monitoring location (Wyoming Department of Environmental Quality (WYDEQ) 2001).

In addition to the USGS data for Lost Creek, water quality monitoring has been performed at the License Area by Uranium One in the spring of 2007 and 2008. No water was present in surface water bodies during any other seasonal period during the year. Water quality discussions are presented in detail in Sections 2.7 & 2.9.

The WYDEQ classifies surface waters according to their quality and their degree of protection, and publishes these classifications in the Wyoming Surface Water Classification List (WYDEQ 2001). Based on the WYDEQ classification list, all three major streams in and surrounding the Antelope and JAB License Area, i.e. Lost Creek, Arapahoe Creek, and Osborne Draw, are classified as Class 3B waters, which support recreation, wildlife, agricultural and industrial uses. Crooks Creek, which drains the northern portion of the 3.0-mile review area north of the Antelope site to the Sweetwater River in the Sweetwater Basin, is classified as Class 2AB. Class 2AB waters support cold water game fisheries, as well as other aquatic life, recreation, wildlife, agriculture, industry and scenic values (WYDEQ 2001). Crooks Creek has been listed on the Wyoming state impaired surface waters list (303(d)) for the years 1998, 2000, 2002 and 2004 due to impairment from oil deposits (USEPA 2007).

2.2.3.2 Ground Water

Groundwater within the Great Divide Closed Basin is typically found in artesian aquifers although it is also found in unconfined alluvial valleys, and sometimes in saturated isolated outcrops (BLM 2007). Major aquifers identified in the Great Divide and Washakie Basins include Quaternary Deposits, Tertiary Aquifer System (Wasatch, Battle Spring, Fort Union, Lance-Fox Hills Formations), Cretaceous Mesaverde Formation, and Paleozoic Aquifer System (Tensleep Sandstone, Madison Limestone, undifferentiated Cambrian rocks) (WYDEQ 1997). The direction of groundwater flow in Tertiary aquifers is generally south-southeast. Groundwater flow direction is also south-southeast for regional Cretaceous aquifers likely due to a geologic structural dip and surface topography (Collentine et al. 1981 & BLM 2005).

2.2.3.2.1 Ground Water Quantity

Geologic formations capable of producing the greatest quantities of water include Quaternary alluvium, Tertiary deposits in the Battle Spring, Wasatch, and Fort Union Formations, Cretaceous Formations including the Mesaverde Group, Frontier and Cloverly Formations, Jurassic- Sundance-Nugget Formations and Paleozoic Tensleep and Madison Formations (BLM 2007).

The Wasatch Formation represents the most extensive water-bearing formation in the Hydrologic Region that includes the Great Divide Basin (Lowham et al. 1985). The major aquifer located in the eastern Great Divide Basin is the Battle Spring Formation and the Fort Union Formation is another important aquifer near the License Area. Minor aquifers in the area include the Lance and Fox Hills Formations. The Lewis Shale forms an aquitard between the Fox Hills Formation and the Tertiary aquifers, as well as the underlying Mesaverde Group. The Lewis Shale is considered an aquitard because it is made up of carbonaceous shale with numerous beds of siltstone and scattered fine-grained sandstone lenses that limit movement of groundwater. Table 2.2-7 lists the water-producing characteristics of geologic formations near the Antelope and JAB License Area (BLM 2007).

Wells located within and surrounding the Antelope and JAB License Area within the 3.0-mile radius review area are displayed in Figure 2.2-4 (USGS 2008 and WYSEO 2008). According to the Wyoming State Engineer's Office (WYSEO) there are 16 permitted wells and 5 non-active wells within the Antelope site. Ground water rights for these permitted wells are appropriated to Uranium One/Energy Metals and are used for monitoring and miscellaneous purposes. Available depths of these wells range between 237 and 360 feet.

Additionally, there are 12 permitted wells and 6 non-active wells within the 3.0-mile Antelope review Area. These wells are associated with stock, monitoring, and miscellaneous water use (WYSEO 2008). Detailed information on the WYSEO permitted

wells located within the Antelope site and within the 3.0-mile review area is located in Section 2.7, Addendum E.

In addition to the WYSEO permitted wells, there are also 3 USGS wells located within the 3.0-mile Antelope review area. Two USGS wells are located near the main stem of Osborne Draw south of the Antelope site, and the other USGS well is located near Antelope Reservoir between the Antelope and JAB License Area. Groundwater level data for these wells are summarized in Table 2.2-8 (USGS 2008). WYSEO records indicate there are 8 permitted wells and 1 non-active well within the JAB site (Figure 2.2-4). These permitted wells are used for monitoring and miscellaneous purposes. Available well depths range from 192 to 315 feet. Ground water rights associated with these wells are appropriated to UMETCO Minerals Corporation and Energy Metals (WYSEO 2008).

In addition to the WYSEO permitted wells, 4 USGS wells exist within the 3.0-mile review area surrounding the JAB site. Groundwater well level data recorded by the USGS for these wells are presented in Table 2.2-8 (USGS 2008).

2.2.3.2.2 Ground Water Quality

Ground water quality is dependent on aquifer rock type, aquifer depth and aquifer flow. Ground water wells within the Antelope and JAB License Area yield water from the Battle Springs formation (BLM 2007).

Uranium One has conducted groundwater quality sampling at 29 monitoring wells within the License Area. These samples were analyzed for the water quality constituents listed in Table 2.2-9. The objective of this sampling was to characterize the water quality in the target formation and surrounding aquifers. Sampling was performed on a quarterly basis since first quarter 2007.

Sample collection and preservation were performed using standard EPA methods. Prior to sampling, all field pH and conductivity meters were calibrated using known standards. Prior to sampling the well was purged by pumping. The preservatives as specified by Handbook for Sampling and Sample Preservation of Water and Wastewater (Report No. EPA-600/4-82-029) were added to the samples and samples are transported to the lab for analysis. A summary of the results for the 2007-2008 groundwater quality monitoring data is presented in Section 2.7.

2.2.3.3 Potential Impacts to Local Surface/Groundwater Quantity, Quality and Use

Potential impacts to water resources from mining and restoration activities may include:

- Impacts to surface water from construction and decommissioning activities,
- Groundwater consumption,

- Declines in groundwater quality,
- Impacts to groundwater and surface water quality from accidental spills.

2.2.3.4 Impacts to Surface Water from Construction and Decommissioning Activities

Normal construction activities within the well fields, process plants, and along the pipeline courses and roads have the potential to increase the sediment yield of the disturbed areas. However, the relative size of these disturbances is small when compared to the size of the overall areas and to the size of the watersheds. Because field decommissioning and reclamation activities will be on-going throughout the life of the project, the area to be reclaimed at the conclusion of operations will be reduced, however a slight increase in sediment yields and total runoff can still be expected.

2.2.3.5 Groundwater Consumption

Minimal effects to the existing aquifer as a result of drawdown are anticipated. No significant impacts are anticipated to private wells in the project areas due to the minor amount of water use from private wells. If it is determined that potential impacts from ISR operations may occur, then mitigation measures such as deepening private wells into a separated aquifer can be implemented

2.2.3.6 Declines in Groundwater Quality

Water quality impacts in adjacent aquifers from ISR mining activities are related to the identification, control, and clean-up of excursions. During production, injection of the lixiviant into the wellfield results in a temporary degradation of water quality compared to pre-mining conditions. Movement of this water out of the wellfield results in an excursion. Excursions of contaminated groundwater in a wellfield can result from an improper balance between injection and recovery rates, undetected high permeability strata or geologic faults, improperly abandoned exploration drill holes, discontinuity and unsuitability of the confining units which allow movement of the lixiviant out of the ore zone, poor well integrity, or hydrofracturing of the ore zone or surrounding units. Past experience from other commercial scale in-situ recovery projects in Wyoming has shown that when proper steps are taken in monitoring and operating a wellfield, excursions, if they do occur, can be controlled and recovered and that serious impacts on the groundwater are prevented.

Excursions of lixiviant at ISR facilities have the potential to contaminate adjacent aquifers with radioactive and trace elements that have been mobilized by the mining process. These excursions are typically classified as horizontal or vertical. A horizontal excursion is a lateral movement of mining solutions outside the mining zone of the ore-

body aquifer. A vertical excursion is a movement of solutions into overlying or underlying aquifers.

The historical experience at other ISR uranium operations indicates that the selected excursion indicator parameters and UCLs allow detection of horizontal excursions early enough that corrective action can be taken before water quality outside the exempted aquifer boundary is significantly degraded. As noted in NUREG/CR-6733, significant risk from a horizontal excursion would occur only if it persisted for a long period without being detected.

Vertical excursions can be caused by improperly cemented well casings, well casing failures, improperly abandoned exploration wells, or leaky or discontinuous confining layers.

The State of Wyoming and the NRC require restoration of affected groundwater in the mining zone following production activities. Uranium One will be required to return the groundwater in the mining zone to baseline water quality conditions as a primary goal or to class of use standards. The mining aquifer must be exempted by the WYDEQ and the EPA from protection under the Safe Drinking Water Act (SDWA) before mining can occur. One of the criteria for exemption is that the water is not currently used as an underground source of drinking water (USDW) and will not be used as a USDW in the future. By restoring the exempted aquifer, Uranium One ensures that adjacent, non-exempted aquifers will not be affected in the future.

Successful groundwater restoration has been demonstrated using the same methods proposed by Uranium One as discussed in Section 6. Therefore, long term impacts on groundwater quality are expected to be minimal.

2.2.3.7 Impacts to Groundwater and Surface Water Quality from Accidental Spills

The rupture of an injection or recovery line in a wellfield, or a trunkline between a wellfield and the central plant, would result in a release of injection or production solution which would contaminate the ground in the area of the break. Potential impacts to groundwater and surface water may occur during operations as a result of an uncontrolled release of process liquids due to a wellfield leak. Should an uncontrolled wellfield release occur, there would be a potential for contamination of the shallow aquifer as well as surrounding soil. With a slow leak that remains undiscovered or a catastrophic failure, a shallow excursion is one potential impact.

All piping from the Central Plant and Satellite facility, to and within the wellfield will be buried for frost protection. Pipelines will be constructed of high density polyethylene (HDPE) with butt welded joints, or equivalent. All pipelines will be pressure tested at

operating pressures, prior to final burial and production flow, and following maintenance activities that may affect the integrity of the system.

Each wellfield will have a number of headerhouses where injection and production wells will be continuously monitored for pressure and flow. Individual wells may have high and low flow alarm limits set. All monitored parameters and alarms will be observed in the control room via the computer system. In addition, each headerhouse will have a "wet building" alarm to detect the presence of any liquids in the building sump. High and low flow alarms have been proven effective in detection of significant piping failures (e.g., failed fusion weld).

Occasionally, small leaks at pipe joints and fittings in the headerhouses or at the wellheads may occur. Until remedied, these leaks may drip process solutions onto the underlying soil. Uranium One will implement a program of continuous wellfield monitoring by roving wellfield operators and will require periodic inspections of each well that is in service. Small leaks in wellfield piping typically occur in the injection system due to the higher system pressures. These leaks seldom result in soil contamination requiring immediate clean up under NRC regulations. Following repair of a leak, Uranium One will require that the affected soil be surveyed for contamination and the area of the spill documented. If contamination is detected, the soil is sampled and analyzed for the appropriate radionuclides. Based on analytical results soils may be removed and disposed of as appropriate.

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TABLES

Table 2.2-1 2006 Livestock Inventory for Sweetwater County

	Number	Percent of Total	Animal Units [a]	
			Pounds (000s)	Percent
All cattle	15,000	60.0	15,000	88.2
Breeding Sheep & Lambs	10,000	40.0	2,000	11.8
Total animals	25,000	100.0	17,000	100.0

Notes:
[a] Animal unit conversions:

1 cow	=	1,000 lb.
1 sheep	=	200 lb.
1 animal unit	=	1,000 lb.

Source: U.S. Census of Agriculture 2007.

Table 2.2-2 Oil and Gas Leases in the Antelope and JAB License Area

JAB	Antelope
WYW 164752	WYW 131804
WYW 132123	WYW 131545
WYW 164753	WYW 134327
WYW 172775	WYW 155064
WYW 132125	WYW 134305
WYW 155065	WYW 130166
WYW 134340	WYW 131543
WYW 134343	WYW 131795
	WYW 131544
	WYW 132317
	WYW 164993
	WYW 174066
	WYW 154171
	WYW 134326
	WYW 155058
	WYW 155057
	WYW 155052
	WYW 128320
	WYW 132330

Source: USDOI BLM, 2007b.

Table 2.2-3 Recreational Area within 50-miles of the Antelope and JAB License Area

Name of Recreational Facility	Managing Agency	Distance From Antelope and JAB License Area (miles)
Seminoe-Alcova Back Country Byway	Wyoming Department of Transportation	41.0
Continental Divide National Scenic Trail	Various agencies	1.0
Seminoe State Park	Wyoming State Parks and Cultural Resources Department	42.0
Independence Rock Historic Site	Wyoming State Parks and Cultural Resources Department	36.0

Source: DeLorme Maps, 2003

Table 2.2-4 Distance to Nearest Site Boundary from Centers of Antelope and JAB License Area for Each Compass Sector within the 2.0-Mile Radius

Compass Sector[1]	JAB - Nearest Site Boundary (feet/mile)	Antelope - Nearest Site Boundary (feet/mile)
North	3,356.26/0.64	2,828.05/0.54
North-Northeast	3,405.47/0.64	2,857.58/0.54
Northeast	3,966.49/0.75	8,687.56/1.65
East-Northeast	5,833.26/1.10	12,729.50/2.41
East	12,929.63/2.45	13,444.72/2.55
East-Southeast	4,258.48/0.81	8,717.09/1.65
Southeast	2,667.29/0.51	5,659.38/1.07
South-Southeast	2,339.21/0.44	5,469.09/1.04
South	5,036.03/0.95	11,374.53/2.15
South-Southwest	6,210.55/1.18	9,855.52/1.87
Southwest	7,250.57/1.37	6,446.77/1.22
West-Southwest	8,448.06/1.60	6,187.59/1.17
West	8,802.39/1.67	18,402.01/3.49
West-Northwest	9,350.28/1.77	9,432.30/1.79
Northwest	6,994.67/1.32	5,994.02/1.14
North-Northwest	3,438.28/0.65	2,873.98/0.54

[1] $22^1/_2°$ sectors centered on each of the 16 compass points

Table 2.2-5 AADT for Major Roads near the Antelope and JAB Project Area

Highway	2003 AADT	2004 AADT
U.S. 287 from north urban limit of Rawlins to Bell Springs Draw (10.70 miles)	2,290	2,310
U.S. 287 from Antelope Pass to junction with WY 73 (2.42 miles)	2,200	2,220
WY 73 from U.S. 287 at Lamont west to Bairoil (4.64 miles)	240	230

Source: WYDOT, 2005.

Table 2.2-6 USGS Surface Water Quality Stations near the Antelope and JAB License Area

Parameter	Lost Creek Tributary (above Arapahoe Creek)	Lost Creek (above Arapahoe Creek)	Lost Creek (below Arapahoe Creek)	Lost Creek (above Big Bend)	Lost Creek (at Goodford Crossing)	Lost Creek (above Eagles Nest Spring)	Lost Creek (below Eagles Nest Spring)	Lost Creek (above Lost Creek Lake)
USGS Station Number	421440108035001	421438108035001	421310108051501	421255108062001	420848108070001	420604108070701	420425108073001	420045108111001
Sample Period Begin Date m/d/yyyy	4/1/1976	4/1/1976	3/25/1976	4/1/1976	3/25/1976	4/2/1976	4/2/1976	4/11/1976
Sample Period End Date m/d/yyyy	4/1/1976	4/1/1976	4/1/1976	8/25/1976	5/19/1976	4/2/1976	3/29/1978	4/11/1976
Number of Samples[2]	1	1	2	10	7	1	2	1
Temperature, degrees C	0	0	0.3	8.6	6.8	2	10.5	6
Discharge, cfs	5	2	11	11	8	12	3	15
Turbidity, NTU	300	240	360	188	166	450	150	280
Specific conductance, µmhos/cm	62	135	103	326	494	320	535	660
pH, standard units	7.1	7.1	7.8	8.0	8.1	NM	8.1	NM
Bicarbonate, mg/L	31	42	47	79	122	NM	131	92
Carbonate, mg/L	0	0	0	0	0	NM	0	NM
Nitrite-Nitrate, filtered mg/L	0.1	0.07	0.1	0.07	0.06	NM	0.17	0.04
Hardness, mg/L as $CaCO_3$	12	18	20	49	95	NM	103	59
Calcium, mg/L	2.8	4.8	5.7	15.1	30.3	NM	31	18
Magnesium, mg/L	1.1	1.4	1.3	2.8	4.9	NM	6.3	3.5
Sodium, mg/L	8.3	20	18	45.3	55.8	NM	77	42
Sodium Adsorption Ratio	1	2	2	6	3	NM	3	2
Potassium, mg/L	3	2.5	2.5	2.8	3.7	NM	4.3	2.8
Chloride, mg/L	2.6	2.8	3.0	5.2	9.3	NM	11.8	4.8
Sulfate, mg/L	5.1	24	20	78.1	104	NM	140	73
Fluoride, mg/L	0.1	0.1	0.1	0.4	0.2	NM	0.5	0.1
Silica, mg/L	2.5	1.9	2.6	4.7	8.0	NM	8.3	4
Boron, µg/L, filtered	40	20	NM	35.7	47	NM	60	60
Iron, µg/L, filtered	310	90	190	293	94	NM	90	110
TDS, mg/L	41	79	77	193	277	NM	344	194
TSS, mg/L	762	369	680	646	374	1,020	901	NM

Table 2.2-7 Water-Bearing Characteristics of Geologic Formations in the Great Divide and Washakie Basins

Era	Period	Geologic Unit	Thickness (feet)	Hydrologic Properties		
				Well Yield (gpm)	Transmissivity (gpd/ft)	Permeability (gpd/ft)
Cenozoic	Quaternary		0-70	<30	168-560	21-62
	Tertiary	Battle Spring Formation	0-4,700	1-157	29-3,157	NM
		Wasatch Formation	0-4,000+	30-50	150-10,000	0.04-18.2
		Fort Union Formation	0-2,700+	3-300	<2,500	<1
Mesozoic	Upper Cretaceous	Lance Formation	0-4,500+	<25	<20	0.007-8.2
		Fox Hill Sandstone	0-400	NM	10-20	0.9
		Lewis Shale	0-2,700+	2-252	0.03-50	0.002-0.9
		Mesaverde Group (including the Almond Formation)	300-2,800	<100	<3,000	NM
		Baxter Shale (including the Steele Shale and Niobrara Formation)	2,000-5,000+	Hydrologic data unavailable.		
		Frontier Formation	190-1,900+	1-100+	<100-6,500	NM

Source: BLM 2007
gpm = gallons per minute
gpd/ft = gallons per day per foot
NM = Not Measured

Table 2.2-8 USGS Wells within the 3.0-mile Review Area Surrounding Antelope and JAB License Area

USGS WELL ID	LOCATION	NAME	WATER LEVEL (ft below land surface)	Date (m/d/yyyy)
421352107563301	SWNENWS16T26 R093	ANTELOPE RESERVOIR	101	5/23/1963
421112107532301	SWNWNWS36T26 R093	OSBORNE DRAW WELL	231.3	5/23/1963
421132107480601	NWSWSES27T26 R092	OSBORNE DRAW WELL	168	5/17/1963

USGS WELL ID	LOCATION	NAME	WATER LEVEL (ft below land surface)	Date (m/d/yyyy)
421048108052401	SENWSES31T26 R094	LOST CREEK LAKE	84.78	8/22/1962
421109108053001	NESWNES31T26 R094	LOST CREEK LAKE	12.88	8/21/1962
421347108050401	SWNWNWS17T26NR094W	LOST CREEK LAKE	60.00	3/21/1956
421353108050101	NWNWNWS17T26 R094	LOST CREEK LAKE	65.00	2/9/1956

Table 2.2-9 Water Quality Indicators

Physical Indicators		
Specific Conductance	Alkalinity	Total Dissolved Solids
Temperature	pH	

Common Constituents			
Ammonia	Chloride	Silica	Bicarbonate
Magnesium	Sodium	Calcium	Nitrate
Sulfate	Carbonate	Nitrite	Potassium

Trace and Minor Elements			
Arsenic	Fluoride	Nickel	Boron
Iron	Selenium	Barium	Lead
Vanadium	Cadmium	Manganese	Zinc
Chromium	Mercury	Copper	Molybdenum
Aluminum	Cobalt		

Radionuclides	
Radium-226	Natural Uranium

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2.3 POPULATION DISTRIBUTION

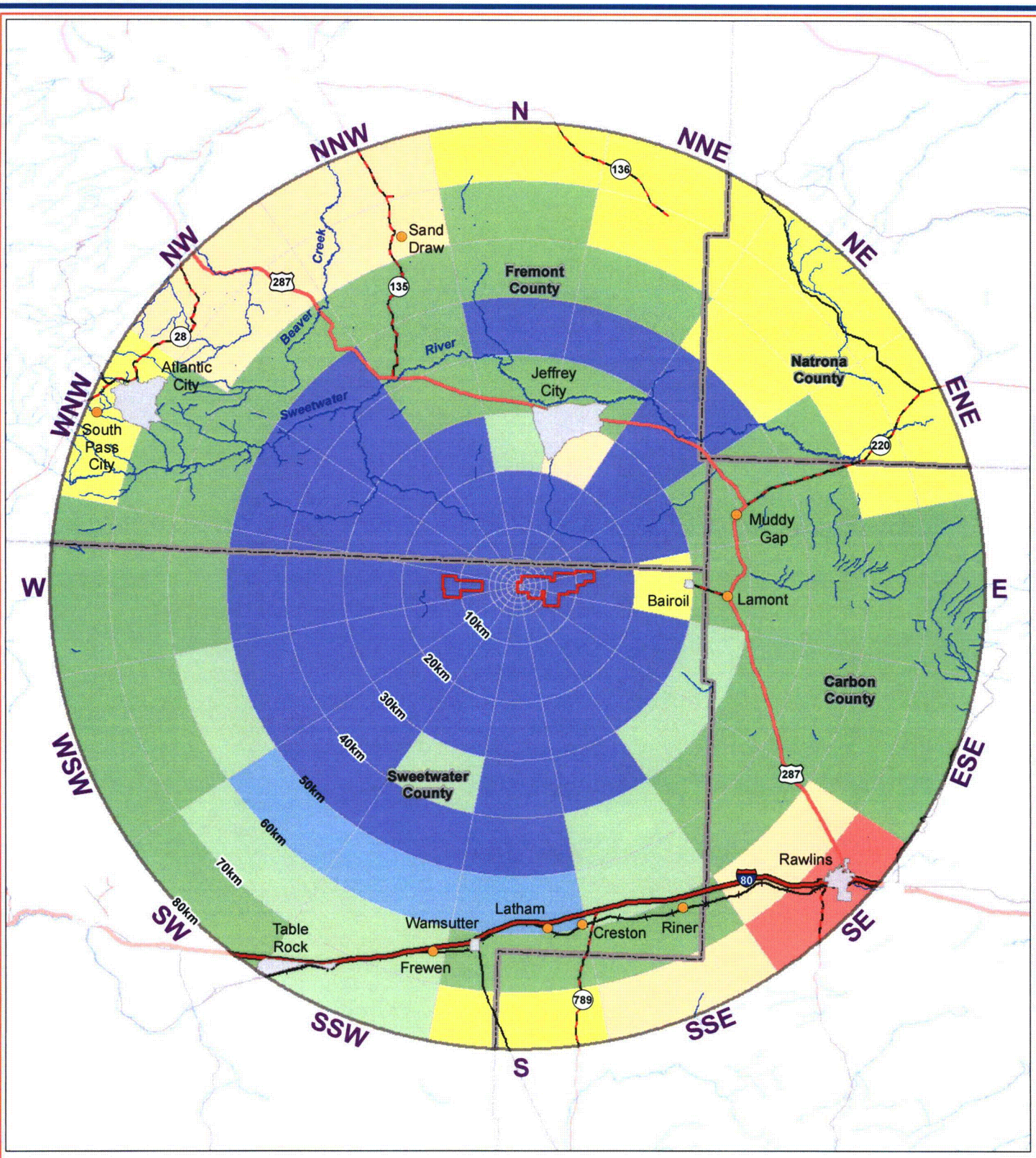
Information presented in this section concerns those demographic and social characteristics of the counties and communities that may be affected by the proposed development of a uranium in-situ recovery facility at the Antelope / JAB Projects (Projects) in Sweetwater County, Wyoming. Data were obtained through the 1980, 1990, and 2000 U.S. Census of Population, the 2005 and 2006 Census Population Estimates program, and various State of Wyoming government agencies. All tables discussed in section 2.3 are presented at the end of the section.

2.3.1 Demography

2.3.1.1 Regional Population

The area within an 80-kilometer (km) radius of the project site includes portions of four counties in central and south central Wyoming, which include Sweetwater County, Fremont County, Carbon County, and Natrona County, as shown on Figure 2.3-1. The proposed Antelope / JAB License Area (License Area) is located in northeast Sweetwater County. The nearest community is Bairoil, a small Sweetwater County incorporated town located east on Bairoil Road, which is a primary access route to the License Area. East of Bairoil, the small communities of Muddy Gap and Lamont are located along State Highway 287, which is the primary north-south transportation route through the region. Jeffrey City, in Fremont County, is located nearly 17 miles north of the License Area. South of the License Area, several communities are located along the Interstate 80 (I-80) highway corridor, including Rawlins, in Carbon County, and the towns of Riner, Creston, Latham, Wamsutter, Frewen, and Table Rock in Sweetwater County.

Historical and current population trends in counties and communities within an 80-km distance reflect past growth trends in the counties relative to state population trends between 1980 and 2006 (Table 2.3-1). During the 1980's, Sweetwater County was the only one of the four-county area (Carbon County, Fremont County, Natrona County, and Sweetwater County) that did not experience a decline in population. This is because the Sweetwater County economy is strongly dependant on trona (soda ash) mining and processing, which was a relatively stable industry during the 1980s and 1990s. The Sweetwater County annual population growth rates have declined since 2000; a direct result of stagnant growth in the soda ash market, and the elimination of jobs in soda ash mining and processing (C. Thomas, et al 2004). In contrast, the economies of Carbon, Fremont, and Natrona counties are more closely tied to other mineral resource development, primarily coal, oil, and natural gas production. The largest growth rates since 2000 occurred in these counties as coal production and coal bed methane development have increased the resident labor force in the counties. The overall state economy is more diverse in the current decade than it was during the 1980s.



Legend

Population

0	51 - 100
1 - 10	101 - 500
11 - 20	501 - 1000
21 - 50	Greater than 1,000

JAB and Antelope Project Areas

0 5 10 20 Miles

ARCADIS

ENERGY METALS CORP.

FIGURE 2.3-1
JAB AND ANTELOPE PROJECT
SIGNIFICANT POPULATION CENTERS
WITHIN 80 KILOMETERS

Project Number: CO001252.0001.0002

I:\CO001252\GIS\ArcMap_MXD\Pop_Rose_JAB.mxd - 6/20/2007 @ 10:14:55 AM

2.3.1.2 Population Characteristics

The 2005 population by age and sex for counties within 80 km of the License Area is shown in Table 2.3-2. Overall, the 40- to 64-year age group (which includes the 'baby boom' cohort (defined by the U.S. Census as a group of individuals born in the same calendar year or group of years) is the largest age group in each of the counties. According to the Wyoming Economic and Demographic Forecast: 2005 to 2014 (Wyoming Economic Analysis Division 2005), the early baby boom population in Wyoming is one of the highest in the nation as a result of the in-migration of workers during the oil boom years in the late 1970s and early 1980s. In contrast, the population in the 27- to 42-year age group is relatively low because there was a high net out-migration (outflow greater than inflow) in this age group between 1995 and 2000 as young adults left the state during a declining economy. The aging population is expected to affect the economy through changes in the labor supply as retiring baby boomers reach retirement age and are replaced by fewer new workers. The older population would also require different types of goods and services, requiring a shift in local economic sectors to accommodate the changing demographics.

In 2005, 91.8 percent of the population in the four counties within a 50-mile radius of the License Area was classified as white. Indians and persons of Hispanic origin comprised 5.6 percent and 7.0 percent, respectively, of the total four-county population of 146,474. The populations in all other racial categories account for less than 1 percent of the total population. The racial characteristics of Carbon, Natrona, and Sweetwater Counties county were similar to the racial characteristics of the state. The Indian population of Fremont County accounted for 20.6 percent on the total county population, which was a considerably large proportion than the 2.4 percent American Indian proportion of the state population. This is because the Wind River Indian Reservation is located within Fremont County. The reservation is outside of the 50-mile region that is centered on the License Area.

2.3.1.3 Population Projections

The projected population for selected years by county within the 80-km radius of the proposed License Area is shown in Table 2.3-3. The population projections between 2000 and 2020 anticipate that the relatively stable population trends evident between 2000 and 2006 will continue for the county and the state. It is not expected that there will be the large in-migrations of population that were typical of the 1980s. However, the projected growth of Sweetwater County of 9.6 percent between 2003 and 2010 would result in a population increase of 3,461 people, which would be an average annual population increase of 494 people.

2.3.1.4 Seasonal Population and Visitors

A primary source of seasonal population in the four-county area is short-term labor for mineral resource development, construction, and service industries engaged in tourist/recreation activities. A review of reports from the Wyoming Economic Analysis research program indicates that these workers are most likely to relocate temporarily from

neighboring counties and states, including Montana, Nebraska, Colorado, and South Dakota. The seasonal labor force for these economic sectors is not included in any available population or labor force data for the counties.

Tourism is also a source of seasonal population and visits to the four counties for a variety of outdoor recreation activities. The proposed License Area consists of public lands in northeast Sweetwater County. The surrounding area within an 80-km radius contains mostly public lands. In general, the lands adjacent to the License Area are public lands, while private lands are mostly located at distances of 10 to 15 miles from the Permit Area boundaries. This is reflected in the sectorial population data, which shows that there are no residents close to the License Area, and that the number of residents in each sector tends to increase with distance from the center of the License Area. Public lands provide open space for a variety of outdoor recreation opportunities. Several recreation facilities and areas are located within an 80 km distance of the License Area. Visitor statistics are not available for most of these sites. Recreation opportunities offered by the private sector consist of community facilities in urban areas and the infrastructure of tourist services and facilities.

The recreational facility that would be a destination for tourists that is closest to the License Area is the Continental Divide National Scenic Trail. The Recreation Management Information System estimates that the portion of the Continental Divide National Scenic Trail in the Lander Field Office receives 45 visits annually, and visitors use the trail in a linear manner (BLM 2005).

The Seminoe State Park is 42 miles east-southeast of the east boundary of the License Area. Approximately 21,176 people visited the park in 2005, which was a decrease of 43 percent from the 37,385 people who visited the park in 2001. Visits to the park were the lowest in 2005 for the years 1998 through 2005 (Wyoming Economic Analysis Division 2006). Comparison of the park visitor fluctuations over this period with other parks and facilities in Wyoming did not reveal a trend or pattern that would account for the annual fluctuations.

Visitor statistics for the Independence Rock State Historic Site, located 36 miles northeast of the License Area, were last compiled in 1998 when 30,960 people visited the site.

2.3.1.5 Schools

The License Area is located within Sweetwater County School District 1, which serves all of Sweetwater County within 80 km; however, the schools closest to the License Area that would likely serve the project labor force are located in Carbon County School District #1. The nearest Sweetwater County community that provides education services to residents in the vicinity of the License Area is the Bairoil Elementary School, which had a 2005 fall enrollment of 10 students. The school is located in Sweetwater County, but is administered through Carbon County School District #1. Rawlins is the closest city to the License Area that provides a full range of education facilities, including three elementary schools (total

2005 fall enrollment of 685) one middle school (2005 fall enrollment of 349), and one high school (2005 fall enrollment of 431) (Carbon County School District #1 2007).

Historic enrollment data indicates a fairly steady decline in school enrollment in the Carbon County School District #1 in the years 1996 to 2005, from a high of 2,216 students in the fall of 1996, to a low of 1,664 in the fall of 2004. The fall enrollment of 1,727 in 2005 was the first year in the reported years of 1996 through 2005 that there was any increase in the number of students enrolled in district schools.

Families moving into the school district as a result of the proposed operations in the License Area would not significantly stress the current school system because it is presently under capacity.

2.3.1.6 Sectorial Population

Existing population in an 80-km radius centered on the combined License Area was estimated for 16 compass sectors, by concentric circles of 1, 2, 3, 4, 5, 10, 20, 30, 40, 50, 60, 70 and 80 km from the center of the Permit Area, for a total of 208 sectors. Sectorial population was estimated with data from the U.S. Census Bureau's Population Estimates Program. Subtotals by sector and compass points, as well as the total population, are shown in Table 2.3-4.

The most recent available population data was acquired from Geographic Data Technology, Inc., a division of the Environmental Systems Research Institute (ESRI). The data was created using U.S. Census 2000 boundary and demographic information for block groups within the United States, and intercensal population estimates for 2004 from the Population Estimates Program.

ArcInfo Geographic Information System (GIS) was used to extract data from U.S. Census 2004 population estimates for Census Tract Block Groups located wholly or partially within the 80 km radius from the approximate center of the License Area. 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 of the block groups.

The sectorial populations calculated using the percentage areas were modified for the sectors within a 20-mile distance because the GIS calculations are averages that do not accurately reflect the distribution of urban and rural populations within the 20-mile (32-km) radius. In addition, many sectors throughout the 80-km radius contain mostly BLM-administered federal lands, particularly those near the License Area, and do not contain any residents. These sectors were assigned a zero population. Most of the area within the 80-km radius is rural, with the majority of the population residing in the small communities near the License Area, or in larger urban areas in the sectors furthest from the License Area center. Urban areas are located mostly along the I-80 corridor to the south of the License Area, and include the city of Rawlins and the towns of Wamsutter and Table Rock.

The total population within the 80 km radius was estimated to be 12,247, once individual sectors were modified to better represent the distribution of urban and rural populations within the area.

2.3.2 Local Socioeconomic Characteristics

2.3.2.1 Major Economic Sectors

The License Area is located in Sweetwater County; however, social and economic characteristics are described for Carbon in addition to Sweetwater County because communities in Carbon County, primarily Rawlins, provide a relatively large resident labor force for mineral extraction and construction industries in south central Wyoming. A substantial portion of the Project labor force is likely to be based in Rawlins. Table 2.3-5 summarizes unemployment rates and employment in Sweetwater and Carbon Counties.

The economy of Sweetwater County depends on trona (soda ash) mining and production. The Carbon County economy depends on the energy sector, primarily coal mining, oil and gas extraction, crude, petroleum-natural gas, and supporting oil and gas field services.

A report prepared by the Wyoming Department of Employment, Research and Planning (2003) analyzes labor supply in Wyoming by place of residence. The analysis concluded that a portion of the available labor pool in Wyoming consists of non-residents. According to the report, the construction sector is one of the industry's most dependent upon seasonal and short-term workers. Of all persons working in heavy construction in 2000, 38.4 percent did not work in Wyoming in 1999.

Table 2.3-5 also shows the labor force characteristics in Sweetwater and Carbon Counties in 2005. In general, unemployment rates were highest in the early 1990s and have decreased overall by 2005 because of renewed energy development in south-central Wyoming. Annual fluctuations in unemployment rates are driven primarily by short-term changes in production due to changing prices for trona, coal, oil, and coal bed methane gas.

Per capita personal income is the income that is received by persons from all sources, including wages and other income over the course of one year. In 2005, personal income in Sweetwater County was $38,039, which was 102 percent of the state average of $37,305. The county ranks fifth out of 23 counties in the state (BEA 2006). Carbon County had a lower per capita income of $30,961, which was 83 percent of the state average and ranked 18th in the state. Sweetwater County has a higher per capita personal income because of relatively high-paying jobs in the trona mining industry.

2.3.2.2 Housing

The nearest substantial housing stock is located in the town of Rawlins, in Carbon County. Nearby communities such as Bairoil (Sweetwater County) and Jeffrey City (Fremont County) are small, with correspondingly small numbers of available housing. According to the U.S. Census 2000 (the most recent year for which housing data were available for

communities), there were 78 housing units in Bairoil. Of these units, 42 units were occupied, and the vacancy rate was 46.2 percent. In Jeffrey city, there were 112 housing units in 2000, and a 59.8 percent vacancy rate. In Rawlins, there were 3,860 housing units in 2000, including 540 vacant units for a vacancy rate of 13.4 percent.

It is likely that current vacancy rates in these communities have decreased since 2000 as a result of increasing in-migration of workers for employment in ongoing mineral resource development. A rental vacancy survey summarized in the Wyoming Community Development Authority report shows that rental vacancy rates in Carbon County decreased to 0.98 percent from a post-U.S. Census 2000 high of 16.08 percent in 2001. A more modest decrease in rental vacancy rates occurred in Sweetwater County, from a high of 8.16 percent in 2000, to the 2006 rate of 0.63 percent. This has occurred because the influx of labor into these counties, as a result of economic growth stimulated by mineral production, has outstripped the available rental housing supply.

The housing needs forecast included in the above cited report projects an increase of 11,932 households (a household is defined as all the persons who occupy a housing unit) in Sweetwater County from 14,105 in 2000 to 26,037 in 2030. The number of renters in Sweetwater County is projected to increase from 3,519 in 2000, to 5,472 in 2030. In Carbon County, the number of households is projected to increase by 2,389, from 6,129 in 2000, to 8,518 by 2030. The number of renters is expected to increase from 1,775 in 2000, to 1,967 in 2030.

2.3.2.3 Temporary Housing

Temporary housing options in the vicinity of the License Area include hotels, motels, and campgrounds. Vacancy rates are not currently available for temporary accommodations in Sweetwater and Carbon Counties. Available local motels/hotels/cabin establishments in the region generally have low vacancy rates during hunting seasons. There is also a high level of occupancy by coal bed methane gas workers. Many motels and recreational vehicle (RV) campgrounds in the region provide accommodation for long-term visits by the week or month.

The temporary lodgings closest to the License Area are in Rawlins and smaller communities along the I-80 corridor to the south. Accommodations in Rawlins include 867 rooms in 14 hotels/motels, and 230 spaces in 5 campground/RV parks (Wyoming Tourism 2007).

2.3.3 Evaluation of Socioeconomic Impacts of the Proposed Operation

The construction and operating work force for the Antelope / JAB Project is anticipated to come from the surrounding region, primarily Sweetwater and Carbon Counties in south-central Wyoming. At least 50 percent of the work force would likely be located in Rawlins, which provides labor for a number of large-scale energy related projects in the region. The proposed project is located in Sweetwater County, which would experience effects to

housing, public and other community services, recreation, county and municipal finances, crime, and the local transportation network. The adjacent Carbon County would also experience effects to housing and community services, as some of the project workforce would likely reside in Carbon County communities.

It is anticipated that the overall effect of the proposed facility operations on the local and regional economy would be beneficial. Purchases of goods and services by the mine and mine employees would contribute directly to the economy. Local, state, and the federal governments would benefit from taxes paid by the mine and its employees. Indirect impacts, resulting from the circulation and recirculation of direct payments through the economy, would also be beneficial. These economic effects would further stimulate the economy, resulting in the creation of additional jobs. Beneficial impacts to the local and regional economies provided by the proposed Antelope / JAB Project would continue for the life of the facility, estimated to be 15 years for the well field operation and 25 years for the Central Plant operations.

2.3.3.1 Construction

The construction phase would cause a moderate impact to the local economy, resulting from the purchases of goods and services directly related to construction activities. Impacts to community services in rural Sweetwater County or the nearby town of Bairoil, such as roads, housing, schools, and energy costs would be minor or non-existent and temporary.

An estimated 50 percent of the construction work force would be based in Sweetwater County, which contains the License Area. The workforce hired outside of the county would likely be based in Rawlins, located in the neighboring Carbon County, as Rawlins is a regional economic hub that provides a variety of construction services and labor for projects located throughout Wyoming.

Most construction work available to the local construction labor pool consists of temporary contract work that varies in duration, depending on the scope of each construction project. Further, the number of unemployed construction workers does not represent the number of workers that would be available to the proposed Projects from the local construction labor pool. The number is an annual average that does not take into account monthly variations in the available construction labor pool from construction start-ups and completions. Contractors for projects located throughout Wyoming typically hire the local construction labor pool. The actual number of construction workers available for the proposed project would potentially draw from the entire construction labor pool of 6,268 (2005 estimate; the construction labor pool as of 2007 is likely to be larger), as construction activities from some active projects would conclude so that workers would be available for future projects.

2.3.3.2 Operations Workforce

An estimated 40 to 60 people would be required for the operation of the proposed Antelope / JAB Project. It is not known how many of the required operations workforce would be

hired from outside of Sweetwater and Carbon Counties. In the event that the entire operations workforce and their families relocated to the counties, the population increase would be a maximum of 151, based on the 2005 average household size of 2.52 in Wyoming. This increase would account for 0.1 percent of the population of Sweetwater and Carbon Counties, and is smaller than the projected annual growth rate; therefore, there would be little to no effect to the vacancy rates of any type of housing in the Rawlins area or Sweetwater County.

2.3.3.3 Effects to Housing

The License Area lies within commuting distance of Rawlins and other communities along the I-80 corridor in Sweetwater and Carbon Counties, so that workers from these counties would likely commute from their homes. There would be no impact to temporary housing located within commuting distance (an estimated 1 to 2 hours) of the License Area.

In the event that workers from other states are hired for construction of the proposed Antelope / JAB Project, temporary housing such as motel/hotel rooms and RV sites located within commuting distance would be required, as no on-site housing (man camp) would be available. The available stock of motel/hotel rooms would accommodate relocating workers.

It is recognized, however, that mineral industries are presently a dominating factor for temporary housing availability in the area, and the workforce employed in these industries occupy much of the temporary housing that becomes available.

It is anticipated that few of the construction work force during construction of any phase of the Antelope / JAB Project would purchase or rent housing of any type; therefore, there would be no effects on the costs of any type of housing in the counties. Because rental housing usually require a long-term lease (generally a minimum of 6 months), only operations employees would likely enter into this type of lease agreement.

At least 50 percent of the operations workforce is expected to come from Sweetwater and Carbon counties. Those not located within commuting distance of the Antelope / JAB Project would likely rent or purchase housing. In the unlikely event that the entire operations workforce are non-local and relocated to these counties, a maximum of 180 housing units would be required to accommodate relocating workers. Under this extreme scenario, the available housing units in Sweetwater and Carbon counties would not meet the demand for housing. On the other hand, the population increase would be a maximum 454 (180 workers times 2.52) based on the 2005 average household size of 2.52 in Wyoming. This increase would account for about one percent of the population of Sweetwater County as of 2006, and is within the county's annual projected population increase of 494 people per year between 2003 and 2010.

Household projections estimate a threefold increase in households from 2000 to 2030 as 291 percent in Sweetwater County, and 39 percent in Carbon County. The existing housing

stock would not accommodate the projected households. Local communities in general are aware of the pressing need for the new residential development.

2.3.3.4 Effects to Services

It is likely that both the construction and operating work force would be from the Sweetwater and Carbon Counties, or other nearby counties in central Wyoming, and would not require permanent or temporary housing. In the event that up to 50 percent of the construction and operating workforce are non-local workers, it is anticipated that there would be a less than one percent increase in the population of Sweetwater and Carbon counties from the permanent relocation of the workers and their families. Most non-local workers would use temporary housing. Man camps or other housing would not be constructed for the project workforce, so no new water, sewer, electrical lines, or other infrastructure would be required. There would be no additional demands of increases in service levels for local infrastructure, such as police, fire, water, or utilities. In addition, there would be little measurable increase in non-basic employment, as these jobs are generated from ongoing employment of the existing base of construction workers, and would be maintained through the continued employment of local construction workers. Therefore, construction and operation of the Antelope / JAB Project would not significantly affect the various public and non-public facilities and services described above from the in-migration of workers for non-basic employment opportunities.

2.3.3.5 Effects to Traffic

The most heavily used public road segments would be Bairoil Road west of the town of Bairoil, State Highway 73 between Lamont and Bairoil, and State Highway 287 between I-80 through Rawlins north to State Highway 73 at Lamont. Most construction traffic, the construction workforce, and the operations workforce would access the License Area via these road segments. The highest levels of project-related traffic would be from the operations workforce, and assuming there would be an average of one employee per vehicle, per one-way vehicle trip, there could be an increase of 5.4 percent in daily traffic along the highway. This 5.4 percent (10.8 percent for two trips per day) percent increase is well below the 25 percent threshold generally used for predicting significant effects to a transportation system.

Equipment needed for construction and installation of the proposed facility would include heavy equipment (cranes, bulldozers, graders, track hoes, trenchers, and front-end loaders), and heavy- and light-duty trucks. It is anticipated that heavy equipment will be transported primarily to the site during off-peak traffic hours.

2.3.4 Environmental Justice

The U.S Census 2000 Decennial Population program provides race and poverty characteristics for Census Tracts and Block Groups, which are subdivisions of Census Tracts. The License Area and the surrounding 2.0-mile buffer are contained within Census

Tract 9716 in Sweetwater County, and in Block Group 1, Census Tract 3 in Fremont County. There is no population within the License Area or the surrounding 2.0-mile buffer.

The State of Wyoming was selected to be the geographic area to compare the demographic data for the population in the affected Census Tracts. This determination was based on the need for a larger geographic area encompassing affected area Census Tracts in which equivalent quantitative resource information is provided. The population characteristics of the affected Census Tracts are compared with Wyoming population characteristics to determine whether there are concentrations of minority or low-income populations in the Census Tracts relative to the state.

As summarized in Table 2.3-6, the combined population within the Census Tracts that encompass the License Area buffer was 3,926. Minority populations accounted for a small proportion of the total population, with percentages of minorities generally similar to or smaller than those of the state as a whole, with the exception of the Hispanic population and the portion of the population that are racially characterized as two or more races. The proportion of the Hispanic population to the total population was slightly larger in Census Tract 9716 than in the state. Those people who are two or more races were also a slightly higher proportion of the total population in both census tracts than in the state.

No concentrations of minority populations were identified as residing near the License Area, as residents nearest are rural populations. There would be no disproportionate impact to minority population from the construction and implementation of the Antelope / JAB Project.

The populations within the Tracts exhibit lower rates of people living below the poverty level than the state. Both Tracts contain rural populations; therefore, there is no concentration of people living below the poverty level in these Tracts. No disproportionate adverse environmental impacts would occur in populations living below the poverty level within the Census Tracts from proposed Project activities.

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TABLES

Table 2.3-1 1980 – 2006 Historical and Current Population Change for Counties and Towns within 80 km of the Antelope / JAB License Area

Note – Population estimates for 2006 are not available for cities and towns.

State/County/City	Year						Average Annual Percent Change				
	1980	1990	2000	2002	2004	2006	1980/ 1990	1990/ 2000	2000/ 2002	2002/ 2004	2004/ 2006
State of Wyoming	469,557	453,588	493,782	498,973	505,534	515,004	-0.3%	0.9%	0.5%	0.7%	0.9%
Carbon County	21,896	16,659	15,639	15,382	15,346	15,325	-1.9%	-0.9%	1.1%	-0.2%	0.0%
Rawlins	11,547	9,380	8,538	8,725	8,692	-	-1.4%	0.6%	0.3%	0.3%	-
Fremont County	38,992	33,662	35,804	36,032	36,218	37,163	-1.5%	0.9%	0.7%	1.1%	1.0%
Natrona County	71,856	61,226	66,533	67,519	68,988	70,401	-0.7%	-0.3%	-0.4%	0.4%	1.6%
Sweetwater County	41,723	38,823	37,613	37,294	37,570	38,763	0.7%	-5.7%	-0.5%	0.0%	0.0%
Bairoil	214	228	97	96	96	-	-6.5%	0.9%	0.0%	0.6%	-
Wamsutter	681	240	261	261	264	-	-0.3%	0.9%	0.5%	0.7%	-

Sources: U.S. Bureau of the Census Decennial, 2000 Decennial; U.S. Bureau of the Census Population Estimates Program, 2007.
- = Not available

Table 2.3-2 2005 Population by Age and Sex for Counties within the 80 km Radius of the Antelope / JAB License Area

Area	Age	Male	Female	Total	Total Percent Breakdown
State of Wyoming	Under 5	16,247	14,818	31,065	6.1%
	5 - 19	51,074	48,270	99,344	19.5%
	20 - 34	53,964	49,387	103,351	20.3%
	35 - 64	107,479	106,018	213,497	41.9%
	65+	27,962	34,075	62,037	12.2%
	Total	256,726	252,568	509,294	100.0%
Carbon County	Under 5	16,247	14,818	31,065	6.1%
	5 to 19	51,074	48,270	99,344	19.5%
	20 to 39	69,455	64,312	133,767	26.3%
	40 to 64	91,988	91,093	183,081	35.9%
	65+	27,962	34,075	62,037	12.2%
	Total	256,726	252,568	509,294	100.0%
Fremont County	Under 5	847	444	403	5.6%
	5 to 19	2,629	1,383	1,246	17.4%
	20 to 39	3,576	2,019	1,557	21.7%
	40 to 64	6,229	3,326	2,903	40.5%
	65+	2,050	998	1,052	14.7%
	Total	15,331	8,170	7,161	100.0%
Natrona County	Under 5	2,398	1,216	1,182	6.4%
	5 to 19	2,608	3,826	3,591	19.5%
	20 to 39	8,479	4,313	4,166	22.6%
	40 to 64	13,007	6,339	6,668	36.1%
	65+	5,190	2,348	2,842	15.4%
	Total	36,491	18,042	18,449	100.0%
Sweetwater County	Under 5	2,350	2,208	4,558	6.5%
	5 to 19	7,002	6,680	13,682	19.6%
	20 to 39	9,267	9,080	18,347	26.3%
	40 to 64	12,103	12,245	24,348	34.9%
	65+	3,828	5,036	8,864	12.7%
	Total	34,550	35,249	69,799	100.0%

Source: U.S. Bureau of the Census 2007

Table 2.3-3 2005-2025 Population Projections for Counties within the 80 km Radius of the Antelope / JAB License Area

Area	Census 2000	Projected 2005	Projected 2010	Projected 2015	Projected 2020
State of Wyoming	494,078	506,184	519,595	529,352	533,534
Carbon County	15,594	15,047	14,671	14,345	13,965
Fremont County	35,841	36,138	36,872	37,251	37,135
Natrona County	66,550	68,965	70,529	71,685	72,151
Sweetwater County	37,487	36,654	35,567	34,293	32,759

Note: Population projections for the years after 2020 are not available.
Source: Wyoming Department of Administration and Information, Economic Analysis Division 2007.

Table 2.3-4 2004 Population within the 80 km Radius of the Antelope / JAB License Area

	Radius in km													
Sector	**0-1**	**1-2**	**2-3**	**3-4**	**4-5**	**5-10**	**10-20**	**20-30**	**30-40**	**40-50**	**50-60**	**60-70**	**70-80**	**Total**
N	0	0	0	0	0	0	0	19	27	0	42	50	57	195
NNE	0	0	0	0	0	0	0	106	27	0	42	52	60	287
NE	0	0	0	0	0	0	0	0	0	0	51	62	71	184
ENE	0	0	0	0	0	0	0	0	24	31	42	54	66	217
E	0	0	0	0	0	0	0	96	21	27	34	40	46	264
ESE	0	0	0	0	0	0	0	0	18	27	34	40	46	165
SE	0	0	0	0	0	0	0	0	15	23	32	289	8,658	9,017
SSE	0	0	0	0	0	0	0	0	0	13	13	40	103	169
S	0	0	0	0	0	0	0	0	0	0	10	45	71	126
SSW	0	0	0	0	0	0	0	0	14	0	10	12	14	50
SW	0	0	0	0	0	0	0	0	0	0	10	18	31	59
WSW	0	0	0	0	0	0	0	0	0	0	19	28	33	80
W	0	0	0	0	0	0	0	0	0	0	28	34	39	101
WNW	0	0	0	0	0	0	0	0	0	0	42	50	57	149
NW	0	0	0	0	0	0	0	0	0	0	42	182	358	582
NNW	0	0	0	0	0	0	0	0	27	34	42	153	346	602
Total	0	0	0	0	0	0	0	221	173	155	493	1,149	10,056	12,247

Notes: Current population living between 10 and 80 km of the mine site were estimated using 2004 census block data. Field reconnaissance was conducted in 2007 to verify data collected within 2 miles (3.22 km). The population between 3 and 30 km was estimated with the average household size in 2000 and aerial photos to count the number of housing units in each sector.

Table 2.3-5 2005 Annual Average Labor Force Characteristics and Employment in Economic Sectors for State of Wyoming for Sweetwater and Carbon Counties

	State of Wyoming		Sweetwater County		Carbon County	
	# of Work Force	Percent Change	# of Work Force	Percent Change	# of Work Force	Percent Change
Labor Force	284,538	-	23,596	-	7,939	-
Employment	274,362	-	23,008	-	7,670	-
Unemployment	10,176	-	588	-	269	-
Unempl. Rate	3.6	-	2.5	-	3.4	-
Total employment	360,558	100.0%	27,628	100.0%	10,015	100.0%
Farm employment	12,096	3.4%	194	0.7%	528	5.3%
Nonfarm employment	348,462	96.6%	27,434	99.3%	9,487	94.7%
Forestry, fishing, related activities, and other 3/	2,780	0.8%	46	0.2%	151	1.5%
Mining	25,578	7.1%	5,225	18.9%	(D)	-
Utilities	2,422	0.7%	(D)	-	65	0.6%
Construction	29,356	8.1%	2,257	8.2%	815	8.1%
Manufacturing	11,352	3.1%	1,236	4.5%	(D)	-
Wholesale trade	8,784	2.4%	(D)	-	228	2.3%
Retail trade	40,188	11.1%	3,106	11.2%	1,025	10.2%
Transportation and warehousing	12,842	3.6%	1,479	5.4%	553	5.5%
Information	5,088	1.4%	261	0.9%	105	1.0%
Finance and insurance	11,247	3.1%	565	2.0%	230	2.3%
Real estate and rental and leasing	13,837	3.8%	867	3.1%	392	3.9%
Professional and technical services	16,000	4.4%	727	2.6%	301	3.0%
Management of companies and enterprises	970	0.3%	97	0.4%	(D)	-
Administrative and waste services	11,871	3.3%	920	3.3%	(D)	-
Educational services	2,985	0.8%	135	0.5%	27	0.3%
Health care and social assistance	26,555	7.4%	1,273	4.6%	594	5.9%
Arts, entertainment, and recreation	6,612	1.8%	(D)	-	243	2.4%
Accommodation and food services	31,964	8.9%	2,327	8.4%	1,087	10.9%
Other services, except public administration	19,524	5.4%	1,216	4.4%	563	5.6%
Government and government enterprises	68,507	19.0%	4,242	15.4%	2,074	20.7%
Federal, civilian	7,491	2.1%	238	0.9%	213	2.1%
Military	6,138	1.7%	215	0.8%	87	0.9%
State and local	54,878	15.2%	3,789	13.7%	1,774	17.7%
State Government	14,942	4.1%	279	1.0%	521	5.2%
Local Government	39,936	11.1%	3,510	12.7%	1,253	12.5%

(D) = Not shown to avoid disclosure of confidential information, but the estimates for this item are included in the totals.
- = Not Available

Table 2.3-6 Race and Poverty Level Characteristics of the Population in the Antelope / JAB License Area Census Tracts

	State of Wyoming	Percent of Total State Population	Census Tract 9716, Sweetwater County	Percent of Census Tract 9716	Block Group 1, Census Tract 3, Fremont County	Percent of Census Tract 3	Total
Total	493,782	100.0%	1,702	100.0%	2,224	100.0%	3,926
Urban:	322,073	65.2%	0	0.0%	0	0.0%	0
Inside urbanized areas	125,706	25.5%	0	0.0%	0	0.0%	0
Inside urban clusters	196,367	39.8%	0	0.0%	0	0.0%	0
Rural	171,709	34.8%	1,702	100.0%	2,224	100.0%	3,926
White alone	454,095	92.0%	1,588	93.3%	2,091	94.0%	3,679
Black or African American alone	3,126	0.6%	2	0.1%	0	0.0%	2
American Indian and Alaska Native alone	11,363	2.3%	16	0.9%	52	2.3%	68
Asian alone	2,972	0.6%	5	0.3%	17	0.8%	22
Native Hawaiian and Other Pacific Islander alone	232	0.0%	1	0.1%	0	0.0%	1
Some other race alone	12,595	2.6%	44	2.6%	11	0.5%	55
Two or more races	9,399	1.9%	46	2.7%	53	2.4%	99
People who are Hispanic or Latino	31,384	6.4%	127	7.5%	67	3.0%	194
Median household income in 1999	37,892	-	49,544	-	38,095	-	-
Per capita income in 1999	19,134	-	19,350	-	20,133	-	-
Population with income in 1999 below poverty level:	54,777	-	150	-	136	-	**286**
Percent below poverty level	11.1%	-	8.8%	-	6.1%	-	**0**

Source: U.S. Bureau of Census 2000

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2.4 HISTORIC, ARCHEOLOGICAL, CULTURAL AND SCENIC RESOURCES

2.4.1 Historic, Archeological, and Cultural Resources

2.4.1.1 Antelope Site

Uranium One contracted Jones and Stokes to conduct a Class III cultural resource inventory of the proposed Antelope site of the Antelope and JAB License Area in Sweetwater County, Wyoming. The Antelope site is located approximately 10 miles west of the town of Bairoil, Wyoming. It can be found on the Antelope Reservoir (1961 Photo revised 1981) and Osborne Well (1961 Photo revised 1981) topographic maps. The site is comprised of public lands managed by the Lander Field Office of the Bureau of Land Management (BLM).

The proposed site encompasses approximately 10,535 acres. Approximately 10,418 acres were inventoried for cultural resources in 2007, with the remaining 117 acres to be surveyed early in 2008. Initial disturbance within the project area will consist of exploratory drilling within existing claims to determine the location and extent of ore trends. Uranium One uses a single drill rig during exploration operations.

Because in situ mining has a much smaller impact footprint than conventional surface mining, surface disturbance is reduced to relatively small areas needed for injection wells, extraction wells, processing facilities, and access roads. Surface disturbance associated with the project is expected to consist of a series of well fields and associated infrastructure (power lines, pipelines, and header sites) in each of the 10 development areas, a processing plant (10 acres), and approximately 24 miles of roads (9 miles of improved existing roads and 15 miles of new roads). Assuming a working right-of-way of 25 feet for roads, construction of new roads and the improvement of existing roads would disturb a maximum of 73 acres within the permit area. The Antelope site could potentially disturb a maximum of 1,162 noncontiguous acres, or approximately 11% of the total acreage within the permit area. All disturbed areas will be reclaimed when the well fields are retired.

A file search (#19374) was conducted with the Wyoming State Historic Preservation Office (SHPO) for the 20 sections in T26N R92W. Results from that search revealed 13 unique inventories covering 40 acres in the sections of interest. The previous inventories were associated with well pads (five), power lines (three), seismic lines (two), and one each with a pipeline, a road, and a range improvement project. A second file search (#19840) conducted for the eight sections of interest in T26N R93W revealed 10 unique

inventories. Four of these were related to a single power line, two were for road projects, two were associated with the development of a uranium mine, one was for a pipeline, and another was for a seismic line.

No archaeological sites are reported from the sections in T26N R92W. A single isolated find, a Late Archaic dart point was reported. Based on the results of previous studies, the potential for cultural resources in this area is considered low. However, it should be noted than less than two-tenths of 1% of this area had been inventoried prior to this study.

Three sites are considered significant under Criteria D, and are therefore potentially eligible for listing on the National Register of Historic Places (NRHP). The other sites are not considered significant because they are small in areal extent, lack features, and exhibit poor integrity.

The Class III Cultural Resource Inventory for the Antelope site in Appendix A contains information that falls under the confidentiality requirement for archeological resources under the National Historic Preservation Act, Section 304 (16 U.S.C. 470w-3(a)). The report, including Wyoming Cultural Resource Forms, has also been submitted to WSHPO for concurrence and the WDEQ-LQD under a separate cover from ARCADIS U.S. The Wyoming Cultural Resource Forms are not included in Appendix A since these forms were not provided to the client due to disclosure restrictions in the NHPA Section 304. Accordingly, disclosure is specifically exempted by statute as specified in 10 CFR §2.390(a)(3). Therefore, Uranium One requests that all applicable portions of Appendix A remain "CONFIDENTIAL" for the purpose of Public Disclosure of this application. Each page of the protected cultural resource information has been marked as follows:

Confidential Information Submitted under 10 CFR 2.390

The cover page for Appendix A has been marked with a more detailed statement, as follows:

Confidential Information Submitted under 10 CFR 2.390
Disclosure is Limited Under the National Historic Preservation Act, Section 304 (16 U.S.C. 470w-3(a)).

2.4.1.2 JAB

Uranium One contracted ARCADIS U.S., Inc. (ARCADIS) to conduct a Class III cultural resource inventory of the proposed JAB site of the Antelope and JAB License Area in Sweetwater County, Wyoming. The site area can be found on the Antelope Reservoir (1983) and Osborne Draw (1988) USGS 7.5' topographic quadrangles (Appendix A). The site area encompasses 4,040 acres within Sections 9, 10, 13, 14, 15, 16, 17, 20, 21, 22, 23, and 24, T26N, R94W. The surface and minerals are administered by the Lander Field Office of the Bureau of Land Management (LFO BLM).

Approximately 2,080 acres of the site were previously surveyed in 1982. Portions of the previously surveyed areas within the site were re-inventoried at the request of the BLM, Lander Field Office, because the LFO BLM wanted to sample areas of high site probability within the previously surveyed area. ARCADIS' Buffalo office conducted the field work between August 13 to August 24, 2007, covering a total of 285 previously surveyed acres and 1,960 new surveyed acres. Previous archaeological surveys cover the remaining portions of the site, and those investigations are discussed further in the Background Research section of this report. Project results document 25 archaeological sites and 29 isolated resources. On November 29, 2007, BLM Lander Field Office archaeologist Craig Bromley requested that seven sites identified during the August 2007 inventory work undergo limited testing to determine potential for subsurface cultural resources. Seven previously recorded sites were shovel tested between June 16 and June 17, 2008, to determine potential for subsurface cultural resources. Five of the seven previously recorded sites did not contain subsurface cultural resources and are recommended not eligible for the NRHP. Two previously recorded sites contained subsurface cultural resources and are recommended eligible for the NRHP. An addendum to the August 2007 Class III inventory for this work is presented in Appendix A.

ARCADIS U.S., Inc. holds Special Use Permit 332-WY-SR06 (expires June 11, 2008) to conduct cultural resource studies on Public lands in Wyoming administered by the BLM. Adam Graves served as Principal Investigator. Ardeth Halm and Teresa Matson were the Crew Chiefs. Crew persons were Cyrena Undem and Brent Slensker. All field notes and records are on file at ARCADIS in Buffalo, Wyoming.

This investigation was carried out in accordance with policies and regulations implementing Section 106 of the National Historic Preservation Act of 1966 (Public Law 89-665). The cultural resource inventory was undertaken to locate, identify, and document cultural resources that might be affected within the proposed undertaking, and to provide recommendations of eligibility to the National Register of Historic Places (NRHP) as specified in Title 36 of Codes of Federal Regulations (36CFR60.4). NRHP eligibility is evaluated in terms of the integrity of the resource, and: (a) its association with significant events, or patterns in history or prehistory; (b) its association with the

specific contributions of individuals significant in our past; (c) its engineering, artistic, or architectural values; or (d) its information potential for important research questions in history or prehistory (National Park Service 1998).

The implementing regulations of Section 106 state that, "The goal of consultation is to identify historic properties potentially affected by the undertaking, assess its effects and seek ways to avoid, minimize or mitigate any adverse effects on historic properties"

(36CRF800.1b). Therefore, the management recommendations made by A.RCADIS archaeologists focus primarily on the potential of the undertaking to pose an adverse effect to historic properties, as defined in 36CFR800.5.

The Class III Cultural Resource Inventory for the JAB site in Appendix A contains information that falls under the confidentiality requirement for archeological resources under the National Historic Preservation Act, Section 304 (16 U.S.C. 470w-3(a)). The report, including Wyoming Cultural Resource Forms, has also been submitted to WSHPO for concurrence and the WDEQ-LQD under a separate cover from ARCADIS U.S. The Wyoming Cultural Resource Forms are not included in Appendix A since these forms were not provided to the client due to disclosure restrictions in the NHPA Section 304. Accordingly, disclosure is specifically exempted by statute as specified in 10 CFR §2.390(a)(3). Therefore, Uranium One requests that all applicable portions of Appendix A remain "CONFIDENTIAL" for the purpose of Public Disclosure of this application. Each page of the protected cultural resource information has been marked as follows:

Confidential Information Submitted under 10 CFR 2.390

The cover page for Appendix A has been marked with a more detailed statement, as follows:

Confidential Information Submitted under 10 CFR 2.390
Disclosure is Limited Under the National Historic Preservation Act, Section 304 (16 U.S.C. 470w-3(a)).

2.4.2 Scenic Resources

2.4.2.1 Introduction

The Antelope and JAB License Area is located in the far northeast portion of Sweetwater County, Wyoming, on public lands managed by the Bureau of Land Management (BLM). The License Area is comprised of two sites the Antelope and JAB. The BLM Lander Field Office is responsible for overseeing activities on public lands within the Antelope and JAB License Area. The BLM policy is that it has a basic stewardship responsibility to identify and protect visual values on public lands. The BLM has inventoried the visual resources of all lands within the boundaries of the Lander Field Office using a Visual Resource Management (VRM) system.

2.4.2.2 Methods

The VRM system is the basic tool used by the BLM to inventory and manage visual resources on public lands. The VRM inventory process involves rating the visual appeal of a tract of land, measuring public concern for scenic quality, and determining whether the tract of land is visible from travel routes or observation points. The BLM has inventoried the landscape within the Antelope and JAB License Area and the surrounding 2.0-mile land use review area.

2.4.2.3 Visual Resource Management Classes

The elements used to determine the visual resource inventory class are the scenic quality, sensitivity levels, and distance zones. Each of the elements used to identify the VRM Class is defined below:

Scenic Quality - Scenic quality is a measure of the visual appeal of a tract of land. In the visual resource inventory process, public lands are assigned an A, B, or C rating based on the apparent scenic quality, which is determined using seven key factors: landform, vegetation, water, color, adjacent scenery, scarcity, and cultural modifications. During the rating process, each of these factors is ranked comparatively against similar features within the physiographic province.

Sensitivity Level – A degree or measure of viewer interest in the scenic qualities of the landscape. Factors to consider include 1) type of users; 2) amount of use; 3) public interest; 4) adjacent land uses; and 5) special areas. Three levels of sensitivity have been defined:

- Sensitivity Level 1 – The highest sensitivity level, referring to areas seen from travel routes and use areas with moderate to high use.

- Sensitivity Level 2 – An average sensitivity level, referring to areas seen from travel routes and use areas with low to moderate use.

- Sensitivity Level 3 – The lowest sensitivity level, referring to areas seen from travel routes and use areas with low use.

Distance Zones – Areas of landscapes denoted by specified distances from the observer, particularly on roads, trails, concentrated-use areas, rivers, etc. The three categories are foreground-middle ground, background, and seldom seen.

- Foreground-Middle ground – The area visible from a travel route, use area, or other observer position to a distance of 3 to 5 miles. The outer boundary of this zone is defined as the point where the texture and form of individual plants are no longer apparent in the landscape and vegetation is apparent only in pattern or outline.

- Background - The viewing area of a distance zone that lies beyond the foreground and middle ground. This area usually measures from a minimum of 3 to 5 miles to a maximum of about 15 miles from a travel route, use area, or other observer position. Atmospheric conditions in some areas may limit the maximum to about 8 miles or increase it beyond 15 miles.

- Seldom Seen – The area is screened from view by landforms, buildings, other landscape elements, or distance.

The visual resource inventory classes are used to develop visual resource management classes, which are generally assigned by the BLM through the resource management plan process[1]. VRM objectives are developed to protect scenic public lands, especially those lands that receive the greatest amount of public viewing. The following VRM classes are objectives that outline the amount of disturbance an area can tolerate before it no longer meets the visual quality of that class.

- Class I Objective: 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.

- Class II Objective: To retain the existing character of the landscape. The level of change to the characteristic landscape should be low.

- Class III Objective: To partially retain the existing character of the landscape. The level of change to the characteristic landscape should be moderate.

- Class IV Objective: To provide for management activities which require major modification of the existing character of the landscape. The level of change to the characteristic landscape can be high.

The Scenic Quality, Sensitivity Level, and Distance Zone inventory levels are combined to assign the VRM Class to inventoried lands as shown in the following matrix:

Determining BLM Visual Resource Inventory Classes								
Visual Sensitivity		High			Medium			Low
Special Areas		I	I	I	I	I	I	I
Scenic Quality	A	II	II	II	II	II	II	II
	B	II	III	III/IV	III	IV	IV	IV
	C	III	IV	IV	IV	IV	IV	IV
Distance Zones		f/m	b	ss	f/m	b	ss	ss

f/m = foreground-middleground
b = background
ss – seldom seen

Affected Environment

The visual resources of both sites were inventoried and classified according to the VRM system defined in the Lander Resource Management Plan (RMP) (BLM 1986a). In the Lander RMP, the BLM defined the scenic quality based on the degree of harmony, contrast, and variety within a landscape. The Scenic Quality Class of the Antelope and JAB License Area is Class C, having low scenic value. The Antelope and JAB License Area is designated as VRM Class IV based on the existing visual resources. The management objective of VRM Class IV is to provide for activities which require major modification of the existing character of the landscape. The level of change to the characteristic landscape can be high. Modification of the landscape character is acceptable, including changes that may subordinate the original composition and character of the landscape. Changes should reflect what could be a natural occurrence in the characteristic landscape.

Scenery in the Antelope and JAB License Area is typical of the Great Divide Basin, with expansive views across flat to moderately undulating terrain. Vegetation in the area is a mix of low, mat-forming plants and low sagebrush on open, exposed areas, and Wyoming big sagebrush and greasewood in draws and lowlands. Numerous small drainages dissect the landscape and provide topographic diversity. Existing visual modifications to the landscape in and near the Antelope and JAB License Area include unimproved roads, evidence of past uranium exploration and development, and some oil and gas production facilities.

Most of the Antelope and JAB License Area are not visually sensitive given the remoteness of viewpoints used by the public or the screening of views by terrain. Motorists traveling U.S. Highway 287/Wyomnig State Highway 789 cannot view the Antelope and JAB License Area because the viewing distance is too great and intervening topography obscures the view. BLM Road 3321, Sweetwater County Road 22 (Bairoil Road), and the Wamsutter-Crooks Gap Road are the primary sensitive viewing areas that could be visited by the public.

There is a low concentration of users near the Antelope and JAB License Area (BLM 2005). Potential viewers include hunters, oil and gas operators, and ranchers with grazing allotments. Some portions of the proposed project facilities may be visible from existing roads, including Sweetwater County Road 22 and the Crooks Gap Road. In general, users of the region are accustomed to viewing mineral resource development; however, visual quality is an important part of the recreational experience for many users.

2.4.2.4 Environmental Consequences

Some project facilities may be visible from BLM Road 3321, Sweetwater County Road 22, or Wamsutter-Crooks Gap Road. Potential viewers of the contrasts of proposed project facilities with the surrounding landscape would be few (BLM 1986a) and would include hunters and other recreationists, ranchers, and oil and gas industry workers.

Short-term Effects

Short-term effects to visual resources would occur from construction of the processing plant and well drilling in the Antelope and JAB License Area: Effects to visual resources would typically be associated with drilling rigs, construction equipment, service trailers, and the general industrial character of drilling and the construction of well pads, access roads, pipelines, power lines, and plant buildings. Additional short-term effects may result from fugitive dust generated during the construction phase. Fugitive dust would be controlled by applying water, chemical dust suppressants, or other means when air quality is impaired.

The severity of effects with the BLM VRM rating system is related to the scenic quality, sensitivity level, and distance zone of the affected environment. In general, short-term effects would be most severe where the level of contrast is high and is highly visible to the most viewers. The short-term effects would be considered acceptable in a Class IV area. Because of a low concentration of users, the contrasts during construction would be seen by relatively few viewers. In addition, effects associated with construction at each well location would be visible only for a short time (7 to 14 days).

Long-term Effects

Long-term effects to visual resources would occur as a result of permanent production facilities, as described in Section 2 of the Technical Report, and would be evident in the landscape over the life of the Antelope and JAB Project. The plant buildings, roads, pipeline corridors, wellheads, and other aboveground facilities would be screened to the extent feasible. All permanent aboveground structures that would remain longer than 6 months would be painted Carlsbad Canyon Brown or other standard colors required by the BLM. This measure would not apply to structures that require safety coloration, as prescribed by the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA).

During the production and maintenance phase, permanent facilities would create contrasts in line, form, color, texture, and overall pattern in the landscape that would

remain for the duration of the project. Effects from fugitive dust as part of ongoing operations would also persist but could be reduced by using appropriate dust abatement measures. However, as noted for short-term effects, these contrasts would not be visible to many viewers. The level of contrast would not exceed Class IV standards if the mitigating measures as described below are implemented. Levels of contrast would, however, detract from the recreation experience of visitors to the Antelope and JAB License Area

The objective of VRM Class IV is to provide for activities which require major modification of the existing character of the landscape. The level of change to the characteristic landscape resulting from the Antelope and JAB Project should be moderate and consistent with the BLM objective of VRM Class IV. The existing rural/agricultural landscape would be retained, but would be modified with a noticeable, but minor, industrial component. Line and textural contrasts of the well houses, the plant, and associated access roads and distribution lines would be visible from sensitive viewing areas; however, contrasts would be low to moderate. The VRM Class IV objectives would be met by proposed long-term project facilities.

With the implementation of mitigitative measures described in Section 2.4.2.5, effects to visual and scenic resources as a result of the construction and operation of the Antelope and JAB Project are expected to be negligible.

2.4.2.5 Mitigation

Mitigation measures are meant to minimize adverse contrasts of project facilities with the existing landscape. The measures should be applied to all facilities, even those that meet VRM objectives. Mitigation would enable proposed project facilities to harmonize with the surrounding landscape to the extent feasible.

In addition to selecting paint colors that harmonize with the surrounding landscape, several other measures would minimize adverse effects of project facilities in the landscape.

- Using existing vegetation and topographic features to screen wells, facilities, and roads;
- Painting facilities with non-reflective paint that harmonizes with the surrounding landscape;
- Avoiding straight line-of-sight road construction;

- Aligning roads with the contours of the topography rather than cutting straight across contours to well houses, although this method of aligning the roads may result in a greater area of disturbance;

- Constructing clearings to appear as natural clearings by rounding corners and feathering the vegetation interface between the clearing and the surrounding grasses and shrubs (In those areas where the existing vegetation is dense, clearings should be irregular in shape); and

- Removing construction debris immediately because it creates undesirable textural contrasts with the landscape.

In general, resource protection measures proposed for erosion control, road construction, rehabilitation and re-vegetation, and wildlife protection would mitigate effects to visual quality.

2.4.3 References

United States Department of the Interior (USDOI), Bureau of Land Management (BLM). 1986a. Lander Field Office EIS/Resource Management Plan. [Web Page] http://www.blm.gov/rmp/WY/application/rmp_toc.cfm?rmpid=101. Accessed June 8, 2007.

BLM. 1986b. Visual Resource Inventory (VRM). BLM Manual Handbook 8410-1.

BLM. 1986c. Visual Resource Contrast Rating. BLM Manual Handbook 8431-1.

BLM. 1985. Rawlins Field Office EIS/Resource Management Plan. [Web Page] http://www.blm.gov/rmp/WY/application/rmp_toc.cfm?rmpid=101. Accessed June 8, 2007.

BLM. 2005. Draft Environmental Assessment for the Pappy Draw Coalbed Natural Gas Pilot Project. U. S. Department of Interior Bureau of Land Management Lander Field Office. August 2005.

[1] United States Department of the Interior (USDOI), Bureau of Land Management (BLM). Buffalo Resource Management Plan. [Web Page] http://www.blm.gov/rmp/WY/application/rmp_toc.cfm?rmpid=101. Accessed June 8, 2007.

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2.5 METEOROLOGY

2.5.1 Introduction

Meteorological data have been compiled for fifteen sites surrounding the Antelope and JAB License Area. Data have been acquired through the Western Regional Climate Center (WRCC, 2007) for 14 COOP and ASOS stations operated by the National Weather Service (NWS) including Alcova 17NW, Bitter Creek 4NE, Farson, Gas Hills 4E, Jeffery City, Leo 6SW, Muddy Gap, Pathfinder Dam, Rawlins AP, Rock Springs AP, Sand Draw, Seminoe Dam, South Pass City, and Wamsutter. In addition, Seminoe II Mine meteorological data have been obtained through Inter-Mountain Laboratories (IML). The latter mentioned site is operated in compliance with regulations set forth by the Wyoming Air Quality Division (AQD) for air quality monitoring. IML has maintained the site and archived the data for nearly 13 years. Table 2.5-1 provides the station id, coordinates, and period of operation for each site.

Table 2.5-1 Meteorological Stations Included in Climate Analysis.

Name	Agency	Lat	Long	Elev	Years_Operation
Seminoe II Mine	AQD	41.89	106.54	7055	1995-2007
Alcova 17NW	NWS	42.44	107.01	6870	1962-1987
Bitter Creek 4NE	NWS	41.35	108.31	6720	1962-2005
Farson	NWS	42.07	109.26	6590	1948-2005
Gas Hills 4E	NWS	42.5	107.29	6470	1962-2005
Jeffery City	NWS	42.3	107.5	6340	1964-2005
Leo 6SW	NWS	42.12	106.51	6040	1948-2005
Muddy Gap	NWS	42.22	107.28	6240	1949-2005
Pathfinder Dam	NWS	42.28	106.51	5930	1948-2005
Rawlins AP	NWS	41.48	107.12	6740	1928-2005
Rock Spring AP	NWS	41.36	-109.04	6740	1948-2005
Sand Draw	NWS	42.46	108.11	5960	1948-1979
Seminoe Dam	NWS	42.08	106.53	6840	1948-2005
South Pass City	NWS	42.28	108.48	7840	1948-2005
Wamsutter	NWS	41.41	107.59	6800	1948-2005

The 15 sites collectively have been analyzed to provide a regional climatic temperature and precipitation analysis of the project area. Only the Seminoe II Mine site will be analyzed for the wind summary. The 14 NWS sites will be incorporated into the snowfall discussion as the mines do not record snowfall data. Figure 2.5-1 shows the 15 sites in relation to the project permit boundaries. The closest NWS operated station which continuously records all weather parameters is the Rawlins AP site.

No on-site data are available for the proposed area. The Seminoe II Mine meteorological data are proposed as the most representative available data set for the site specific analysis. Seminoe II Mine lies 70 miles east of the proposed project area (Figure 2.5-17), with similar terrain (Figure 2.5-18). The elevation at Seminoe II is slightly less than 6,900 ft. while elevations in the Antelope and JAB License Area are typically 7,100 to 7,200 ft. Both sites are influenced by east-southeast to west-northwest trending mountain ranges located 10 to 15 miles to the north. Muddy Gap, at 23 miles from the central project area, is the NWS station closest to the Antelope and JAB License Area While winds at Muddy Gap are not expected to be representative of the project area, data from Muddy Gap exhibit precipitation totals (Figure 2.5-19) very similar to Seminoe II. Meteorological instrument locations and specifications for Seminoe II appear in Table 2.5-8.

On-site meteorological data from the Sweetwater Uranium Project, although collected during the 1975-1994 time period, show similarities to Seminoe II. The Sweetwater Project is located approximately 12 miles southeast of the Antelope and JAB License Area. Table 2.5-7 presents a comparison of monthly temperature statistics for Sweetwater and Seminoe II. Diurnal temperature variations by season (Figure 2.5-3) resemble those presented in the Sweetwater Uranium Project report. Wind speeds from 2001 through 2005 average somewhat higher at Seminoe II (14.7 mph) than those recorded from 1983 to 1987 at Sweetwater (9.5 mph); however, the directional trends are similar. Roughly 43% of the winds at Seminoe II originate from the WSW, SW and SSW directions, compared with 34% at the Sweetwater site. Precipitation for Sweetwater averaged 5.4" per year from 1978 to 1990, compared to 9.4" per year for Seminoe II between 2001 and 2005. Pan evaporation for the Sweetwater site averaged 60" per year, typical of published values for this region. No pan evaporation was measured at Seminoe II.

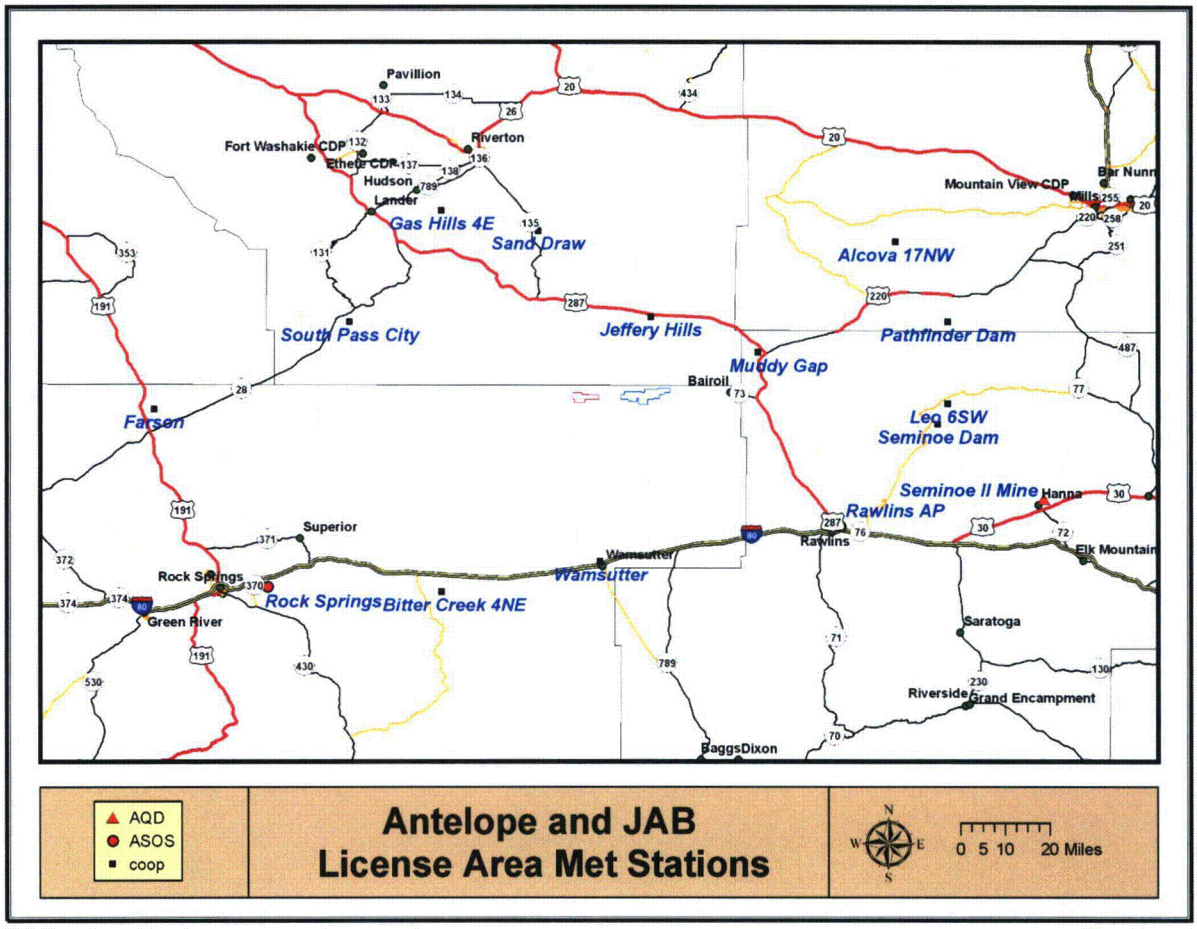
A recent, one-year monitoring program at the Lost Soldier meteorological station also tends to validate the suitability of the Seminoe II Mine as a representative data source. The Lost Soldier site is near Baroil, and approximately 10 miles east of the Antelope and JAB License Area. Data from this site were summarized in the Lost Creek Project, NRC Technical Report (2007). Winds at Lost Creek were predominantly from the west or west-northwest, while winds at Seminoe II are predominantly from the west or west-southwest. In both cases, about 13% of the wind speeds exceeded 11.1 m/sec. The Lost Soldier study cited atmospheric conditions that promote dispersion 91% of the time,

while Seminoe II data show good dispersion 86% of the time (Stability Classes A through D, Table 2.5-6).

A regional climate overview will be presented first. The section will include a discussion of the maximum and minimum temperature, relative humidity, and annual precipitation including snowfall estimates. Seminoe II Mine provides the only wind data for the region. Rawlins AP will be incorporated into the regional overview and Seminoe II Mine will be analyzed for the site specific analysis. The last portion of the regional analysis will include a general climate data summary from Rawlins. No site specific general climate data will be included as the regional evaluation is deemed adequate.

The site specific discussion will follow with the analysis based on the Seminoe II Mine meteorological data with many of the same parameters listed previously. An in-depth wind analysis will be comprised of summaries including wind speed and direction averages, joint frequency distributions to characterize the wind data for the site by stability class, and wind speed distributions to provide insight into the wind speed relative frequencies. A seasonal data discussion is included for the temperature and wind parameters. The seasonal classification does not follow the general calendar dates. The seasons are classified in three month intervals as follows; January – March for winter, April-June for spring, July – September for summer, and October – December for fall.

Figure 2.5-3 NWS and Coal Mine Meteorological Stations.



2.5.2 Regional Overview

2.5.2.1 Temperature

The annual average temperature for the region is approximately 42.5° F. The graph (Figure 2.5-2) below shows monthly average temperatures for the Seminoe II Mine and Rawlins AP sites. As illustrated, there is very little difference exhibited between the two sites. July shows the highest average monthly temperatures followed by August. January and December record the lowest average temperatures for the year. Table 2.5-2 compares the monthly average temperatures for the sites. The slight differences in average temperatures could be attributed to the small change in elevation between the stations.

The proposed project region has annual average maximum temperatures of 54° to 55° F and average minimum temperatures of near 30° F. July has the highest maximum temperatures with averages of 83.5° F while the lowest minimum temperatures are observed in January with averages approaching 9° F. Annual average minimum and maximum temperatures are shown in Figure 2.5-4 and Figure 2.5-5, respectively. The site specific monthly averages are shown in Table 2.5-2.

Large diurnal temperature variations are found in the region due in large part to the high altitude and low humidity. Figure 2.5-3 depicts the average seasonal diurnal temperature variations for the Seminoe II Mine site. Spring and summer daily variations of 16° - 18° F are common with maximum temperature variations of 18° - 22° F observed during extremely dry periods. Less daily variation is observed during the cooler portions of the year as fall and winter have variations of 10° - 13° F.

The late spring and summer months have the greatest diurnal variation in temperature. This is due in large part to the extended periods of high insolation occurring during the long daylight hours. The lesser variation in daily temperature during the fall and winter months can be attributed to more stable atmospheric conditions in the region. Stable periods have much lapse rates allowing for less temperature variation.

Table 2.5-2 Annual and Monthly Average Temperatures for Seminoe II Mine and Rawlins

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Rawlins	21.8	24.2	30.8	40.1	50.1	60.0	67.5	65.5	55.7	44.1	30.4	23.0	42.8
Seminoe II	23.5	21.9	30.4	40.3	49.9	59.7	69.8	64.9	55.5	43.3	29.2	22.5	42.2

Figure 4.5-2 Average Monthly Temperatures for Seminoe II Mine and Rawlins AP

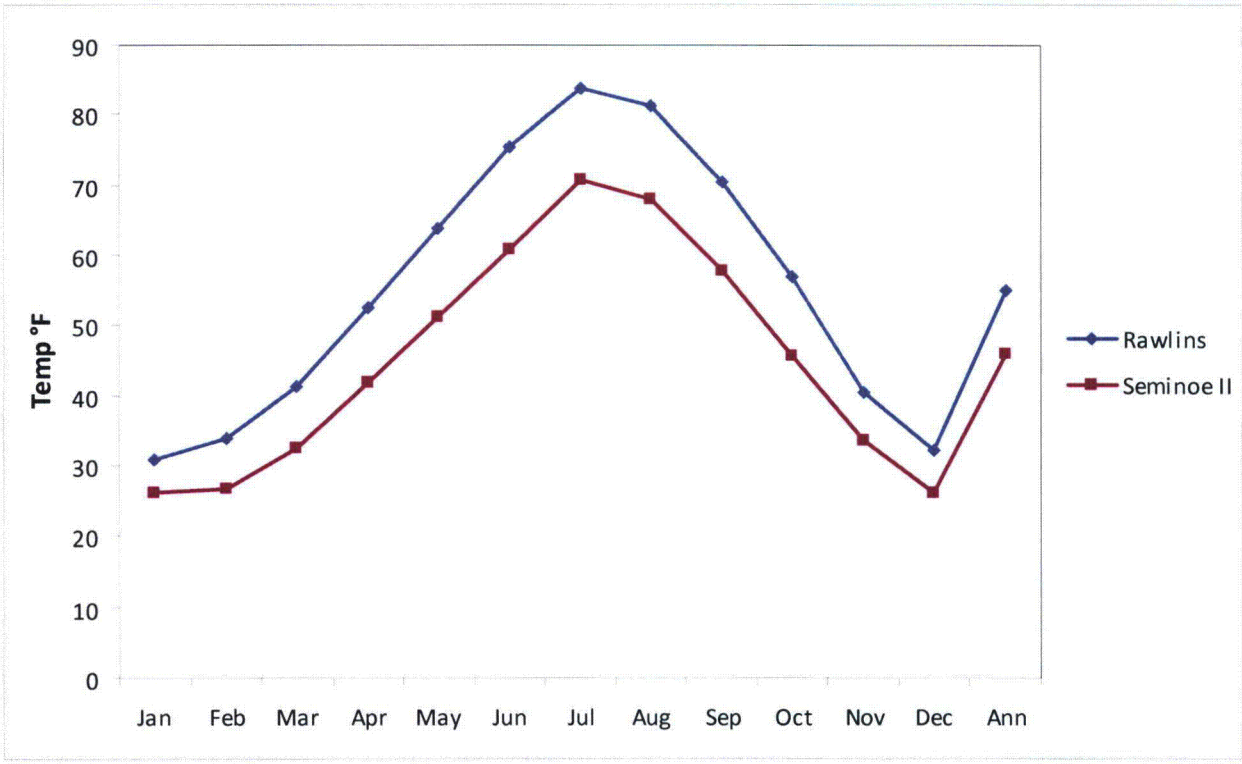


Figure 2.5-3 Seminoe II Mine Seasonal Diurnal Temperature Variations

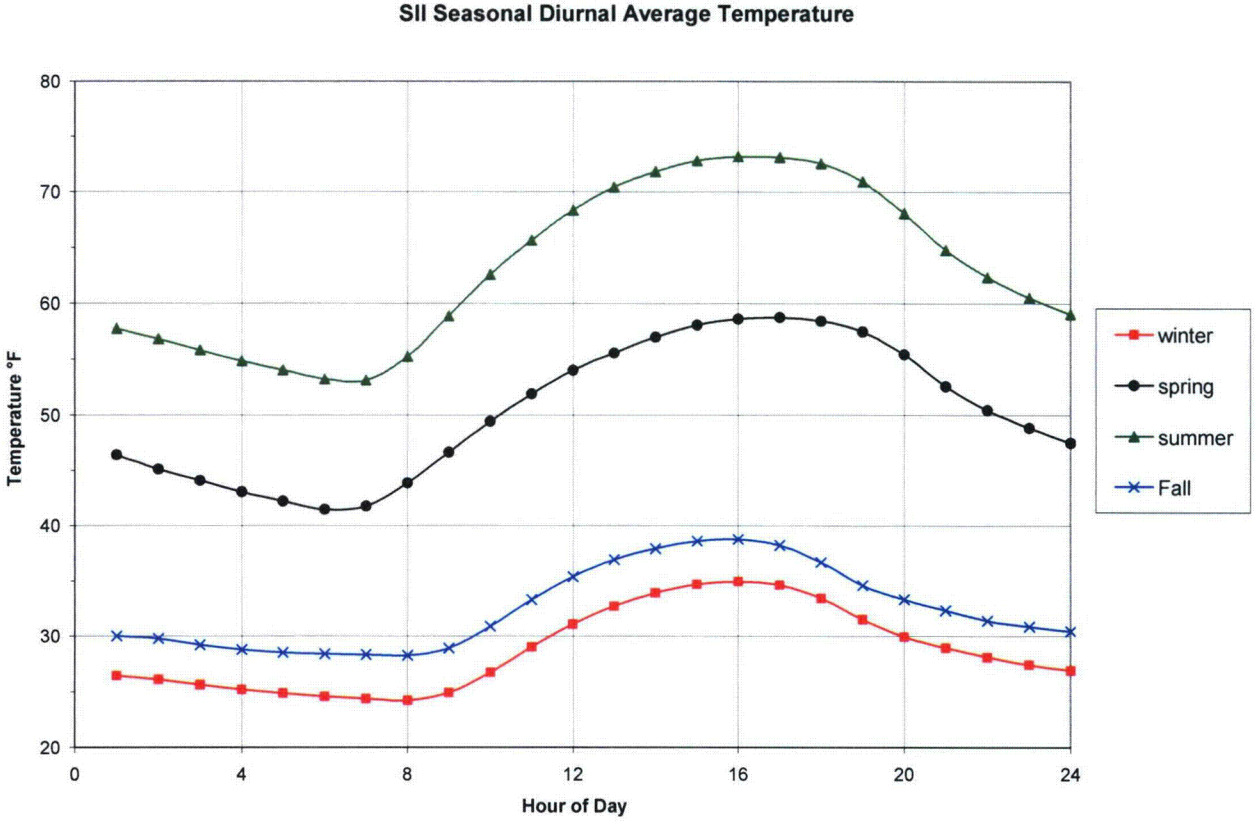


Figure 2.5-4 Regional Annual Average Minimum Temperatures

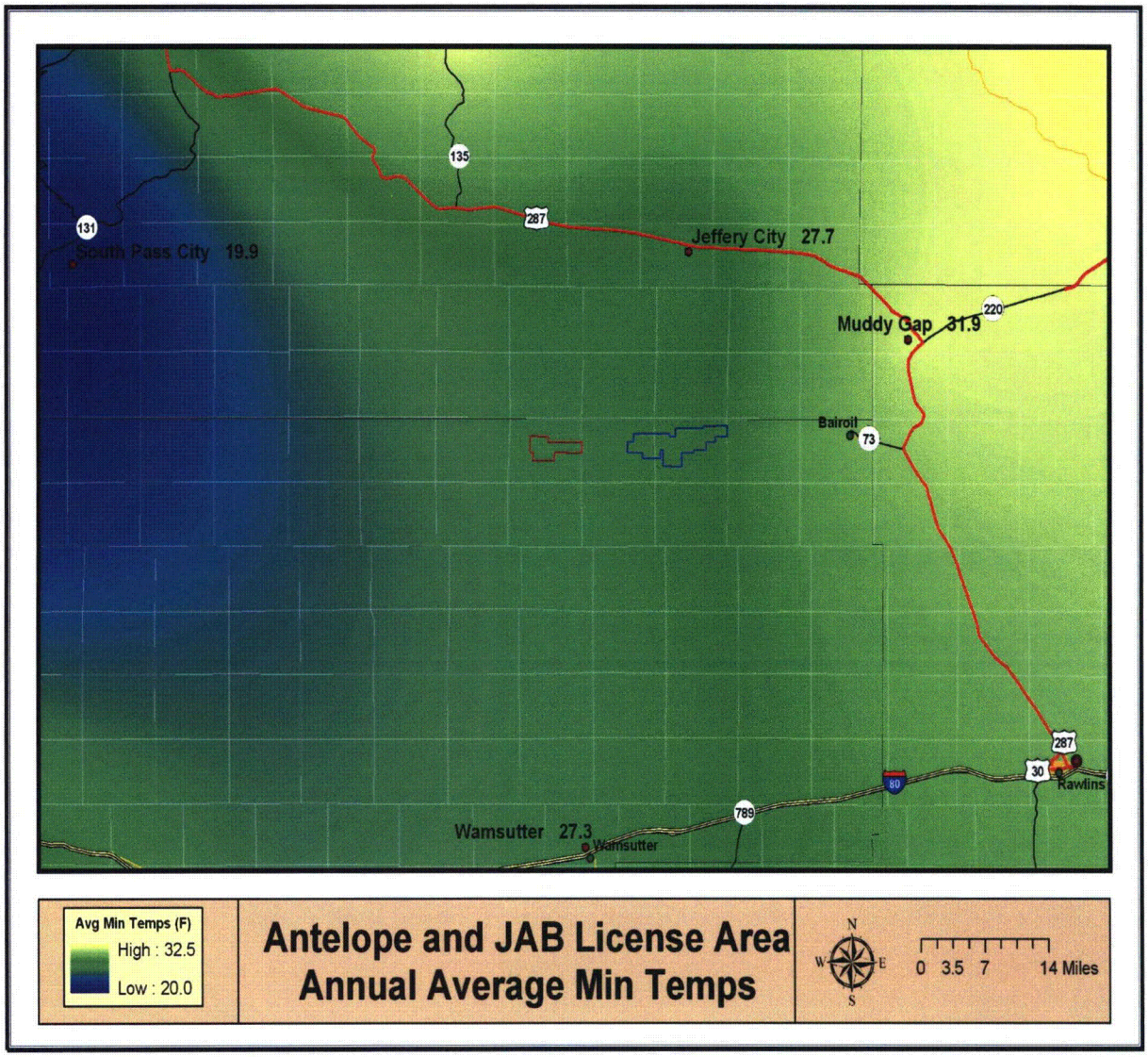
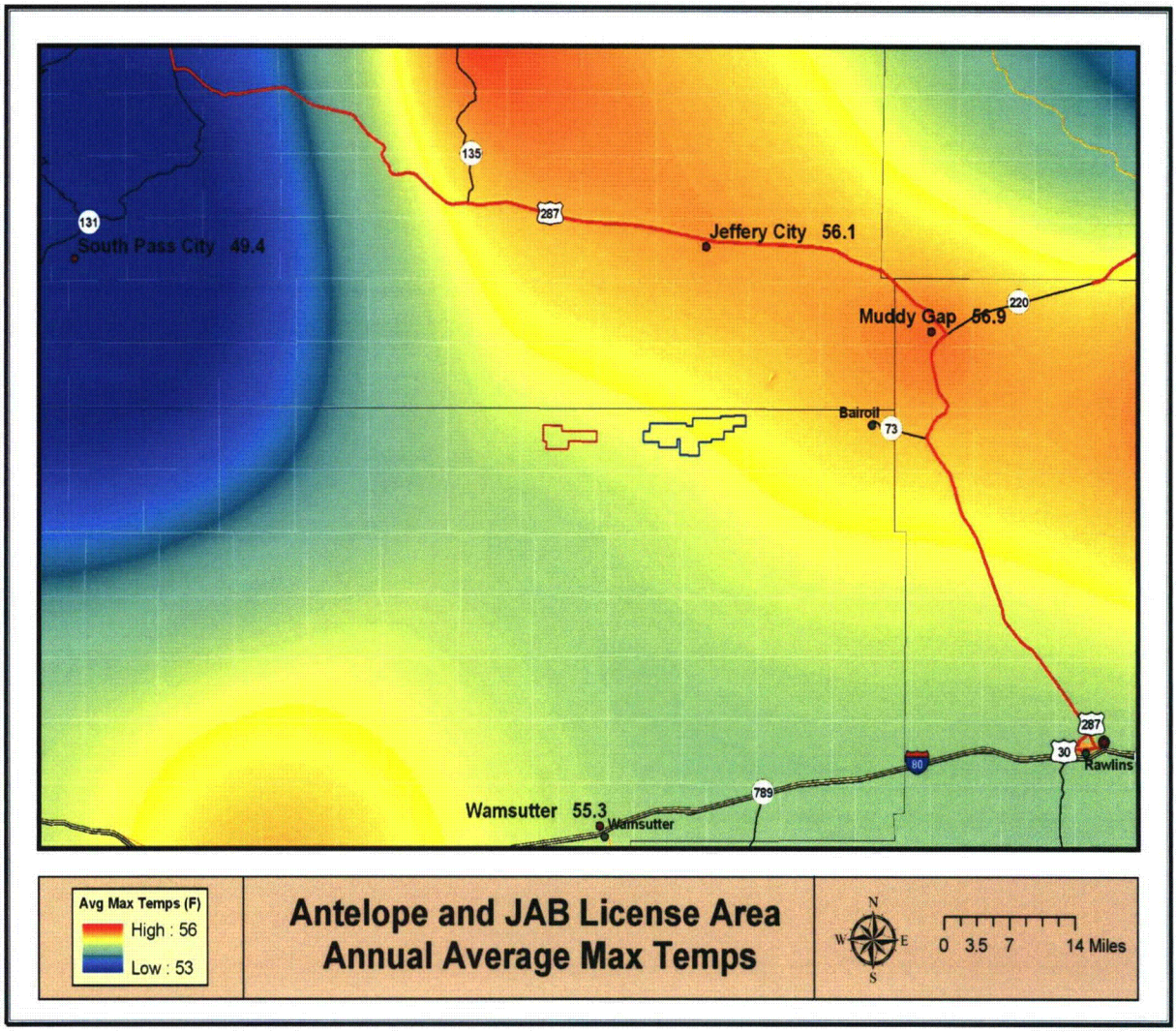


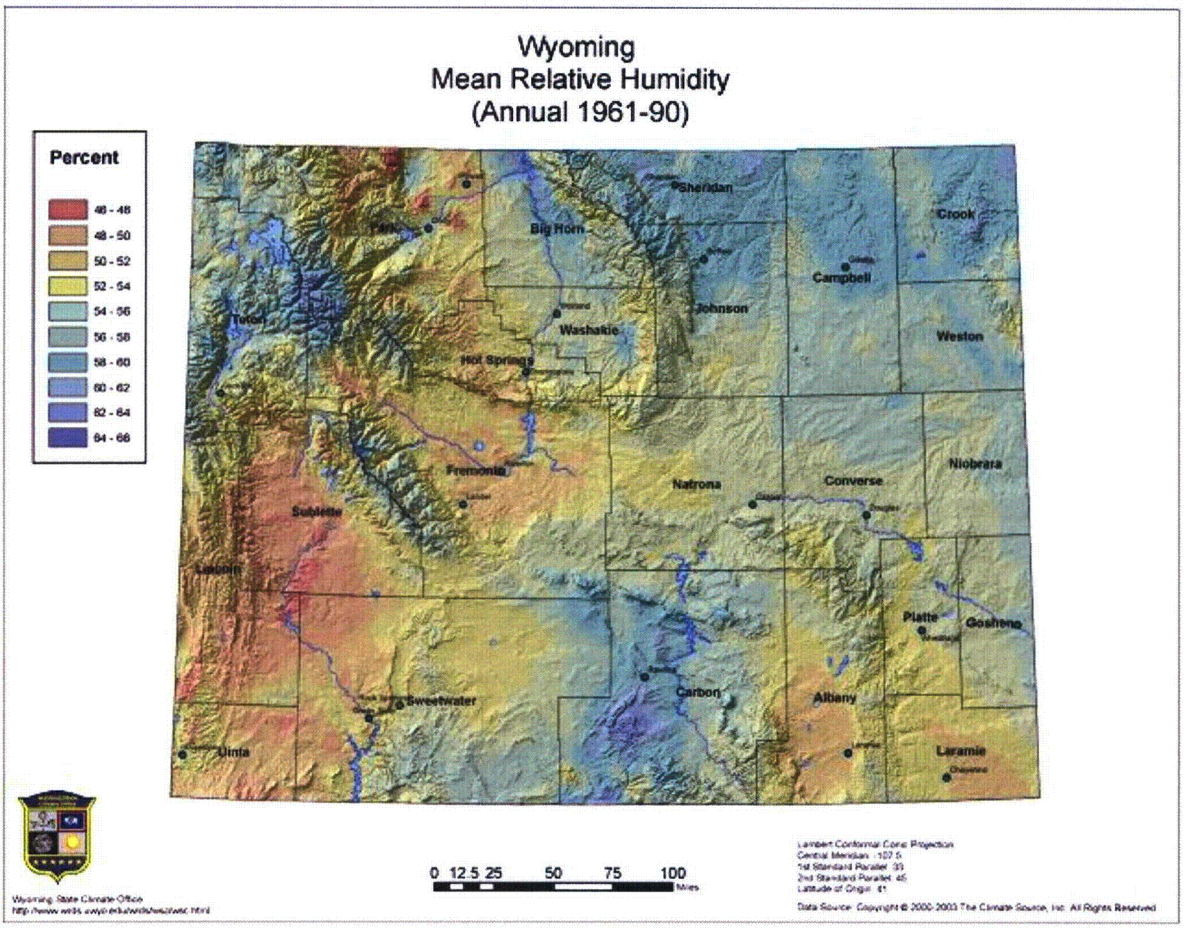
Figure 2.5-5 Regional Annual Average Maximum Temperatures



2.5.2.2 Relative Humidity

The region is characterized by low relative humidity. Summer daytime values typically range from 25 – 30% and can reach extremely low values of 5 – 10%. Summer diurnal variations of 40 – 50% are not uncommon. Winter time variations are usually less extreme than those of summer. This is due in larger part to the higher winds which allows for greater mixing and shorter periods of sunlight which promotes less temperature change. The combination creates diurnal variations of 20 – 25%. The map shown in Figure 2.5-6 presents data taken from the Wyoming Climate Atlas (WRDS, 2007). The region has mean values of 50 – 60%.

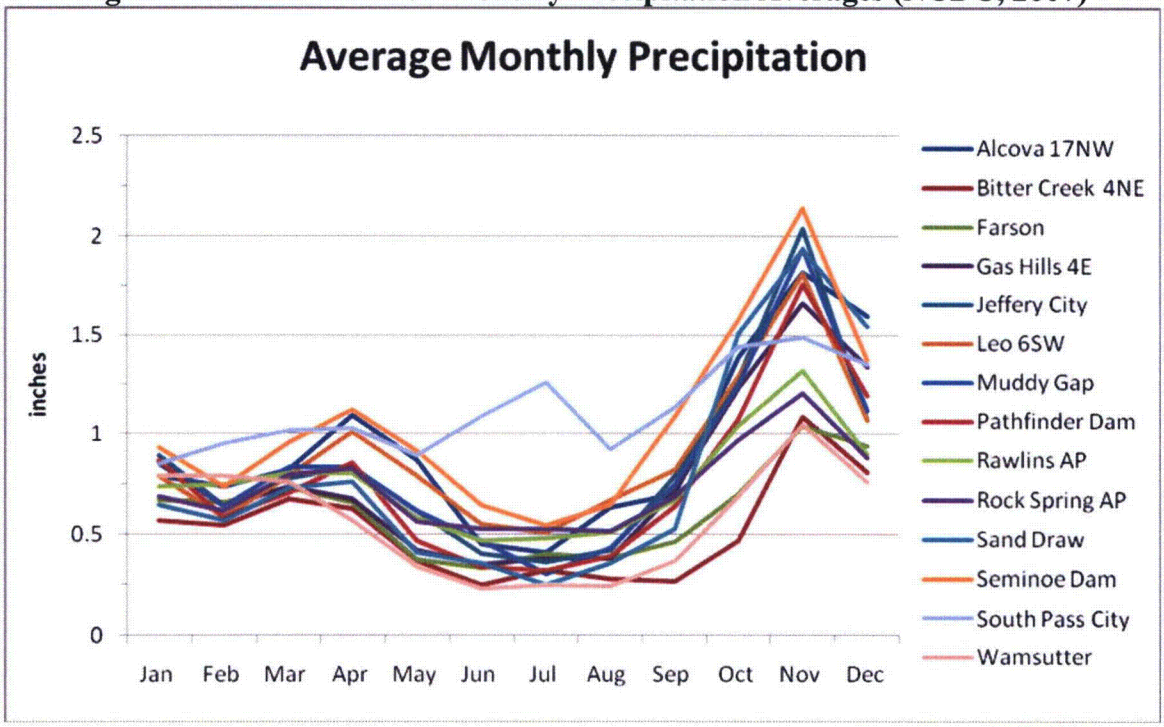
Figure 2.5-6 Mean Monthly and Hourly Relative Humidity for Rawlins AP (WRDS, 2007)



2.5.2.3 Precipitation

The region is characterized by extremely dry conditions. On average, the region experiences only about 80 days with measurable (>0.01 in) precipitation (WRCC, 2007). The proposed project region has an annual average in the 8.5 – 10.5 inch category based on interpolating regional values (Figure 2.5-9). Late fall and early winter (Oct-Dec) precipitation events produce the majority of the precipitation, 40%. November is typically the wettest month of the year; all stations have monthly averages greater than 1 inch for that time as can be seen in Figure 2.5-7 below. January, on the contrary, is the driest month of the year with precipitation totals generally between one half inch and one inch. The summer months (Jul-Sept) typically account for only 15% of the yearly totals. A secondary minimum is also evident during August as warm, dry conditions develop over the course of the summer months. This promotes extremely stable conditions and light precipitation amounts as convective activity is limited.

Figure 2.5-7 NWS Station Monthly Precipitation Averages (NCDC, 2007)



Severe weather does arise throughout the region, but is limited to 3 - 4 severe events per year. These severe events are generally split between hail and damaging wind events. Tornadoes can occur but on rare occasions, with less than one tornado every eight years (Martner, 1986).

Major snowstorms (more than 6 in/day) do frequent the region also. The region experiences one to two of these snowstorms per year. South Pass City has the highest annual snowfall of all the sites with an average of nearly 116 inches. This value is sharply contrasted by four sites having annual averages less than 25 inches. The extremely low averages might be attributed to operator error during the measurements. However, a portion of the disparity between the sites can be attributed to the elevation of South Pass City, located at nearly 8000 ft. above sea level and on average 1500 ft higher than all the other stations included in the study. The interpolated values (Figure 2.5-10) show the project region having averages of 45-50 inches. These values agree well with the Wyoming Climate Atlas (Martner, 1986) which lists averages for northeastern Sweetwater County at 40 inches and southeastern Fremont County having averages of 60 inches. Substantial monthly averages (more than 6 in/month) occur for half the year. "Measurable" averages (>1 in/month) occur an additional three months of the year (Figure 2.5-8).

Figure 2.5-8 NWS Station Monthly Snowfall Averages (NCDC, 2007).

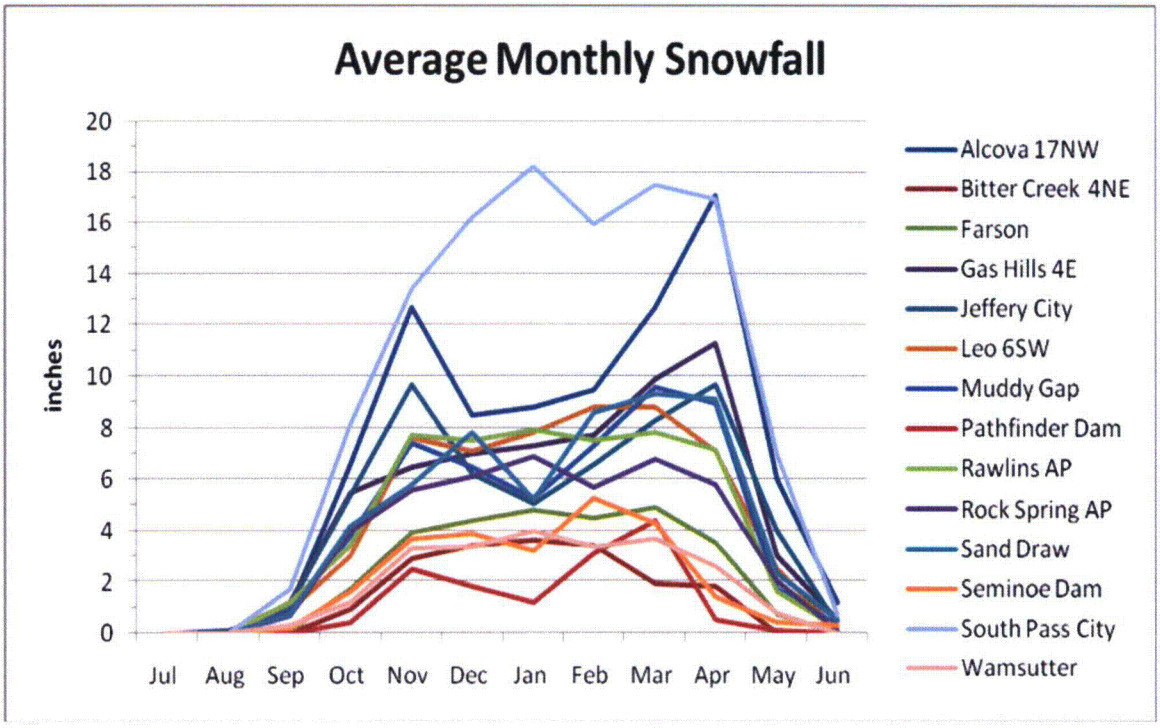


Figure 2.5-9 Regional Annual Average Precipitation

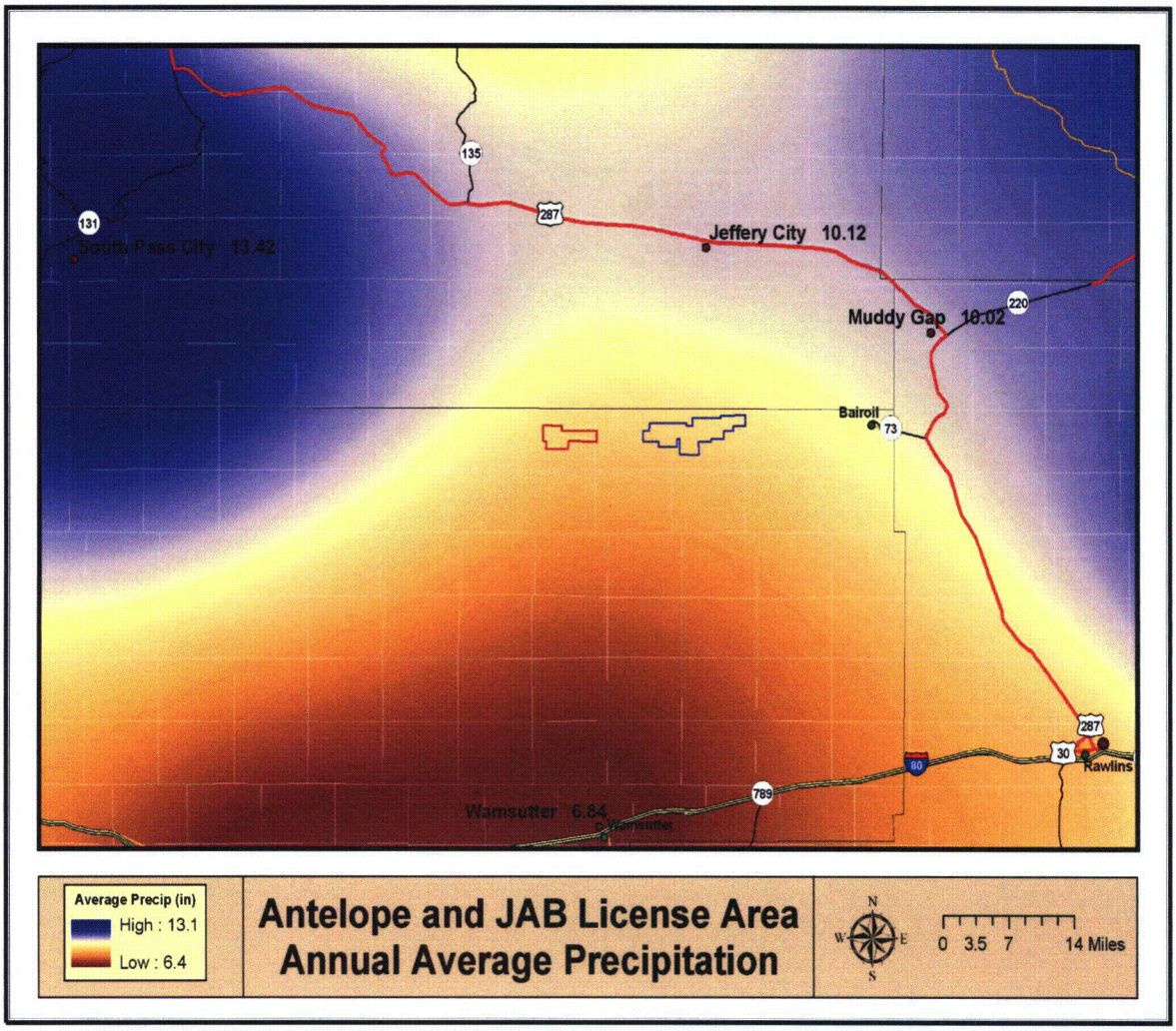
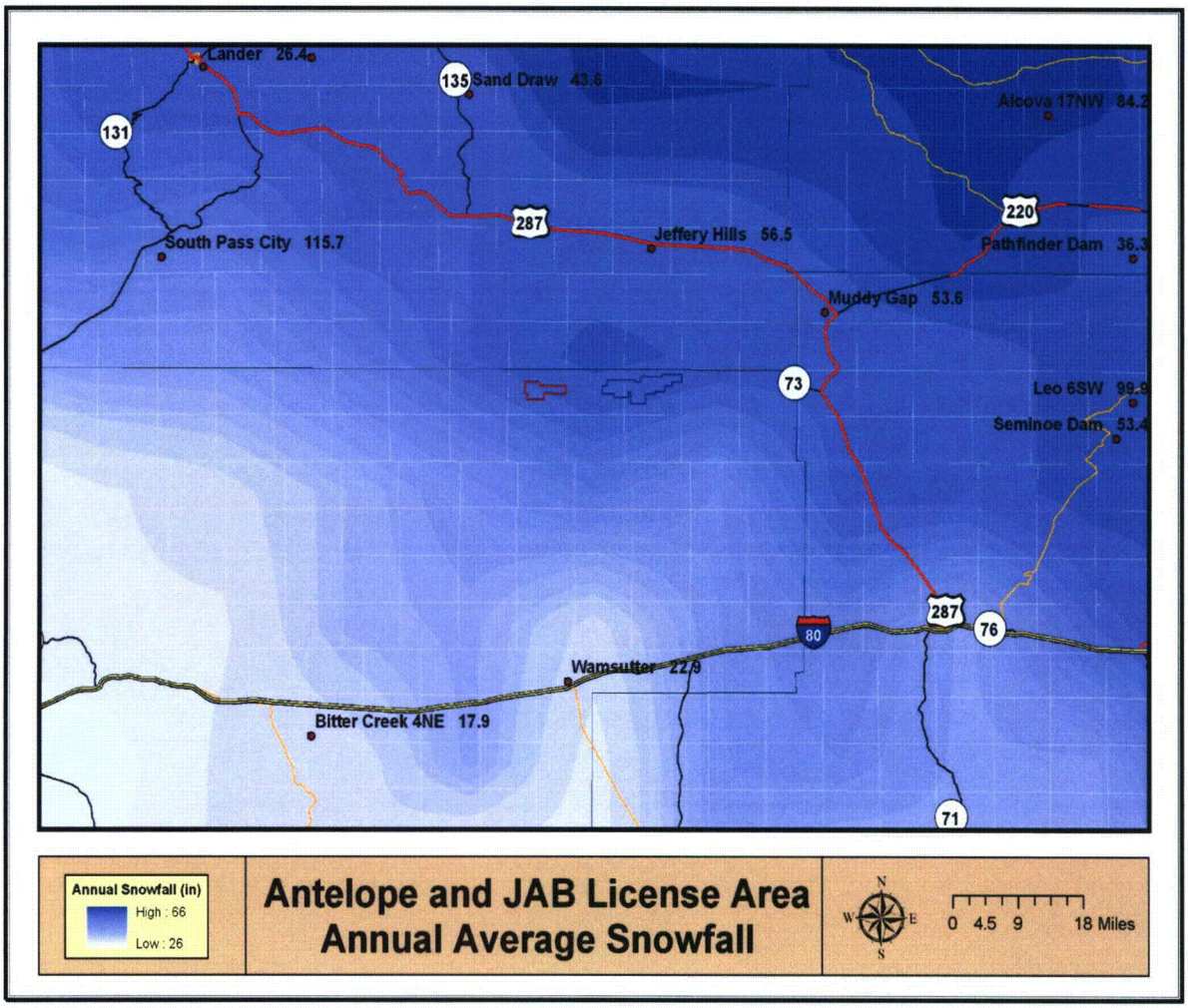


Figure 2.5-10 Regional Annual Average Snowfall



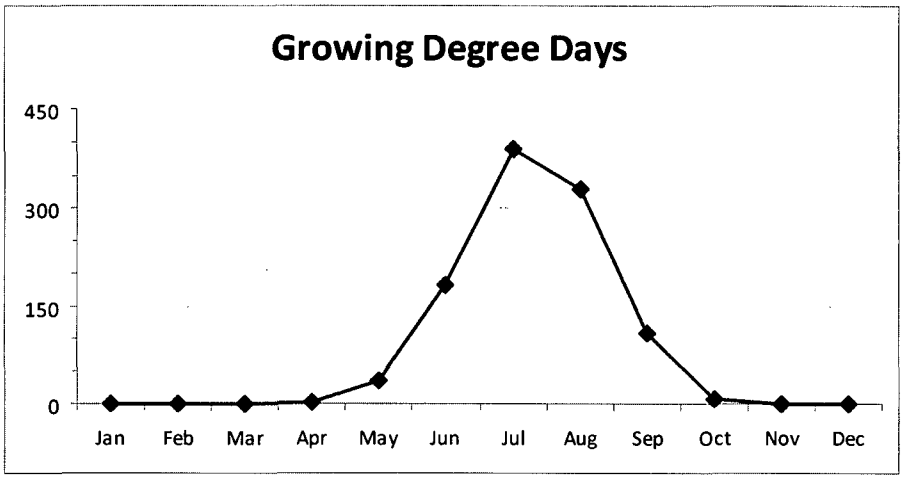
2.5.2.4 Cooling, Heating, and Growing Degree Days

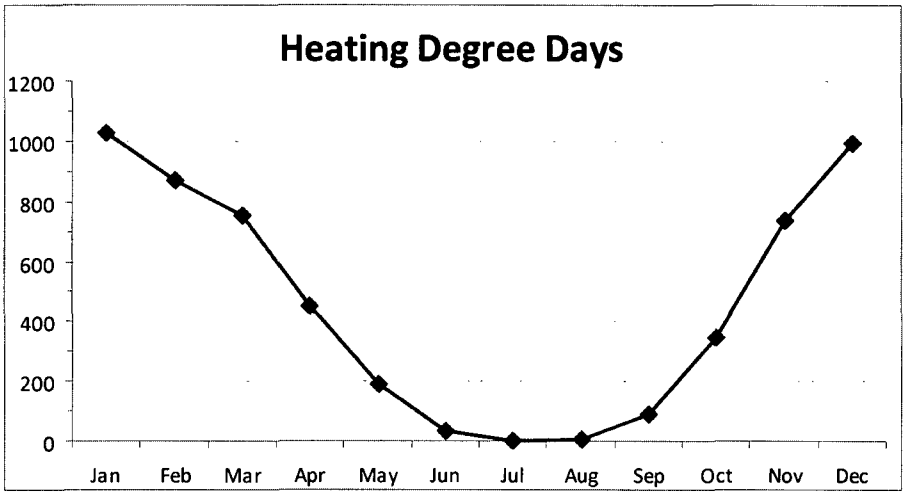
The graphs shown in Figure 2.5-11 summarize the cooling, heating, and growing degree days for Rawlins. The data are assumed to be indicative of the region as the other meteorological parameters for the various sites track very closely.

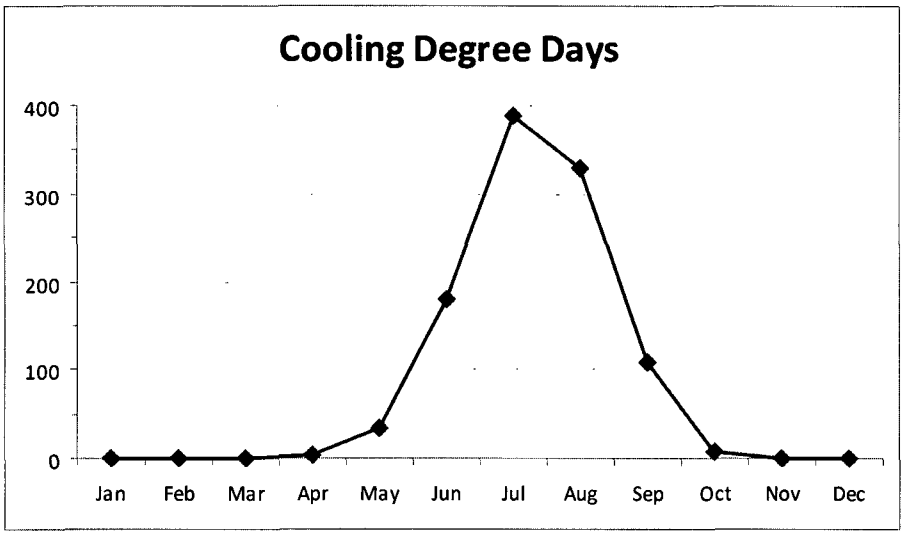
The heating and cooling degree days are included to show deviation of the average daily temperature from a predefined base temperature. In this case, 55 °F has been selected as the base temperature. The number of heating degree days is computed by taking the average of the high and low temperature occurring that day and subtracting it from the base temperature. The calculation for computing growing and cooling degree days is the same. The number of days is computed in the opposite fashion as the base temperature is subtracted from the average of the high and low temperature for the day. Negative values are disregarded for both calculations.

As expected, the heating degree days and cooling degree days are inversely proportional and the number of growing and cooling degree days is identical when the same base temperature is chosen. The maximum number of heating degree days occurs in January, 1029 degree days, which coincides with January having the lowest minimum average temperature. Conversely, July registers the most cooling/growing degree days with 389, which also corresponds to July having the highest maximum average temperature.

Figure 2.5-11 Rawlins Cooling, Heating, and Growing Degree Days (WRCC,2007)


Growing Degree Days
450
300
150
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec


Heating Degree Days
1200
1000
800
600
400
200
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec


Cooling Degree Days
400
300
200
100
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

2.5.3 Site Specific Analysis

The site specific discussion will be limited to the meteorological data from the Seminoe II Mine. As discussed in the Introduction above, this site was chosen as a surrogate site based on its proximity and similar topographic features to the permitted region. This region is characterized by high desert plains with minor ridges. The vegetation types are mainly confined to sage brush. The Seminoe II Mine meteorological station is located on a slight rise with abundant sage brush.

2.5.3.1 Temperature

The annual average site temperature is 42.2° F with a maximum of 93° F and minimum falling to nearly -18° F. Figure 2.5-12 shows the seasonal average temperature for the site. The accompanying Table 2.5-3 provides the maximum, minimum and average seasonal temperatures. Average temperatures range from -25° F in the winter to 63° in the summer.

Table 2.5-4 provides a meteorological summary for the surrogate site. The averages, maximums, and minimums are specified for each parameter recorded at the site along with the recovery rate for each. The recovery rates are 93.6% for all parameters. The high recovery rates reinforce the data as being representative of the conditions present in the region.

Figure 2.5-12. Seminoe II Mine Seasonal Average Temperatures

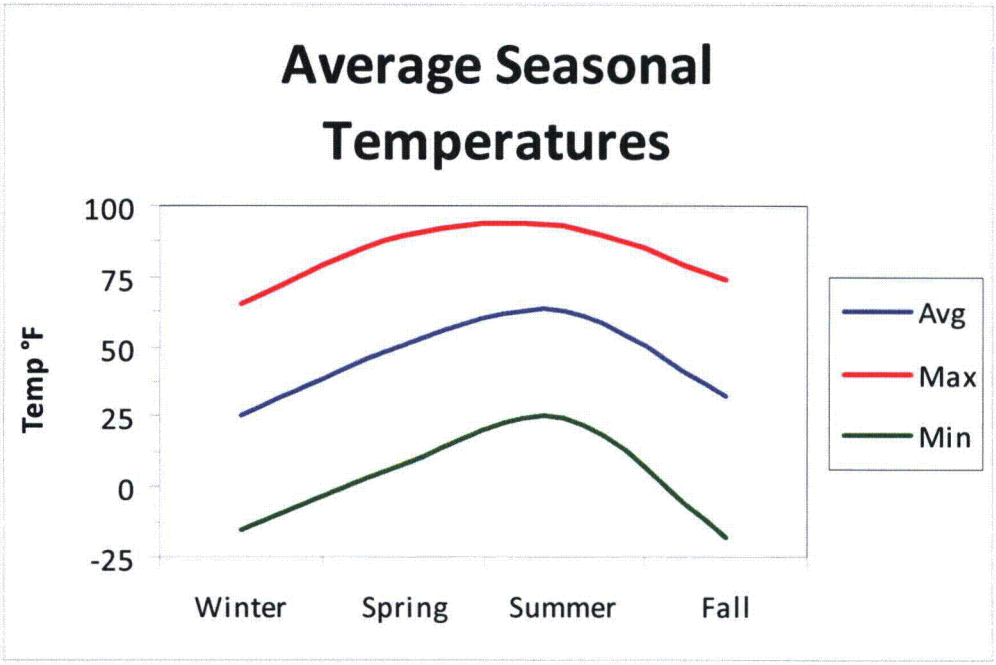


Table 2.5-3 ACC Seminoe II Max, Min, and Average Seasonal Temps (°F)

	Seminoe II Mine		
	Avg	**Max**	**Min**
Winter	25.4	65.7	-15.2
Spring	50.4	90.0	8.2
Summer	63.1	93.0	24.8
Fall	32.1	73.8	-17.7

Table 2.5-4 Seminoe II Mine Meteorological Summary for 2001 – 2005

Hourly Data

	Average/Total	Max	Min
Wind Speed (mph)	14.7	51.2	0.0
Sigma-Theta (°)	12.7	81.1	0.0
Temperature (F)	42.2	93.0	-17.6
Precipitation (mm)	1,196	14.73	

Predominant wind direction was from the WSWsector, accounting for 30.1% of the possible winds

Data Recovery

Parameter	Possible (hours)	Reported (hours)	Recovery
Wind Speed	43824	41020	93.60%
Wind Direction	43824	41020	93.60%
Sigma-Theta	43824	41020	93.60%
Temperature	43824	41020	93.60%
Precipitation	43824	41020	93.60%

2.5.3.2 Wind Patterns

Table 2.5-4 summarizes all of the meteorological data collected at the Seminoe II Mine from 2001 through 2005. Figure 2.5-14 shows the seasonal wind roses for Seminoe II Mine during the same period. The Seminoe II Mine predominant wind direction is west/southwest with a secondary westerly maximum. High Pressure located over the southwestern United States is the culprit for the strong west/southwesterly winds which frequent the region. Spring experiences the greatest variability in wind direction with secondary modes from the northeast and easterly directions. The modes are a result of the synoptic scale transition period that occurs during this time. Low pressure regions develop on the lee side of the Rockies bringing "wrap around" east /northeast winds

during development. As the low pressure systems form and move off with the general atmospheric flow, winds switch back to the southwest.

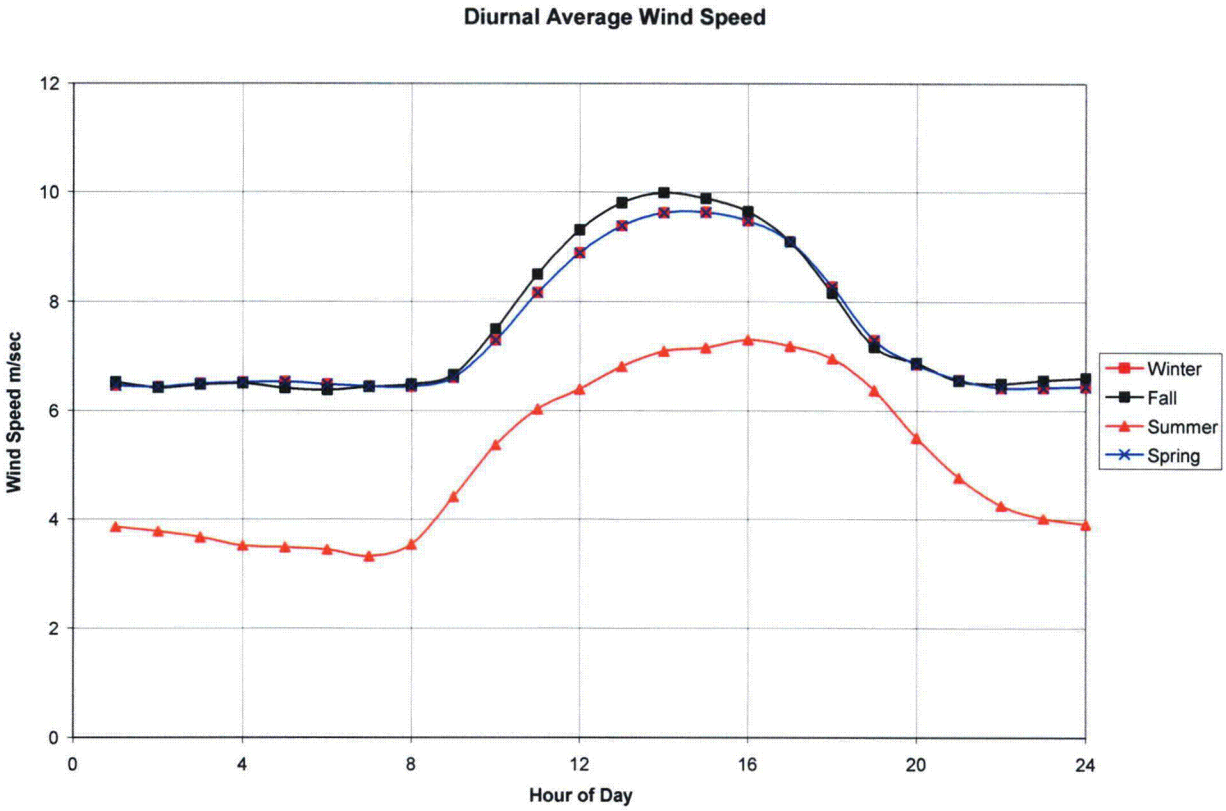
The monthly and seasonal wind speeds are summarized in Figure 2.5-15. The graphs show substantial differences between the winter and summer averages. Late fall and wintertime averages are in the 7-8 m/s (16-17 mph) range while summer time averages dip to 5-6 m/s (low to mid teens mph). Overall, the site experiences differences of 3.5 m/s (approximately 8 mph) from summer to winter months.

The site average wind speed for Seminoe II Mine is 6.55 m/s (14.7 mph) for the five year period analyzed. A closer look at the wind speed, summarized in the Seminoe II Mine wind summary (Table 2.5-5), shows the west/southwesterly component average wind speed is 8.6 m/s (18.4 mph). The values suggest that the predominant wind direction is comprised of high, sustained wind speeds. Maximum hourly averages of greater than 50 mph have been recorded at the mine site. Figure 2.5-16 shows the cumulative frequency wind speed distributions for Seminoe II Mine. It is clearly evident from the graphs that light wind speeds are a rare occurrence.

The diurnal wind speed graph in Figure 2.5-13 shows the highest wind speeds occur during the early afternoon hours while early morning experiences the lowest wind speed averages. The extremes show a difference of close to 4 m/s (8.5 mph). The graph also shows that with the exception of summer the diurnal variation is very uniform.

The Joint Frequency Distribution in Table 2.5-6 is included for the Seminoe II Mine site. The distributions show the frequencies of average wind speed for each direction based on stability class. Nearly seventy percent of all winds at Seminoe II Mine fall into stability class D which represents near neutral to slightly unstable conditions. The light winds which accompany stable environments can be seen by the stability class F summaries (stable) as the site has no wind speed averages greater than 6 knots (6.9 mph). In addition, the low percentage (5.5%) of occurrence of class F shows the region is rarely exposed to extremely stable environments.

Figure 2.5-13. Seminoe II Mine Wind Speed Diurnal Distribution



2.5.3.3 Upper Air Characteristics

The nearest available upper-air data from the National Weather Service are for Riverton, located in central Wyoming. A compilation and screening of hourly data from 2003 through 2007 produced an average morning mixing height of 669 meters (6,379 valid readings) and an afternoon mixing height of 1,162 meters (6,427 valid readings). Morning and afternoon time intervals were taken from EPA modeling guidance.

The Air Quality Division of the Wyoming Department of Environmental Quality (WDEQ-AQD) has provided statewide mixing heights to be used in dispersion modeling with the Industrial Source Complex (ISC3) model. These are based on the methods of Holsworth (1972) as applied to Lander, located in central Wyoming. For modeling purposes, the annual average mixing heights are assigned according to stability class as follows:

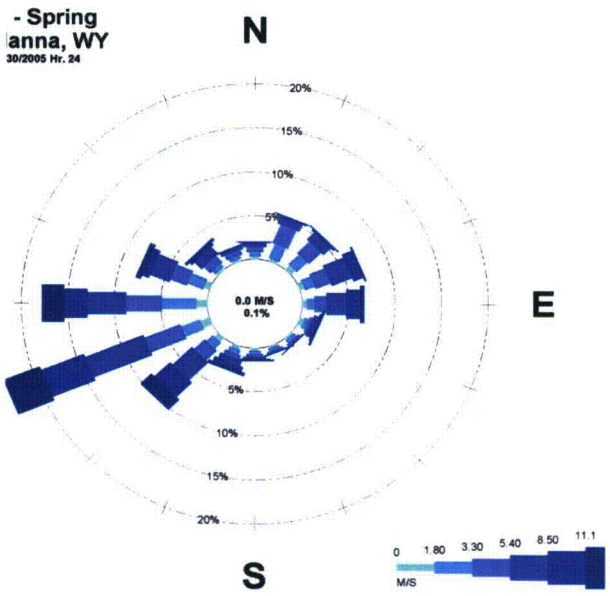
Class A	3,450 meters
Class B	2,300 meters
Class C	2,300 meters
Class D	2,300 meters
Class E	10,000 meters
Class F	10,000 meters

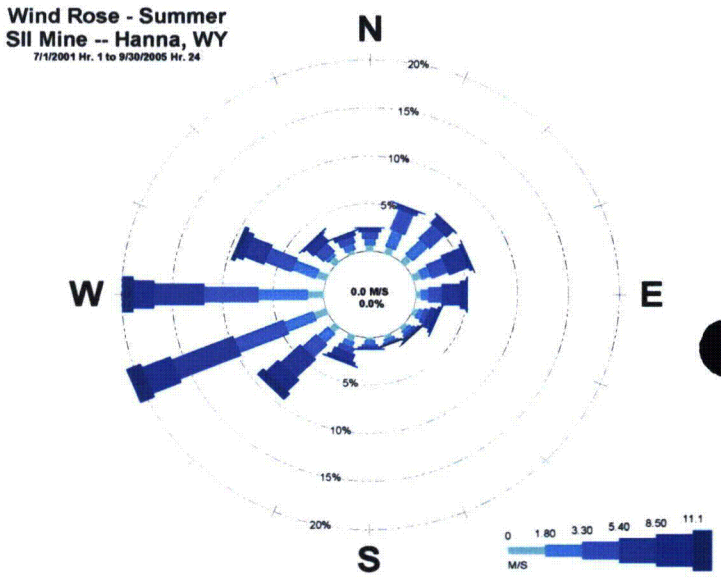
Stability classes E and F are given an arbitrarily high number to indicate the absence of a distinct boundary in the upper atmosphere.

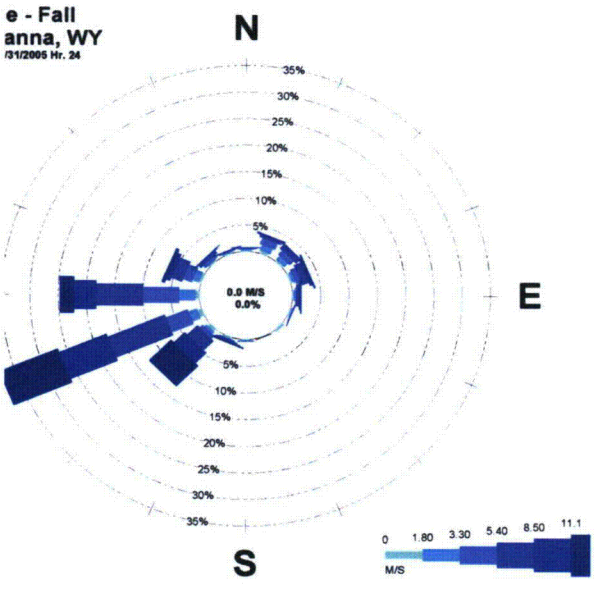
In August of 2000, IML Air Science conducted Sound Detection and Ranging (SODAR) monitoring at the Black Thunder Mine, located in the southern Powder River Basin of eastern Wyoming. The purpose of this monitoring was to support a comprehensive study of NO_x dispersion characteristics following overburden and coal blasting events. The SODAR instrument provided 3D wind speeds, wind directions, temperatures, temperature gradients, and other atmospheric parameters as a function of height above the ground. The vertical range of the SODAR was 1,500 meters, with a sounding performed every 15 minutes. Each sounding resulted in a calculated "inversion height / mixing height" (the two terms are used interchangeably by the SODAR system supplier). These mixing heights were downloaded into a database and queried, resulting in mixing heights of 641 meters in the morning and 1,052 meters in the afternoon. As with the Riverton upper air data, morning and afternoon time intervals were taken from EPA modeling guidance. Although taken only from the month of August, these values show remarkable similarity to the Riverton annual average mixing heights. Neither of these, however, resembles the stability-class-based mixing heights used for ISC3 modeling.

2.5.3.4 Influence of Water Bodies

The nearest significant bodies of water to the project site are Pathfinder and Seminoe Reservoirs. Both are roughly 50 miles from the Antelope and JAB License Area. Seminoe Reservoir is approximately 20 miles from the Seminoe II meteorological site, with Pathfinder being slightly farther. Given the distance and prevailing westerly winds, these water bodies are not believed to exert a significant influence on the meteorology or atmospheric dispersion characteristics of the Antelope and JAB License Area.







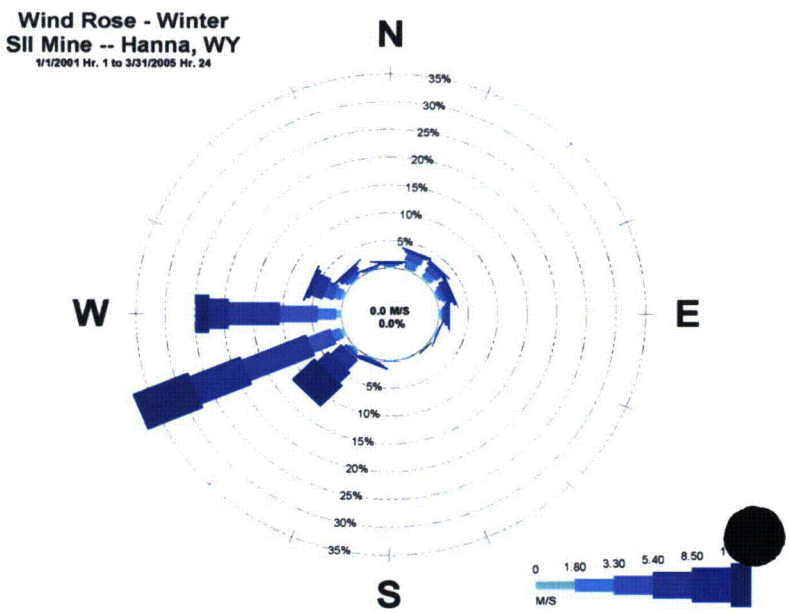
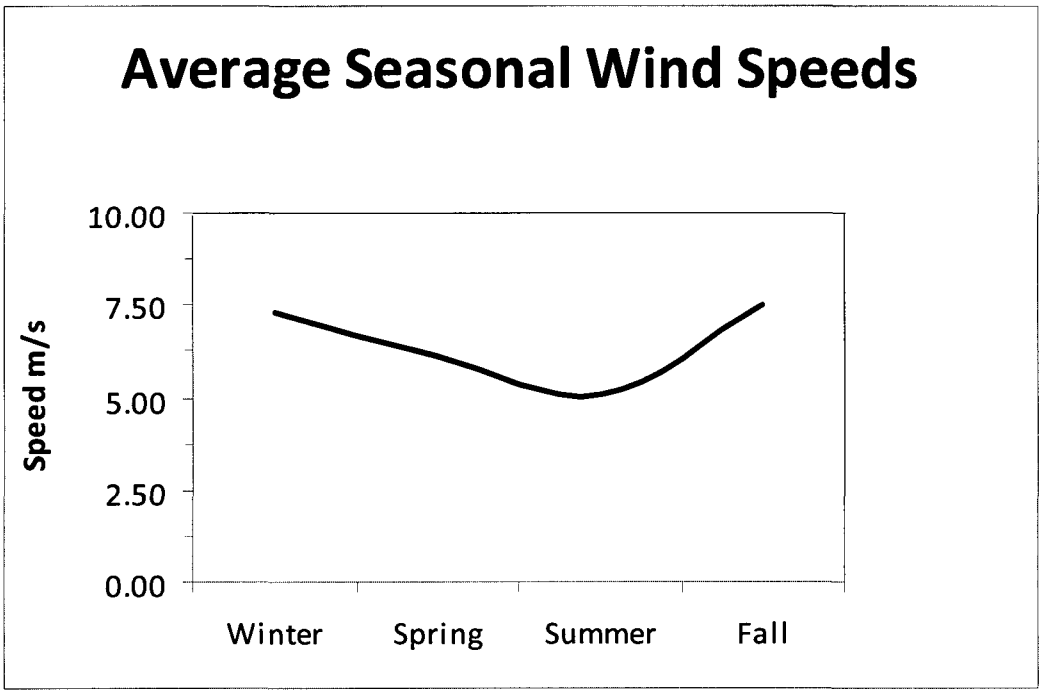


Figure 2.5-14. Seminoe II Seasonal Wind Roses

Figure 2.5-15 Seasonal (top) and Monthly (bottom) Wind Speed Averages for Seminoe II Mine



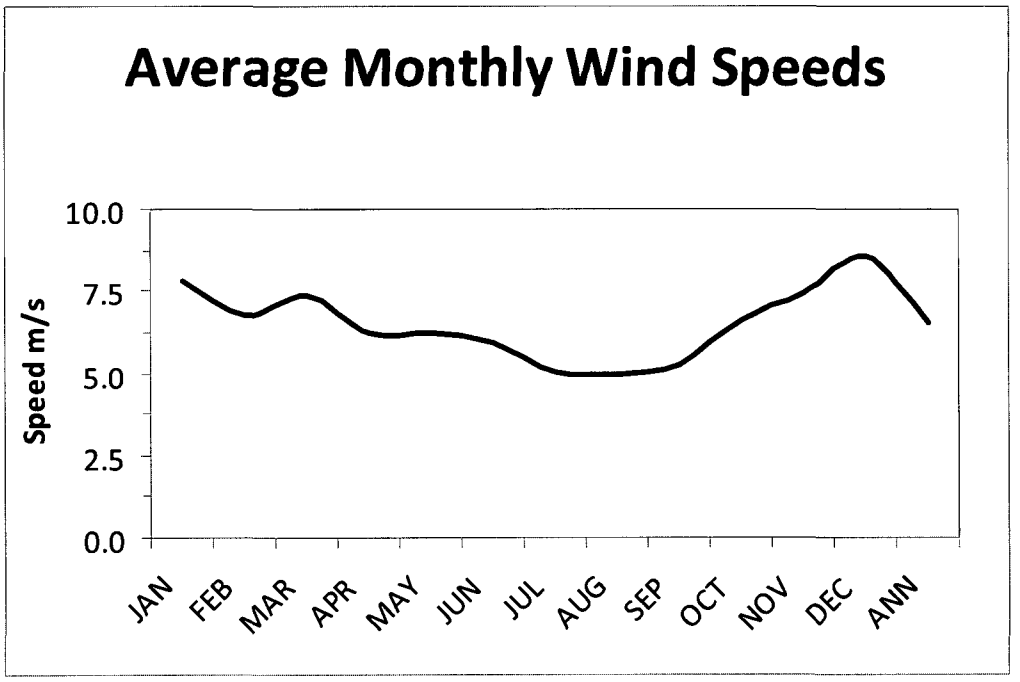


Table 2.5-5 Seminoe II Wind Summary

Seminoe II Mine

Wind Data Summary

1/1/2001 - 12/31/2005

Hourly Data

	Average	Max	Min
Wind Speed (m/sec)	6.55	22.90	-
Sigma Theta (°)	12.74	81.10	-
Wind Direction			
N	4.05	18.51	-
NNE	3.82	12.07	0.38
NE	4.00	11.77	0.20
ENE	5.37	13.92	0.50
E	5.83	17.25	0.15
ESE	4.37	15.31	0.19
SE	3.13	14.69	0.16
SSE	2.96	12.48	0.24
S	3.83	16.79	0.01
SSW	5.50	16.57	0.17
SW	8.64	22.40	0.13
WSW	8.23	22.90	0.30
W	6.23	21.40	0.26
WNW	5.36	21.51	0.40
NW	5.15	15.31	0.30
NNW	4.04	19.12	0.10

Predominant wind direction was from the WSW sector, accounting for 30.1% of the winds, the average wind direction was 263°.

Data Recovery

	Possible (hours)	Reported (hours)	Recovery
Wind Speed	43824	41020	93.60%
Sigma Theta	43824	41020	93.60%
Wind Direction	43824	41020	93.60%

Figure 2.5-16 Seminoe II Mine Wind Speed Distribution for 2001 - 2005

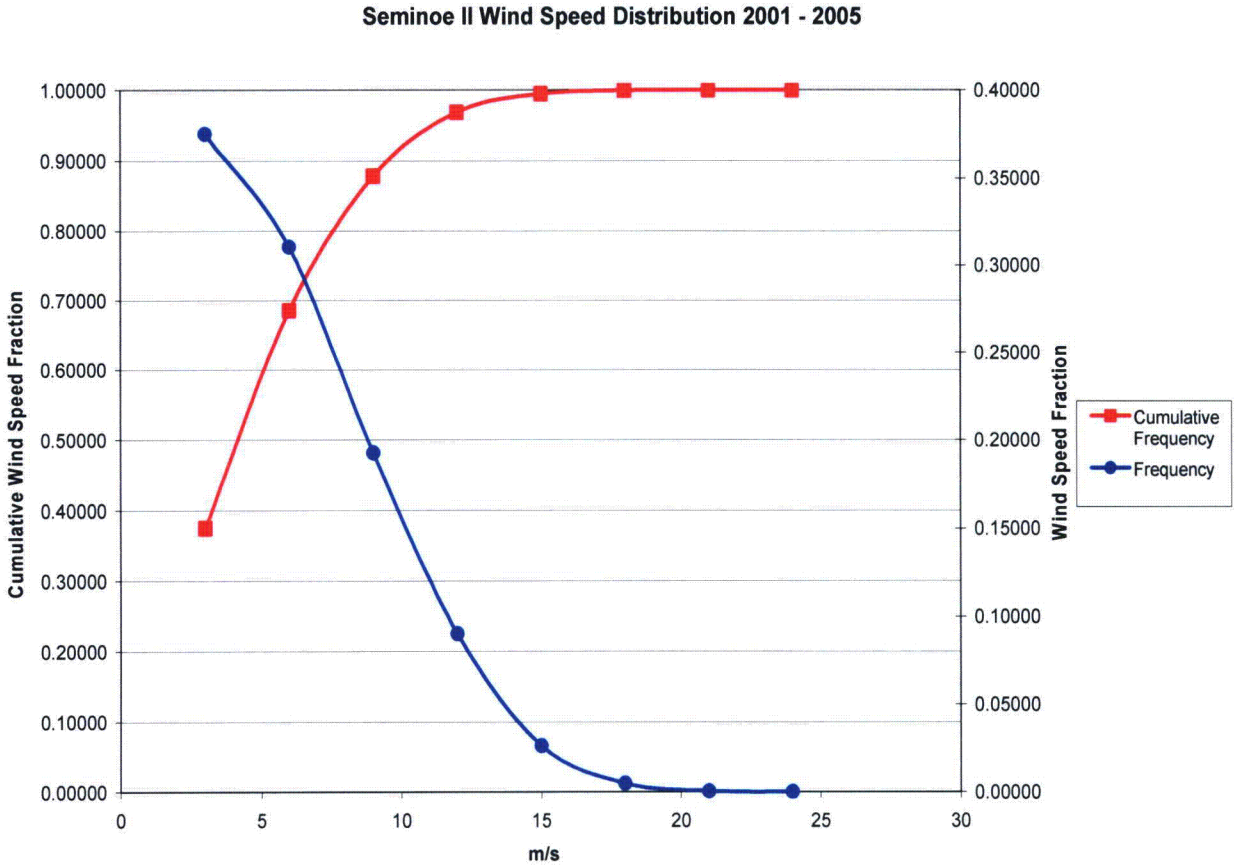


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Table 2.5-6 Joint Frequency Distribution

Seminoe II Mine IML Air Science
Hanna, WY Hourly Average Wind Speed, Wind Direction and Sigma Sheridan, WY
Calm Readings 101 Total Readings 40998 Possible Readings 43824 Data Capture 93.6%
From 1/1/2001 To 12/31/2005

Stability Class A **Wind Speed (Knots)**

Direction	< 3	3 - 6	6 - 10	10-16	16 - 21	> 21	Row Total
E	0.00076	0.00137	0.00068	0.00022			0.00303
ENE	0.00097	0.00156	0.00090	0.00010			0.00353
ESE	0.00115	0.00124	0.00046	0.00012			0.00297
N	0.00048	0.00100	0.00056	0.00012	0.00002		0.00219
NE	0.00061	0.00144	0.00066	0.00007		0.00002	0.00281
NNE	0.00064	0.00166	0.00029	0.00002			0.00261
NNW	0.00028	0.00080	0.00083	0.00007	0.00002		0.00201
NW	0.00056	0.00088	0.00161	0.00061	0.00002		0.00368
S	0.00076	0.00098	0.00041	0.00020	0.00005		0.00240
SE	0.00089	0.00088	0.00034	0.00007			0.00218
SSE	0.00069	0.00061	0.00029	0.00007		0.00002	0.00169
SSW	0.00104	0.00110	0.00076	0.00041	0.00002		0.00334
SW	0.00135	0.00190	0.00154	0.00073	0.00005	0.00002	0.00559
W	0.00104	0.00224	0.00341	0.00173			0.00843
WNW	0.00069	0.00083	0.00324	0.00134	0.00002		0.00613
WSW	0.00148	0.00244	0.00276	0.00102	0.00002		0.00772
Sum	0.01339	0.02093	0.01876	0.00693	0.00024	0.00007	0.06032

Table 2.5-6 GCC Joint Frequency Distribution (Continued)

Stability Class B **Wind Speed (Knots)**

Direction	< 3	3 - 6	6 - 10	10-16	16 - 21	> 21	Row Total
E	0.00018	0.00046	0.00056	0.00022			0.00142
ENE	0.00020	0.00066	0.00051	0.00012			0.00150
ESE	0.00015	0.00027	0.00017	0.00017	0.00002		0.00079
N	0.00005	0.00005	0.00010	0.00007			0.00027
NE	0.00010	0.00039	0.00027	0.00005			0.00081
NNE	0.00008	0.00029	0.00020	0.00017	0.00005		0.00078
NNW	0.00008	0.00010	0.00037	0.00032			0.00086
NW		0.00022	0.00041	0.00088	0.00002	0.00002	0.00156
S	0.00005	0.00005	0.00015	0.00012			0.00037
SE	0.00015	0.00010	0.00017	0.00005	0.00002		0.00049
SSE	0.00005	0.00007	0.00002				0.00015
SSW	0.00018	0.00017	0.00015	0.00029	0.00010	0.00005	0.00093
SW	0.00031	0.00056	0.00088	0.00129	0.00027		0.00331
W	0.00023	0.00059	0.00178	0.00520	0.00107	0.00005	0.00891
WNW	0.00008	0.00034	0.00163	0.00234	0.00037	0.00002	0.00478
WSW	0.00020	0.00088	0.00173	0.00315	0.00051	0.00007	0.00655
Sum	0.00209	0.00520	0.00910	0.01444	0.00244	0.00022	0.03348

Table 2.5-6 GCC Joint Frequency Distribution (Continued)

Stability Class C **Wind Speed (Knots)**

Direction	< 3	3 - 6	6 - 10	10-16	16 - 21	> 21	Row Total
E		0.00041	0.00071	0.00083	0.00015	0.00002	0.00212
ENE	0.00018	0.00061	0.00100	0.00051	0.00012		0.00242
ESE	0.00008	0.00017	0.00020	0.00068	0.00002		0.00115
N	0.00005	0.00012	0.00022	0.00020	0.00002		0.00061
NE	0.00013	0.00107	0.00078	0.00010			0.00208
NNE	0.00015	0.00071	0.00046	0.00017	0.00002		0.00152
NNW	0.00005	0.00012	0.00027	0.00051	0.00010		0.00105
NW	0.00003	0.00007	0.00063	0.00159	0.00029	0.00010	0.00271
S	0.00005	0.00005	0.00022	0.00010	0.00005		0.00047
SE	0.00008	0.00015	0.00010	0.00015			0.00047
SSE	0.00008	0.00002	0.00010	0.00015		0.00002	0.00037
SSW	0.00005	0.00010	0.00022	0.00059	0.00068	0.00012	0.00176
SW	0.00020	0.00078	0.00088	0.00268	0.00268	0.00061	0.00784
W	0.00028	0.00146	0.00312	0.01000	0.00702	0.00498	0.02687
WNW	0.00003	0.00046	0.00112	0.00361	0.00139	0.00056	0.00717
WSW	0.00013	0.00190	0.00381	0.01161	0.00832	0.00310	0.02886
Sum	0.00155	0.00822	0.01383	0.03347	0.02088	0.00951	0.08746

Table 2.5-6 Joint Frequency Distribution (Continued)

Stability Class D **Wind Speed (Knots)**

Direction	< 3	3 - 6	6 - 10	10-16	16 - 21	> 21	Row Total
E	0.00028	0.00156	0.00461	0.01095	0.00646	0.00227	0.02613
ENE	0.00013	0.00220	0.00741	0.01642	0.00632	0.00144	0.03391
ESE	0.00013	0.00078	0.00129	0.00227	0.00134	0.00078	0.00659
N	0.00023	0.00105	0.00246	0.00256	0.00090	0.00049	0.00769
NE	0.00056	0.00581	0.00895	0.01002	0.00198	0.00015	0.02746
NNE	0.00036	0.00495	0.00788	0.00585	0.00178	0.00020	0.02102
NNW	0.00005	0.00063	0.00185	0.00234	0.00046	0.00022	0.00556
NW	0.00013	0.00056	0.00410	0.00607	0.00207	0.00117	0.01410
S	0.00005	0.00022	0.00090	0.00080	0.00037	0.00041	0.00276
SE	0.00008	0.00046	0.00083	0.00056	0.00051	0.00007	0.00252
SSE	0.00013	0.00029	0.00066	0.00046	0.00010	0.00002	0.00166
SSW	0.00013	0.00061	0.00173	0.00366	0.00249	0.00195	0.01057
SW	0.00023	0.00198	0.00666	0.02105	0.02044	0.03512	0.08548
W	0.00087	0.01837	0.03844	0.05203	0.02366	0.01815	0.15151
WNW	0.00071	0.00754	0.00920	0.01534	0.00571	0.00422	0.04271
WSW	0.00061	0.00793	0.02793	0.07435	0.05949	0.07181	0.24211
Sum	0.00466	0.05493	0.12491	0.22474	0.13408	0.13847	0.68179

Table 2.5-6 GCC Joint Frequency Distribution (Continued)

Stability Class E	Wind Speed (Knots)			
E	0.00041	0.00078	0.00144	0.00263
ENE	0.00046	0.00149	0.00185	0.00380
ESE	0.00033	0.00068	0.00037	0.00138
N	0.00025	0.00098	0.00129	0.00252
NE	0.00069	0.00302	0.00459	0.00830
NNE	0.00053	0.00459	0.01017	0.01529
NNW	0.00033	0.00039	0.00076	0.00148
NW	0.00051	0.00061	0.00151	0.00263
S	0.00010	0.00024	0.00027	0.00061
SE	0.00023	0.00044	0.00015	0.00081
SSE	0.00013	0.00010	0.00012	0.00035
SSW	0.00031	0.00049	0.00044	0.00123
SW	0.00051	0.00146	0.00132	0.00329
W	0.00112	0.00763	0.00832	0.01707
WNW	0.00089	0.00456	0.00498	0.01043
WSW	0.00084	0.00373	0.00468	0.00926
Sum	0.00764	0.03120	0.04225	0.08108

Table 2.5-6 GCC Joint Frequency Distribution (Continued)

Stability Class F **Wind Speed (Knots)**

Direction	< 3	3 - 6	6 - 10	10-16	16 - 21	> 21	Row Total
E	0.00122	0.00122					0.00244
ENE	0.00204	0.00161					0.00365
ESE	0.00125	0.00085					0.00210
N	0.00140	0.00156					0.00296
NE	0.00219	0.00234					0.00453
NNE	0.00188	0.00222					0.00410
NNW	0.00158	0.00139					0.00297
NW	0.00191	0.00105					0.00296
S	0.00102	0.00093					0.00195
SE	0.00115	0.00076					0.00190
SSE	0.00081	0.00073					0.00155
SSW	0.00191	0.00120					0.00310
SW	0.00219	0.00193					0.00412
W	0.00349	0.00315					0.00663
WNW	0.00242	0.00207					0.00449
WSW	0.00313	0.00329					0.00642
Sum	0.02958	0.02629					0.05587

Figure 2.5-17 Relationship between Seminoe II Mine and Project Area

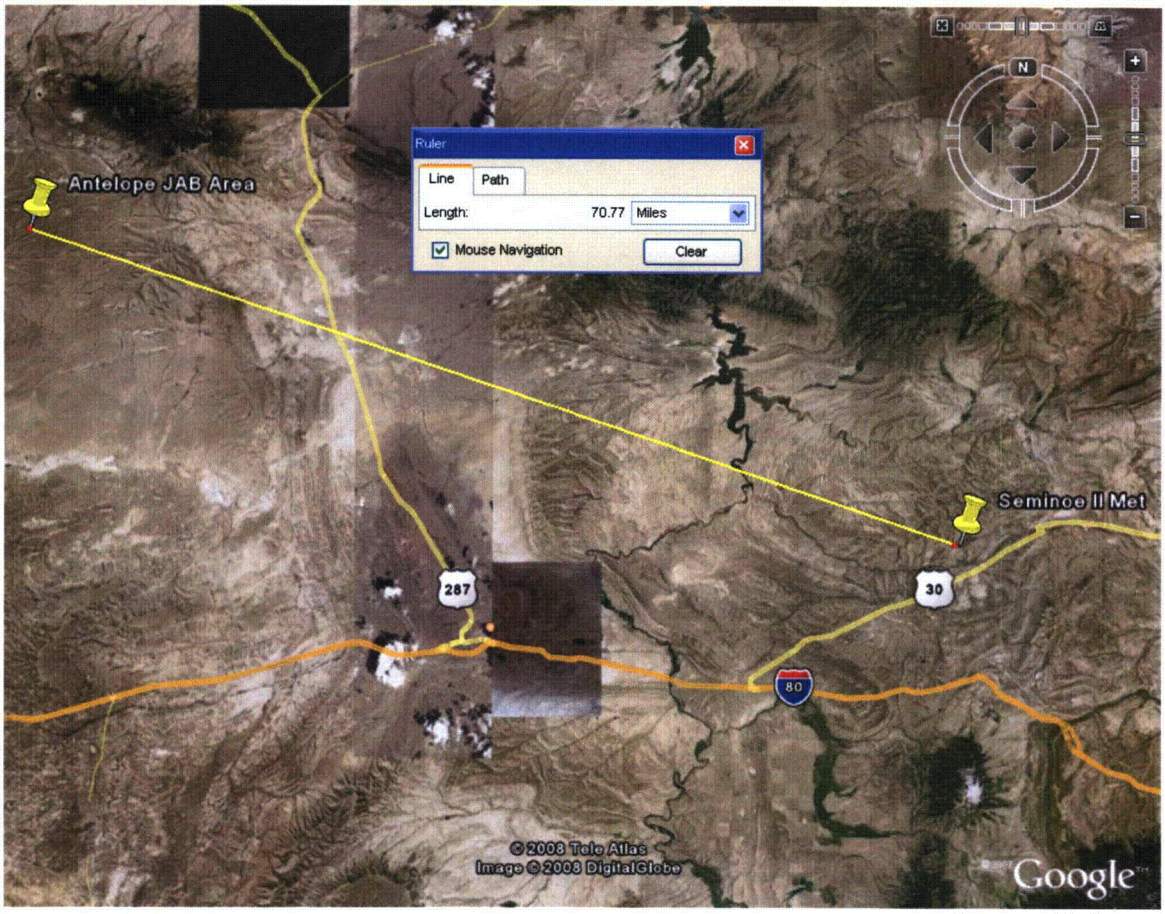

Figure 2.5-18 Geography of Seminoe II Mine and Project Area

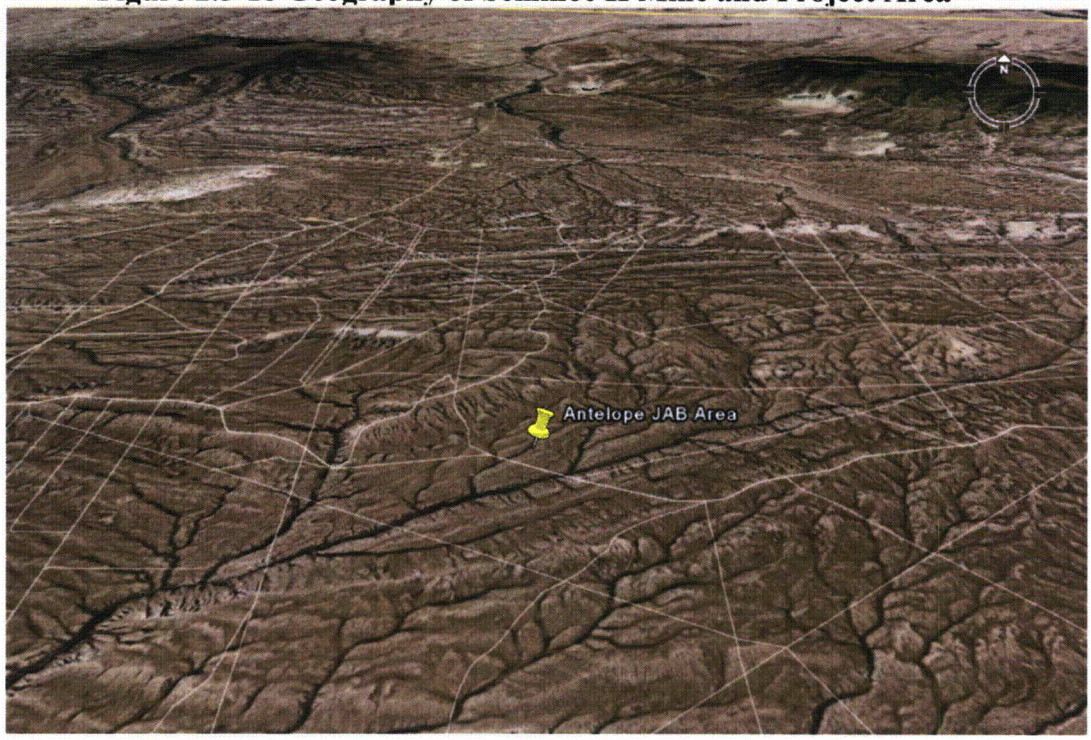

Table 2.5-7 Seminoe II vs. Sweetwater Uranium Project Temperatures

	Seminoe II Mine (2001-2006)			Sweetwater Uranium Site (1991-1993)		
Month	Seminoe Average Temperature (°F)	Seminoe Avg. Daily Maximum Temperature (°F)	Seminoe Avg. Daily Minimum Temperature (°F)	Sweetwater Average Temperature (°F)	Sweetwater Avg. Daily Maximum Temperature (°F)	Sweetwater Avg. Daily Minimum Temperature (°F)
January	23.8	41.0	4.2	13.3	24.8	1.8
February	21.4	39.7	-2.3	17.3	29.8	4.8
March	30.0	52.7	8.9	31.7	41.5	21.9
April	40.8	62.5	21.2	36.9	47.1	26.8
May	49.9	73.0	29.1	49.6	61.2	38
June	60.5	83.5	39.2	58.0	71.5	44.5
July	70.0	88.7	50.8	59.6	73.5	45.8
August	65.0	84.0	47.5	60.4	75.3	45.4
September	54.8	76.0	34.5	53.2	68.0	38.4
October	42.6	65.7	22.8	42.0	57.3	26.8
November	29.9	50.6	11.1	23.4	33.0	13.9
December	22.4	39.6	2.1	13.9	25.0	2.8
Annual Average	42.6	63.1	22.4	38.3	50.7	25.9

Figure 2.5-19 Precipitation at Seminoe II Mine and Muddy Gap

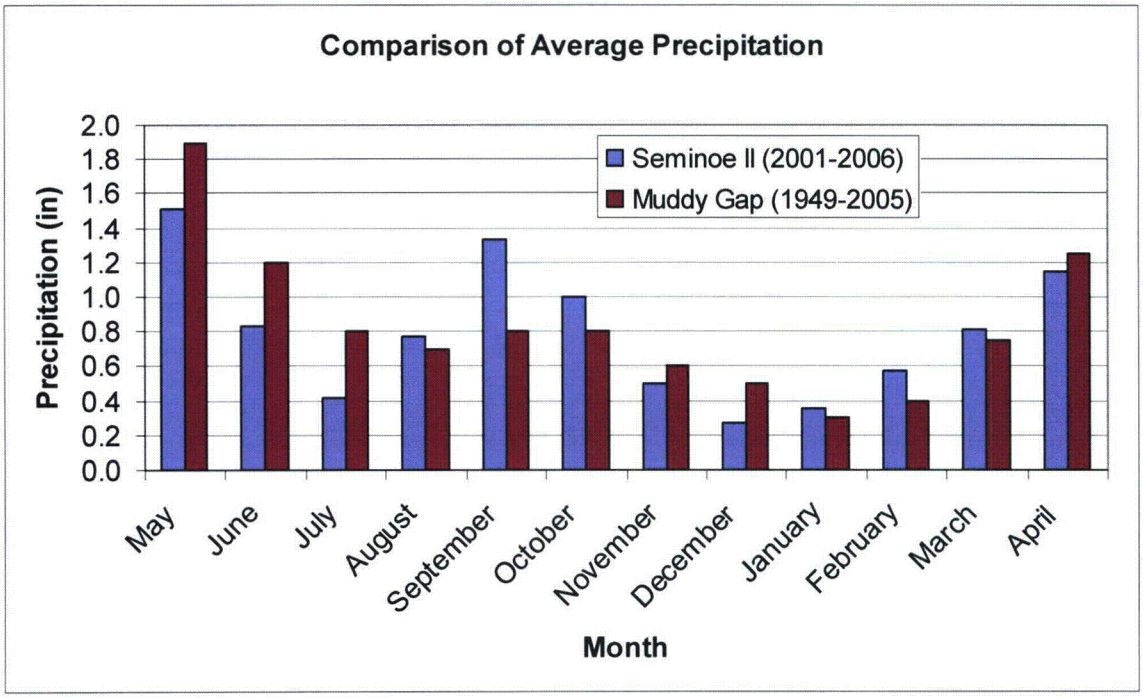

TABLE 2.5-8

Seminoe II	10m tower	CR10 Data Logger		Lat: 41° 53' 24" Elev. 6,890 ft Long: -106° 32' 24"	
Parameter	**Instrument**	**Range**	**Accuracy**	**Threshold**	**Instrument Height**
Wind Speed	RM Young Wind Monitor AQ	0-112 mph	±0.4 mph or 1% of reading	0.9 mph	10 meters
Wind Dir	RM Young Wind Monitor AQ	0-360°	±3°	1.0 mph	10 meters
Temp	Fenwall Electronics Model 107	-35°- 50° C	±0.5° C @ given Range	--	2 meters
Precip	Met One 12" tip	Temp: -20° - 50° C	±0.5% @ 0.5 in/hr rate	--	1 meter

2.5.4 References

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LIST OF ADDENDUMS

2.6 Geology

2.6 Geology

All figures and table discussed in Sections 2.6-1 through 2.6-4 are presented in Addendum 2.6-A at the end of Section 2.6.

2.6.1 Regional Geology

The Antelope/JAB property lies within the northern portion of the Great Divide Basin. The Great Divide Basin is an oval shaped hydrologically closed basin bounded on the north by the Granite Mountains and the Wind River Mountains, on the south by the Wamsutter Arch, on the west by the Rock Springs Uplift, and on the east by the Rawlins Uplift (Figure 2.6-1). The Great Divide Basin was developed during the Laramide Orogeny followed by Tertiary basin fill. These Tertiary deposits constitute up to 15,000 feet of sediments overlying Cretaceous and older rocks within the Basin.

The Tertiary Paleocene Fort Union Formation unconformably overlies the Cretaceous Lance Formation. The Fort Union consists of up to 6,200 feet of interbedded lacustrine shales, and fluviatile siltstones and sandstones and can contain local lignite beds.

The Tertiary Eocene Battle Springs Formation unconformably overlies the Fort Union Formation. The Battle Springs consists of some 6,500 feet of alluvial fan type sediments, primarily being fine to coarse grained arkosic sandstones, shales, siltstones and some conglomeratic units. The source of the sediments is believed to have been the Granite Mountains to the north.

The Battle Springs Formation is gradational and interfingers with the Wasatch Formation in the western Great Divide Basin southwest of the JAB area. The Wasatch Formation consists of lacustrine and paludal sediments of shales, siltstones, and sandstones.Figure 2.6-2 shows the stratigraphic column of the Great Divide Basin. Pliocene pediment deposits are present within the northern portion of the Great Divide Basin.

The JAB and Antelope properties lie along the southern flank of a long anticlinal fold in the northeast corner of the Great Divide Basin known as the Antelope Arch. The Antelope Arch is an extension of the Wind River Mountain uplift to the west and contains a number of large scale deep seated normal and reverse faults. These large scale faults are mostly masked by the Tertiary sediments covering the basin and are not usually projected to the surface.

Smaller scale faulting does occur within the Tertiary sediments throughout the basin and one such fault occurs at the JAB Project with as much as 80 feet of displacement. No

faulting has been observed at the Antelope property, but that is not to say that some shallow faults do not exist within proximity to the permit area.

2.6.2 Site Geology

The Eocene Battle Springs Formation is the host of the uranium deposits at the Antelope/JAB project area. It is approximately 6500' thick and is comprised of alluvial fan sediments primarily being fine to coarse grained arkosic sandstones, shales, siltstones and some conglomeratic units. The source of the sediments is believed to have been the Granite Mountains to the north.

The Battle Springs Formation is gradational and interfingers with the Wasatch Formation in the western Great Divide Basin southwest of the JAB area. The Wasatch Formation consists of lacustrine and paludal sediments of shales, siltstones, and sandstones. The Battle Springs Formation dips at a low angle 2-5 degrees toward the south in both areas.

2.6.2.1 JAB Area Site Geology

The JAB Permit Area is located near the north-central part of the Basin. Geological cross sections throughout the Permit Area are shown in Figures 2.6-3 through 2.6-6. Figure 2.6-7 contains copies of a typical geophysical log from the Permit Area.

The primary stratigraphic unit in the Permit Area is the Battle Spring Formation, which is the host to uranium mineralization. The Battle Springs Formation is overlain by erosional remnants of the Laney Member of the Green river Formation and the Bridger Formation in the far southwest portion of the Permit Area. The Battle Spring Formation in the Permit Area was deposited by a large alluvial fan system, consisting of deposits of very fine to very coarse grained arkosic sandstones with interbedded thin shales, mudstones, and localized conglomerates. The lithology of the Battle Springs Formation varies greatly, both laterally and vertically, which is typical of an alluvial fan deposit. For the purpose of this report, the discussion of the local Permit Area site geology will be limited to five units: The Underlying Sand Unit, the Lower Confining Unit, the Mineralized Unit, the Upper Confining Unit, and the Overlying Sand Unit. They will be discussed, starting with the Lower Sand Unit and progressing upward in the sequence.

The Underlying Sand Unit is a fine to coarse grained arkosic sandstone with thin, interbedded shale and mudstone layers. This unit ranges from two to thirty four feet thick in the Permit Area, with approximately fifteen feet in thickness the average. The Underlying Sand Unit is a typical alluvial fan channel deposit. The variations in the sand thickness are indicative of the channels of the alluvial fan moving laterally and vertically

over time. The interbedded shales and mudstones represent lower energy flood plain and sheet flow deposits, more distal from the main channel deposits.

The Underlying Confining Unit is a carbonaceous shale. The carbonaceous shale is a member of the Wasatch Formation that is inter-tongued with the arkosic sands of the Battle Springs Formation. The carbonaceous shale is a lacustrine – plaudal deposit, indicating a period of non-erosion from the ancestral Granite Mountains to the north, and a concurrent period of regional subsidence, allowing the expansion of the ancient lakes to the south of the Permit Area. This theory is supported by the thickening of the carbonaceous shale unit to the south and southwest of the Permit Area. In the Permit Area the carbonaceous shale is between six and thirty feet thick, with ten to twelve feet thick the average. The carbonaceous shale may also be the primary reducing agent responsible for the formation of the roll-front deposit.

The Mineralized Zone is a typical alluvial fan channel deposit consisting of fine to very coarse grained arkosic sands. The Mineralized Zone ranges from twenty-two to fifty four feet thick in the Permit Area, with thirty five to forty feet thick the average. The sand units are fairly thick, with the lowest sand unit ranging from eight to 10 feet thick. The remaining sands are separated by thin interbedded clay and mudstone units.

The Upper Confining Unit is a thinly interbedded sandstone, shale, and mudstone unit. This unit represents the over bank and sheet flow deposits that are deposited away from the main channel deposition areas. It is part of the normal, fining upward sequence of an alluvial fan depositional sequence. The Overlying Confining Unit ranges from three to thirty three feet thick in the Permit Area, with ten to fifteen feet thick the average.

The Upper Sand Unit is a typical alluvial fan channel deposit consisting of fine to coarse grained arkosic sands. The sand units are separated by thin shale and mudstone layers. This unit ranges from four to twenty three feet thick in the permit area with ten feet being the average.

There is little geologic structure of the Permit Area. The regional dip in that part of the Great Divide Basin is approximately five degrees to the southwest. There is one fault that has been identified in the Permit Area. It is a normal, high angle, scissor fault, with displacement that ranges from zero to eighty feet in the Permit Area. The fault has a trend of east – west, with the displacement increasing to the east. This fault may be associated with the Chicken Springs Fault System located to the east of the Permit Area. The fault serves as the northern boundary of the mineralized zone, and may be a controlling factor in the formation of the roll front deposit, however, it is not clear at this time what role the fault had in the formation of the deposit.

The fault appears to act as a hydrologic barrier. Pump tests performed in 1981 and 2008 showed little to no water lever change across the fault and that the underlying sand north of

the fault is not readily connected to the production sand. The extent and magnitude of hydraulic communication in this area will be further defined during wellfield specific testing and additional operational controls and monitoring in the underlying area may be proposed based on results of those tests.

Isopachs of the underlying sandstone, underlying shale, production sand, overlying confining unit and overlying sandstone are shown in Figures 2.6-8 through 2.6-12.

2.6.2.2 Antelope Property

The mineralized units at Antelope are also contained within the fluvial sandstones of the Battle Springs Formation. Some of the individual sand units had been assigned alphabetic designations by Teton Exploration on their Lee Claims during the 1970's and 1980's. The letter designations decrease with depth. These units, as well as shallower and deeper units have been re-designated with a numbering system from 0-250 by Uranium One. Many of these units have been lumped together as sand packages with underlying and overlying confining units.

The sand packages are designated the 40-10 Sand, 90-50 Sand, 140-100 Sand, 190-150 Sand, 240-200 Sand from lowermost unit to the uppermost respectively. The confining units are designated the 05 Shale, 45 Shale, 95 Shale, 145 Shale, 195 Shale and 245 Shale from lowermost unit to uppermost respectively. See Type Log in Figure 2.6-13.

The 05 Shale confining unit is composed of green-grey shale and some siltstone. It is 8-18' thick, averaging 14' and is presumed to be continuous throughout the Antelope property (Figure 2.6-14).

The 05 Shale is overlain by the 40-10 Sand. It is 257-314' thick, averaging 287' and consists of very fine to coarse grained arkosic sandstone with interbedded green-grey shale and siltstones (Figure 2.6-15). It often contains abundant pyrite.

The 45 Shale overlies the 40-10 Sand and is 5-25' thick, averaging 14' and appears to be continuous throughout the Antelope area. It is composed of green-grey shale and siltstone (Figure 2.6-16).

The 90-50 Sand overlies the 45 Shale and is 233-371' thick and averages 284'. It consists of arkosic, very fine to coarse grained sandstone with interbedded green-grey shales and siltstones, and can contain abundant pyrite. Figure 2.6-17 shows the isopach map of the 90-50 Sand.

Overlying the 90-50 Sand is the 95 Shale. It is 3-35' thick, averaging 14' and consists of green-grey shale and siltstone. It is laterally continuous throughout the permit area (Figure 2.6-18).

The 95 Shale is overlain by the 140-100 Sand. It is 219-405' thick, averaging 291' and consists of arkosic and quartzose very fine to very coarse grained sandstsone with interbedded shale and siltstones. The shale can range in color from green-grey to pale purple. Minor black chert and pebble conglomerate layers can also be present and the unit often contains some pyrite. (Figure 2.6-19).

The 145 Shale overlies the 140-100 Sand and is 4-30' thick, averaging 12' and consists of greenish-gray shale. It is laterally continuous throughout the permit area (Figure 2.6-20).

The 190-150 Sand overlies the 145 Shale and is 167-322' thick, aveaging 252'. It consists of arkosic very fine to very coarse grained sandstsone with interbedded shale and siltstones. It contains minor black chert, and minor to moderate pyrite. Along the northern edge of the permit area, the 190-150 Sand is exposed at the surface and the top portion has been partially eroded (Figure 2.6-21).

The 195 Shale overlies the 190-150 Sand and is 4-43' thick, averaging 14' and consists of greenish-gray shale. It is exposed on the surface and has been eroded in the northernmost edge of the permit area. Where it has not been removed by erosion it is laterally continuous (Figure2.6-22).

Overlying the 195 Shale is the 240-200 Sand. It is 205-298' thick, averaging 254' and consists of arkosic very fine to very coarse grained sandstsone with interbedded yellow, purple, and greenish-grey shale. Pebble conglomerate can be present at the base of the individual channel sand units. Minor chert and pyrite can also be observed. A complete section of the 240-200 Sand is present in the southern two-thirds of the permit area, but becomes an erosional surface in the northern third (Figure 2.6-23).

Overlying the 240-200 Sand is the 245 Shale. It is 5-25' thick, averaging 12' and consists of gray shale and siltstone. Color can vary from green-grey, pale purple and yellow. The 245 Shale is present in the southern portion of the permit area, but has been removed by erosion in the north (Figure 2.6-24).

Units above the 245 Shale are arkosic very fine to very coarse grained sandstones with interbedded shale and siltstones. These units are present in only the southern portion of the Antelope permit area as they have been eroded in the northern portion.

Figures 2.6-25 through 2.6-33 show cross sections through the Antelope Project area.

2.6.3 Ore Mineralogy and Geochemistry

Uranium mineralization within the Battle Springs formation generally occurs as roll front and tabular type deposits within the Great Divide Basin. Oxygenated groundwater carrying dissolved uranium migrates down dip through the sandstone units. It oxidizes

the contained pyrite as well as alters the feldspar minerals to clay minerals, typically kaolinite, and changes the sandstone color from gray to a buff, pink, yellow or greenish gray. Uranium minerals are then precipitated out of solution as the groundwater encounters reducing conditions. Reducing conditions occur where the sediments contain organic matter, or through the migration of hydrocarbon bearing solutions.

Typical uranium minerals for these types of deposit include uraninite and coffinite and occur as sub-microscopic grains intergrown with pyrite, as coatings on individual sand grains and as interstitial pore fillings.

The mineralization at the JAB and Antelope area occurs from near surface to 1,200 feet deep. At JAB the primary deposit is from 150-310 feet deep and averages approximately 225 feet deep. The mineralization at JAB averages approximately 10 feet thick with an average grade of .065% U3O8 at a 0.10 GT cutoff.

The mineralization at the western portion of the Antelope property varies from 300-600 feet deep and averages 430 feet. Mineralization is primarily contained within the 240-200 Sand, 190-150 Sand and the 140-100 Sand units, although potential for deeper mineralization exists. The thickness of the mineralization averages 7.5 feet with an average grade of .089% U3O8.

The mineralization at the eastern portion of the Antelope property varies from 200-400 feet deep averaging 300 feet. It is primarily contained within the 290-150 Sand and 140-100 Sand units, again with deeper potential.

2.6.4 Drill Holes

The JAB property was extensively explored in the 1970's and 1980's with the principle exploratory work and drilling completed by Union Carbide Corporation Mining and Metals Corporation (UCC). UCC conducted extensive drilling on the lands currently held by Uranium One including the delineation of 3 mineralized areas with drilling on 50 foot centers and/or on 50 by 100 foot centers. The available historic data includes radiometric and chemical assay data from some 1,560 drill holes completed on the property. It is not known if these holes were plugged in accordance with Wyoming statutes in effect at the time.

Several other companies explored through drilling in the area as well. Wold Nuclear, Climax Uranium, Kerr-McGee Nuclear and possibly others. Climax Uranium drilled a number of holes in the area including 11 holes within the permit area. Apparently Wold Nuclear acquired the property from Climax, and had washed out some of their holes and re-logged them. Wold either washed out or drilled a total of 15 holes within the JAB permit area as well as additional holes outside the permit area. Teton Exploration drilled 7 holes on their DJ claims just north of the permit area and Kerr-McGee drilled at least

one hole within the permit area. It is not known if these holes were plugged in accordance with Wyoming statutes in effect at the time.

At least 56 other holes were drilled in the southwest portion of the JAB permit area, as seen from field observation and Google Earth satellite photos, but the company or companies involved are unknown at this time. It is not known if these holes were plugged in accordance with Wyoming statutes in effect at the time.

Uranium One conducted verification drilling at JAB in 2007 totaling 264 drill holes, 1 core hole, and 2 monitor wells. The drilling was conducted under WDEQ-LQD Drilling Notification #353 and all drill holes were plugged in accordance with Wyoming Statue WS35-11-4-1 as documented.

The Antelope property was explored in the 1970's through early 1990's by several companies. These include Teton Exploration/NEDCO, Newpark Resources, Kerr-McGee, Uranerz, and Cameco Resources.

Teton Exploration drilled 1153 holes primarily in the southwest part of the permit area on their Lee Claim area. It is not known if these holes were plugged in accordance with Wyoming statutes in effect at the time.

Newpark Resouces drilled primarily in the northwest part of the permit area on their Junction orebody with minor drilling on their GO claims in the southwest part of the permit area. In total, 915 drill holes were completed by Newpark but it is not known if these holes were plugged in accordance with Wyoming statutes in effect at the time.

Kerr_McGee drilled 822 holes on their Ross-Rox claims in the central portion of the permit area and 1055 holes on their Osborne Draw project in the eastern part of the permit area. It is not known if these holes were plugged in accordance with Wyoming statutes in effect at the time.

Uranerz drilled 108 holes in section 16, T26N, R92W. One of these holes was used by them as a water supply well. It is not known if these holes were plugged in accordance with Wyoming statutes in effect at the time.

Cameco Resources drilled one monitor well in section 13, T26N, R93W, but it is not known if any additional holes were drilled in the area.

Uranium One conducted verification drilling in 2007 totaling 27 holes and 16 monitor wells. The drilling was conducted under WDEQ-LQD Drilling Notification # 353 and all drill holes were plugged in accordance with Wyoming Statue WS35-11-4-1 as documented.

Table 2.6-1 lists all drill holes known to Uranium One in the project area. Figure 2.6-34 is a map of the JAB property and Figure 2.6-35 is a map of the Antelope property showing these known drill hole locations.

2.6.5 Soils

The Energy Metals Corporation, Antelope and Jab Uranium Project, was evaluated by BKS Environmental Associates, Inc. (BKS), Gillette, Wyoming in 2007. All the tables discussed in Sction 2.6.5 are presented in Addendum 2.6-B at the end of Section 2.6.

A total of 14,647.21 acres were included in the final soil mapping of the Antelope and Jab License Area. However, soils were only sampled within the 2,482.93 acres of the Antelope and Jab License Area which is based upon the proposed disturbed area as defined by initial estimates of the ore body, facilities and major roads. Soils mapped by BKS Environmental Associates, Inc. are illustrated on Addendum 2.6-G.

Stripping depths for the Antelope and Jab License Area were evaluated during mapping and sampling. Soil depths within a given mapping unit will vary based on any combination of the five primary soil forming factors, i.e., climate including effective precipitation, organisms, relief or topography, parent material, and time. Subtle differences in any one of the previously mentioned factors will impact development between series and within series designation but may not be as noticeable as when topography is a major factor. The proposed topsoil salvage depths for the Antelope and Jab License Area are based on laboratory data of the samples found within the borders of the unit, as well as field observations and knowledge of the soils in Sweetwater County, Wyoming.

Soils in the Antelope and Jab License Area are typical for semi-arid grasslands and shrublands in the Western United States. Parent material included colluvium, residuum, and alluvium. Most soils are classified taxonomically as Typic Torriorthents, Ustic Haplargids, Ustic Torriorthents, Ustic Calciargids, and Aridic Ustifluvents.

All soils have some suitable topsoil. The primary limiting chemical factor within the Antelope and Jab License Area is likely electrical conductivity (EC) (based upon lab analysis) and calcium carbonate in calcareous soils (based upon field observations). The majority of soils, however, were noncalcareous. The primary limiting physical factors are texture and coarse fragments (based upon lab analysis).

The mapping and reporting for the Antelope and Jab License Area incorporated map unit information from the previous NRCS soil surveys. Soil sampling needs were determined from WDEQ Guideline 1 (August 1994 Revision).

Refer to Addendum 2.6-C for the Soil Mapping Unit Descriptions. Refer to Addendum 2.6-D for the Soil Series Descriptions. Refer to Addendum 2.6-E for the Original Laboratory Data Sheets. Refer to Addendum 2.6-F for the Prime Farmland Designation and Addendum 2.6-G for soils maps.

2.6.5.1 Methodology

Review of Existing Literature

The nearest NRCS Order 3 mapped soils to the project area are Soil Survey Eden Valley Area, Sweetwater and Sublette Counties, October 1990 and Soil Survey of Fremont County, East Part and Dubois Area, Wyoming, July 1993. In addition to these NRCS surveys, historical soil mapping was available for the Jab License Area. Baseline Soil Assessment of the A-C Project Area was mapped in March 1999 in anticipation of an in-situ operation. Generalized NRCS soil series information is available on the internet at www.nrcs.usda.gov.

Project Participants

BKS performed the 2007 soil survey field work and compiled the resulting report. All soil analysis was handled by Energy Laboratories. All samples were taken to Energy Laboratories in Gillette, Wyoming. Regarding the Antelope Area, the samples were shipped to Casper, Wyoming and analyzed. The Jab Area samples were analyzed in Gillette, Wyoming; however, metal analysis was completed in Billings Montana and Total Organic Carbon analysis was completed in Casper, Wyoming.

Soil Survey

Construction of the Antelope and Jab License Area soil map was completed according to techniques and procedures of the National Cooperative Soil Survey. Guideline No. 1 (original November, 1984 and updated August, 1994) of the Wyoming Department of Environmental Quality, Land Quality Division (WDEQ-LQD) was followed during all phases of the work.

A total of 14,647.21 acres were included in the final soil mapping of the Antelope and Jab License Area.

Refer to Tables 2.6-2 and 2.6-3 for soil mapping unit designations and associated acreage within the Antelope and Jab License Area. Tables 2.6.1.1 and 2.6.1.2 also describes the soil map units in terms of actual map designations and slope percentages.

Field Sampling

Soil series were sampled to reflect recommended sample numbers in WDEQ Guideline 1 (August 1994 Revision) based on mapping acreage.

Series were sampled and described by coring with a mechanical auger, i.e., truck-mounted Giddings. The physical and chemical nature of each horizon within the sampled profile was described and recorded in the field. Although numerous holes were augured for series and map unit verification, only the field locations of profiles selected for laboratory analysis are plotted on the soils map included with this report. Sampled soil material was placed in clean, labeled, polyethylene plastic bags and kept cool to limit chemical changes. Samples were kept out of direct sunlight and transported to Energy Labs for analysis. A total of 26 sites on the Antelope area were sampled for analysis; all had corresponding soil profile descriptions written. A total of 34 sites on the Jab area were sampled for analysis; all had corresponding soil profile descriptions written. Refer to Tables 2.6-4 and 2.6-5 for the Antelope and Jab Soils Series Sample Summaries and Tables 2.6-6 and 2.6-7 for the Antelope and Jab Soil Sample Locations.

Laboratory Analysis

Samples were individually placed into lined aluminum pans to air dry. Coarse fragments were measured with a 10 mesh screen prior to grinding; the entire sample was then hand ground to pass 10 mesh. An approximate 20 ounce subsample was obtained through splitting with a series of riffle splitters and subsequently analyzed. A second subsample was maintained in storage at Energy Laboratories. Approximately 10 percent of the samples are run for duplicate analysis. Actual laboratory analysis follows the methodology outlined in WDEQ-LQD Guideline 1 (August 1994 Revision). In general, samples were analyzed within 45 days of receipt of the samples at the laboratory. All analytical data is presented in Addendum 2.6-E, Original Laboratory Data Sheets.

2.6.5.2 Results and Discussion

Soil Survey - General

General topography of the License Area includes rolling hills and ridges, as well as drainages. The soils occurring on the Antelope and Jab License Area were generally a sandy loam texture throughout with patches of loam and gravelly textures. The project area contained deep soils on lower toe slopes and flat areas near drainages with shallow and moderately deep soils located on upland ridges and shoulder slopes.

Soil Mapping Unit Interpretation

The primary purpose of the 2007 fieldwork was to characterize the soils within the Antelope and Jab License Area in terms of topsoil salvage depths and related physical and chemical properties. The total number of samples per series was established in line

with WDEQ Guideline 1 (August 1994 Revision) recommendations based on estimated acreage of soil series known within the Antelope and Jab License Area. Refer to Addendum 2.6-C and 2.6-D for soil mapping unit descriptions and soil series descriptions, respectively.

Analytical Results

Analyzed parameters, as defined in WDEQ Guideline 1 (August 1994 Revision), are in Addendum 2.6-E, Original Laboratory Data Sheets. Laboratory soil texture analysis did not include percent fine sands. Field observations of fine sands within individual pedestals as well as sample site topographic position were used in conjunction with laboratory analytical results to determine series designation. Where applicable, field observation of fine sands is also included in the textures found in the soil series descriptions in Addendum 2.6-D. In several sampling locations, noncalcareous variants were found. This is unusual as these series were typically calcareous in many or all horizons. Noncalcareous variants were found in the following soil series: Blazon, Bluerim, Carmody, Cragoson, Cushool, Lechman, and Rock River.

Topsoil Volume Calculations

Based on the 2007 fieldwork with associated field observations and subsequent chemical analysis, recommended topsoil average salvage depths over the Antelope area were determined to be 1.07 feet. The recommended topsoil average salvage depths over the Jab area were determined to be 1.05 feet. Refer to Tables 2.6-10 and 2.6-11, Approximate Soil Salvage Depths.

In accordance with WDEQ Guideline 4, suitable topsoil shall be salvaged from permanent or long-term Antelope and Jab facilities areas. All long-term topsoil stockpiles will be constructed and maintained in accordance with WDEQ-LQD Rules and Regulations, Chapter 2.

Topsoil is not stripped from wellfield areas, and no other large structures such as tailings disposal ponds, evaporation ponds, or overburden piles will be constructed at the site that would require salvage of topsoil.

Soil Erosion Properties and Impacts

Based on the soil mapping unit descriptions, the hazard for wind and water erosion within the Antelope and Jab License Area varies from slight to severe. The potential for wind and water erosion is mainly a factor of surface characteristics of the soil, including texture and organic matter content. Given the sandy loam, loam, and gravelly texture of the surface horizons throughout the majority of the Antelope and Jab License Area, the soils are more susceptible to erosion from wind than water. See Tables 2.6-12 and 2.6-13

for a summary of wind and water erosion hazards within the Antelope and Jab License Area.

The Antelope and Jab License Area is underlain by soils with a slight potential for water erosion and a severe potential for wind erosion. All topsoil will be stripped, stockpiled and maintained in accordance with WDEQ-LQD rules and regulations, the surface will be graded, and stormwater will be routed. These measures will help reduce the effect of construction on soil erosion.

The soils underlying the proposed wellfields are at a moderate to severe risk of erosion from both wind and water. Though no topsoil will be stripped from the wellfields, construction may result in an increase in the erosion hazard from both wind and water due to the removal of vegetation and the physical disturbance from heavy equipment. All areas are reseeded as soon as possible to keep the duration of bare soil to a minimum. Reseeding will help mitigate the increased erosion potential from the construction disturbance.

Prime Farmland Assessment

No prime farmland was indicated within the Antelope and Jab License Area based on a reconnaissance survey by the NRCS in Riverton, Wyoming. Refer to Addendum 2.6-F, Prime Farmland Designation, for the NRCS letter of negative determination.

2.6.6 Seismology

The discussion of seismology within the Permit Area and surrounding areas includes: an analysis of historic seismicity; a deterministic analysis of nearby faults; an analysis of the maximum credible "floating earthquake;" and a discussion of the existing short- and long-term probabilistic seismic hazard analysis. The materials presented here are mainly based on the seismologic characterization of Sweetwater, Carbon, Fremont, and Natrona Counties by James C. Case and others from the Wyoming State Geological Survey (Case, et. al., 2002a, 2002b, 2002c and 2003).

2.6.6.1 Historic Seismicity

The Permit Area is located in the north-eastern portion of the Great Divide Basin, in south-central Wyoming. Historically, south-central Wyoming has had a low to moderate level of seismicity compared to the rest of the State of Wyoming. As shown in Figure 2.6-36, most of the historical earthquakes occurred in the west-northwest portion of Wyoming. Significant historical earthquakes adjacent to the Permit Area are described below, and are organized by areas in which they occurred.

Town of Bairoil Area

Bairoil is located about 15 miles northeast of the Permit Area. Historically, there have been only a few earthquakes that have occurred within 20 miles of Bairoil. On August 11, 1916, a non-damaging intensity III earthquake occurred approximately 17 miles northwest of Bairoil. On June 1, 1993, a non-damaging magnitude 3.8, intensity III earthquake occurred four miles north of Bairoil, and was felt by some residents. On December 10, 1996, a non-damaging magnitude 2.6 earthquake occurred approximately ten miles northwest of Bairoil. A few residents also felt that event.

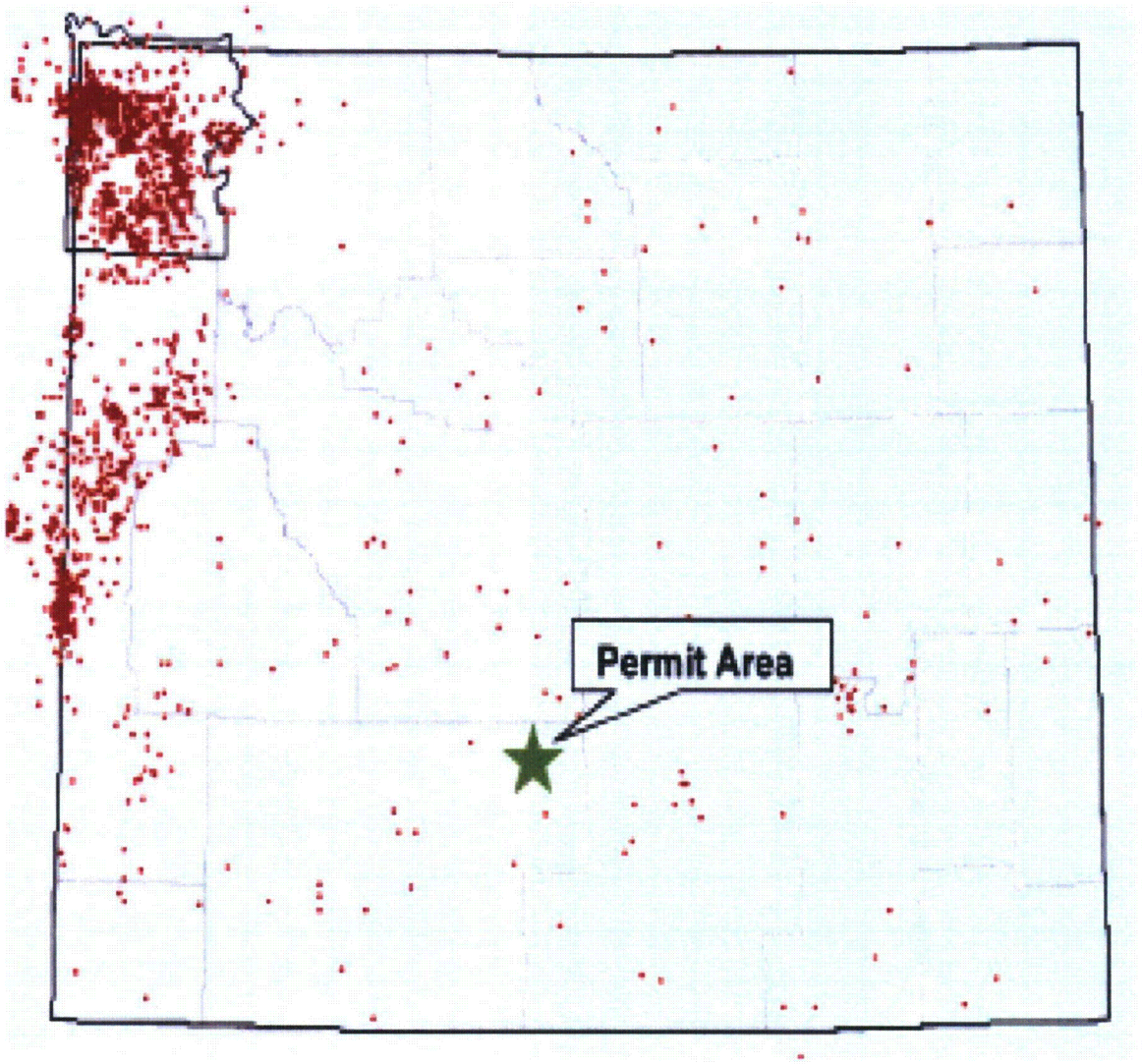
Two recent earthquakes were recorded near Bairoil in 2000. On May 26, 2000, a magnitude 4.0 earthquake occurred, followed by another (magnitude 2.8) four days later, on May 30, 2000. Both earthquakes were located about 3.5 miles southwest of Bairoil. Most residents in Bairoil felt the first earthquake. No significant damage was associated with either seismic event (Case, et.al, 2002a).

Town of Jeffrey City Area

Jeffrey City is located approximately 20 miles north of the Permit Area. There have been few recorded earthquakes in the Jeffrey City area. On August 11, 1916 an intensity III earthquake, centered approximately 6 miles south of Jeffrey City was recorded. No damage was reported from this event (Case, et. al, 2002b).

Figure 2.6-36 Historical Seismicity Map

Historical seismic activities in the State of Wyoming.*



* Red dots are locations of epicenters for those magnitude > 2.5 or intensity > 11 earthquakes recorded from1871 to present. (Wyoming Water Resource Data System Web Site, http://www.wrds.uwyo.edu/, Online Data, Cooperative Projects, Wyoming Earthquake Database, April 2008)

On April 22, 1973 a magnitude 4.8, intensity V, earthquake centered approximately 12 miles north of Jeffrey City was recorded. This event rattled dishes and disturbed pictures hanging on walls in Jeffrey City (Case, et. al, 2002b). On March 25, 1975 a magnitude 4.8, intensity II earthquake was detected approximately 18 miles northwest of Jeffrey City. A mobile home, 35 miles southeast of Riverton was reported to have been moved one inch off of its foundation by the event (Case, et. al, 2002b). On December 19, 1975 a magnitude 3.5 earthquake, located approximately 25 miles northeast of Jeffrey City was recorded. There was no report of damage from this event. On August 19, 2000, a 3.2 magnitude earthquake was reported approximately 25 miles west-northwest of Jeffrey City (Case, et. al, 2002b).

City of Rawlins Area

Rawlins is approximately 38 miles southeast of the Permit Area. The first recorded earthquake that was felt and reported immediately southwest of Rawlins occurred on March 28, 1896. The intensity IV earthquake shook for about two seconds. On March 10, 1917, an earthquake (intensity IV) was recorded approximately one mile northeast of Rawlins. The earthquake was felt as a distinct shock that caused wooden buildings to noticeably vibrate. Stone buildings were not affected by the event (Case, et. al, 2002a).

On September 10, 1964, a magnitude 4.1 earthquake occurred approximately thirty miles west of Rawlins. One Rawlins resident reported that the earthquake caused a crack in the basement of his home in Happy Hollow. No other damage was reported (Case, et. al, 2002a).

Small earthquakes were detected, on April 13, 1973, May 30, 1973, and June 1, 1973, approximately six miles west of Hanna. No one reported feeling these events. On July 11, 1975, Rawlins residents felt an intensity II earthquake event that was centered near Seminoe Reservoir. On January 27, 1976, an earthquake, magnitude 2.3, intensity V, occurred approximately 12 miles north of Rawlins. Several people reported that they were thrown out of bed. (Case, et. al, 2002a). On March 3, 1977, an intensity V earthquake was reported approximately 18.5 miles west-northwest of Encampment. Doors and dishes were rattled in southern Carbon County homes, but no significant damage was reported (Case, et. al, 2002a).

On April 13, 1991 and April 19, 1991, magnitude 3.2 and magnitude 2.9 earthquakes, respectively, occurred near the center of the Seminoe Reservoir. A magnitude 3.1 earthquake occurred on December 18, 1991, approximately 15 miles northeast of Sinclair. There was no damage reported from these Seminoe Reservoir area earthquakes. On August 6, 1998, a magnitude 3.6 earthquake occurred approximately 13 miles north of Rawlins. Residents in Rawlins reported hearing a sound and then feeling a jolt. On April, 1999, a magnitude 4.3 earthquake occurred approximately 29 miles north-

northwest of Baggs. It was felt in Rawlins and residents reported that pictures fell off the walls (Case, et. al, 2002a).

City of Rock Springs Area

Rock Springs is located approximately 80 air miles southwest of the Permit Area. The first recorded earthquake in Sweetwater County occurred on April 28, 1888. This intensity IV earthquake, which originated near Rock Springs, did not cause any appreciable damage. On July 25, 1910 an intensity V earthquake occurred at the same time that the Union Pacific Number One Mine in Rock Springs partially collapsed. On July 28, 1930, an intensity IV earthquake, with an epicenter near Rock Springs, was felt in Rock Springs and Reliance (Case, et. al, 2002c). The earthquake awakened many residents; and some merchandise fell off of store shelves.

On March 21, 1942, a non-damaging, intensity III earthquake was felt in Rock Springs area. This event was followed by an intensity IV earthquake on September 14 1946. On October 25, 1947, a small earthquake with no assigned intensity or magnitude occurred southeast of Rock Springs. Two intensity IV earthquakes occurred in the Rock Springs area on September 24, 1948. These events rattled dishes in Rock Springs area.

A magnitude 3.9 event was recorded on January 5, 1964, approximately 23 miles south of Rock Springs. The University of Utah Seismograph Stations detected a non-damaging, magnitude 2.4 earthquake on March 19, 1968. This event was centered approximately 17 miles southeast of Rock Springs. A magnitude 3.2 event occurred on May 29, 1975, approximately 13 miles northeast of Superior. A week later, on June 6, 1975, a magnitude 3.7 earthquake was recorded in the same area. No damage was associated with any of the 1975 events.

The University of Utah Seismograph Stations recorded a non-damaging, magnitude 2.7 earthquake on June 5, 1986. This event was located approximately 14 miles southwest of Green River, Wyoming.

On February 1, 1992, the University of Utah Seismograph Stations recorded a non-damaging, magnitude 2.3 earthquake approximately seven miles north of Rock Springs.

City of Lander Area

Lander is located approximately 70 miles northwest of the Permit Area. The first reported earthquake occurred on January 22, 1889, and had an intensity of III to IV. This was followed by an intensity IV event on November 21, 1895, during which houses were jarred and dishes rattled. On November 23, 1934, an intensity V earthquake was centered approximately 20 miles northwest of Lander. For a radius of ten miles around Lander, residents reported that dishes were thrown from cupboards, and that pictures fell down

from the walls. Cracks were found in buildings along two business blocks and the brick chimney of the Fremont County Courthouse was separated from the building two inches. The earthquake was felt at Rock Springs and Green River, Wyoming (Case, et. al, 2002b).

There were a series of earthquakes in the Lander area in the 1950s that caused little damage. On August 17, 1950, there was an intensity IV earthquake that caused loose objects to rattle and buildings to creak. On January 12, 1954, there was an intensity II event and on December 13, 1955, there was an intensity IV event near Lander, with no damage reported from either event.

On June 14, 1973, a small earthquake was reported about eight miles east-northeast of Lander. The earthquake has been recently interpreted as a probable explosion. On January 31, 1992, a non-damaging magnitude 2.8 earthquake occurred approximately 20 miles northwest of Lander. This event was followed, on October 10, 1992, by a magnitude 4.0, intensity III earthquake centered approximately 22 miles east Lander.

City of Casper Area

Casper is located about 90 miles northeast of the Permit Area. Two of the earliest recorded earthquakes in Wyoming occurred near Casper. The first was on June 25, 1894, and had an estimated intensity of V. In residences on Casper Mountain, dishes rattled and fell on the floor and people were thrown from their beds. Water in the Platte River changed from fairly clear to reddish, and became thick with mud, due to the river banks slumping into the river during the earthquake. On November 14, 1897, an even larger event was felt. This intensity VI to VII earthquake, one of the largest recorded in central and eastern Wyoming, caused considerable damage to several buildings. As a result of the earthquake, a portion of the Grand Central Hotel was cracked from the first to the third story, and some of the ceilings were also severely damaged (Case, et. al, 2003).

On October 25, 1922, an intensity IV earthquake was reported in the Casper area. Dishes were rattled and hanging pictures were tilted near Salt Creek. No significant damage was reported in Casper (Case, et. al, 2003). On December 11, 1942, an intensity IV earthquake was recorded north of Casper. Although no damage was reported, the event was felt in Casper, Salt Creek, and Glenrock (Case, et. al, 2003). On August 2, 1948, another intensity IV earthquake was reported in the Casper area, again with no damage reported (Case, et. al, 2003). On January 24, 1954, an intensity IV earthquake near Alcova did not result in any reported damage (Case, et. al, 2003). On August 19, 1959, an intensity IV earthquake was felt in Casper. Most recently, on October 19, 1996, a magnitude 4.2 earthquake was recorded approximately 15 miles north-northeast of Casper. No damage was reported from this event (Case, et. al, 2003).

2.6.6.2 Deterministic Analysis of Active Fault Systems

There are two active fault systems in the vicinity of the Permit Area, the Chicken Springs Fault System and the South Granite Mountain Fault System (Figure 2.6-37).

The Chicken Springs Fault System, located six miles east of the Permit Area, is composed of a series of east-west trending segments. In 1996, the Wyoming State Geological Survey investigated this fault system, and determined that the most recent activity on the system appears to be Holocene in age. Reconnaissance-level studies indicated that the fault system is capable of generating a magnitude 6.5 earthquake (Case, et. al., 2002a). A magnitude 6.5 earthquake on the Chicken Springs Fault System would generate peak horizontal accelerations of approximately 4.8%g at Rawlins (Case, et. al., 2002a). This acceleration would be roughly equivalent to an intensity V earthquake, which may cause some light damage. Bairoil, however, would be subjected to a peak horizontal acceleration of approximately 23%g, or an intensity VII earthquake (Case, et. al., 2002c). Intensity VII events have the potential to cause moderate damage.

The South Granite Mountain Fault System is located about 14 miles northeast of the Permit Area. This fault system is composed of several northwest-southeast trending normal and thrust faults in southeastern Fremont County and northwestern Carbon County. The active segments of the system have been assigned a maximum magnitude of 6.75, which could generate peak horizontal accelerations of approximately 34%g at Jeffrey City (Case, et. al, 2002b), 20%g at Bairoil, and 6.1%g at Rawlins (Case, et. al., 2002c). These accelerations would be roughly equivalent to an intensity VIII earthquake at Jeffrey City, an intensity VII earthquake at the Bairoil, and an intensity V earthquake at Rawlins. Jeffrey City could sustain moderate to heavy damage, Bairoil could sustain moderate damage, whereas minor or no damage could occur at Rawlins.

Figure 2.6-37 Site Fault Systems

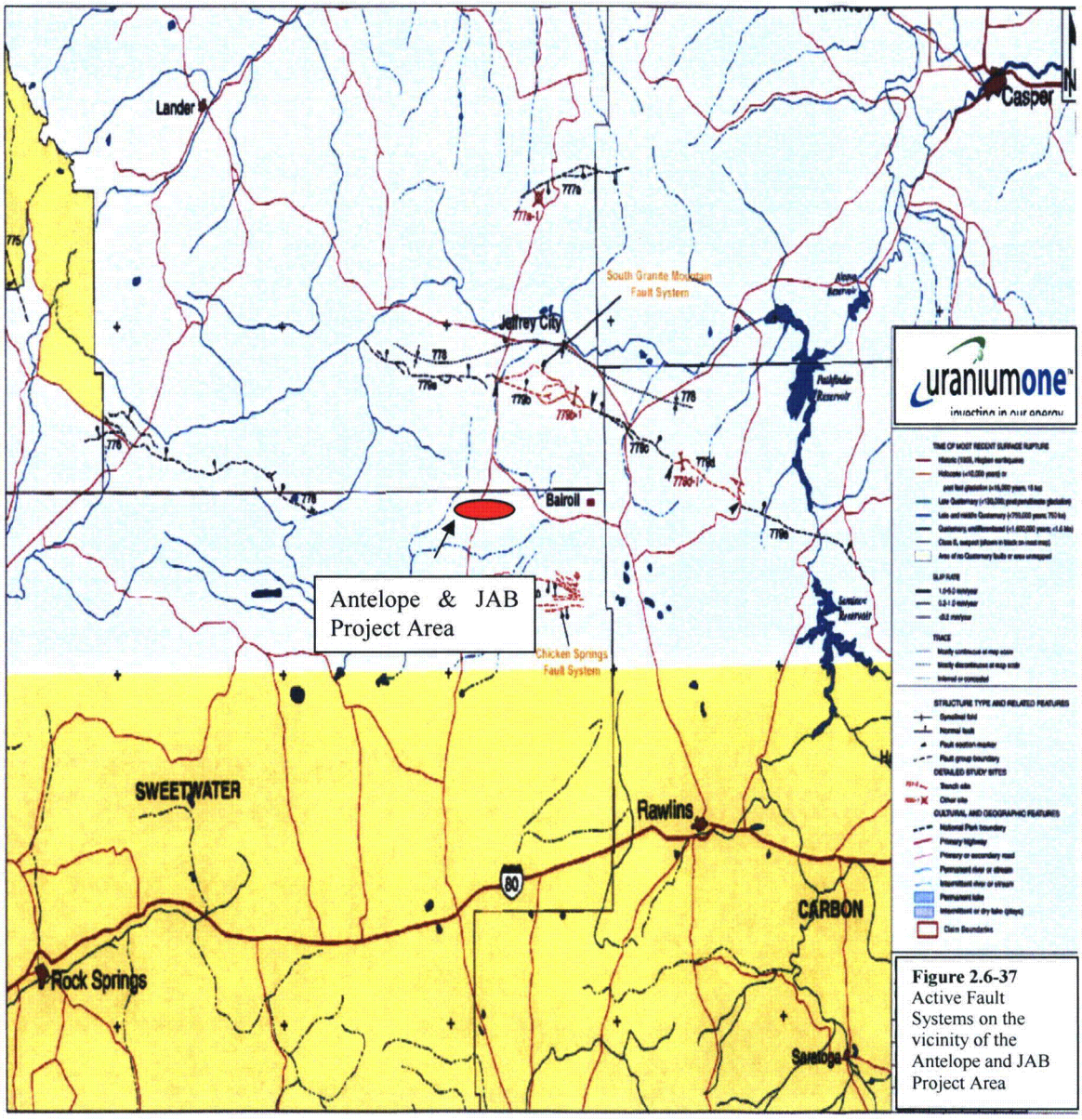


Figure 2.6-37 Active Fault Systems on the vicinity of the Antelope and JAB Project Area

2.6.6.3 Floating or Random Earthquake Sources

Many federal regulations require an analysis of the earthquake potential in areas where active faults are not exposed, and where earthquakes are tied to buried faults with no surface expression. Regions with a uniform potential for the occurrence of such earthquakes are called tectonic provinces. Within a tectonic province, earthquakes associated with buried faults are assumed to occur randomly, and as a result can theoretically occur anywhere within that area of uniform earthquake potential. In reality, that random distribution may not be the case, as all earthquakes are associated with specific faults. If all buried faults have not been identified, however, the distribution has to be considered random. "Floating earthquakes" are earthquakes that are considered to occur randomly in a tectonic province.

It is difficult to accurately define tectonic provinces when there is a limited historic earthquake record. When there are no nearby seismic stations that can detect small-magnitude earthquakes, which occur more frequently than larger events, the problem is compounded. Under these conditions, it is common to delineate larger, rather than smaller, tectonic provinces.

The USGS identified tectonic provinces in a report titled "Probabilistic Estimates of Maximum Acceleration and Velocity in Rock in the Contiguous United States"(Case, et. al, 2002c)., In that report, Sweetwater County was classified as being in a tectonic province with a "floating earthquake" maximum magnitude of 6.1. Geomatrix (Case, et. al, 2002c) suggested using a more extensive regional tectonic province, called the "Wyoming Foreland Structural Province," which is approximately defined by the Idaho-Wyoming Thrust Belt on the west, 104 degrees West longitude on the east, 40 degrees North latitude on the south, and 45 degrees North latitude on the north. Geomatrix (Case, et. al, 2002c) estimated that the largest "floating earthquake" in the "Wyoming Foreland Structural Province" would have a magnitude in the 6.0 to 6.5 range, with an average value of magnitude 6.25.

Federal or state regulations usually specify if a "floating earthquake" or tectonic province analysis is required for a facility. Usually, those regulations also specify at what distance a floating earthquake is to be placed from a facility. For example, for uranium mill tailings sites, the Nuclear Regulatory Commission requires that a floating earthquake be placed 15 kilometers from the site. That earthquake is then used to determine what horizontal accelerations may occur at the site. A magnitude 6.25 "floating" earthquake, placed 15 kilometers from any structure in Sweetwater, Fremont, or Carbon County, would generate horizontal accelerations of approximately 15%g at the site. Critical facilities, such as dams, usually require a more detailed probabilistic analysis of random earthquakes. Based upon probabilistic analyses of random earthquakes in an area distant from exposed active faults (Case, et. al, 2002b), however, placing a magnitude 6.25 earthquake at 15 kilometers from a site will provide a fairly conservative estimate of design ground accelerations in the Permit Area.

2.6.6.4 Probabilistic Seismic Hazard Analyses

The U.S. Geological Survey (USGS) publishes probabilistic acceleration maps for 500-, 1000- and 2,500-year time frames. The maps show what accelerations may be met or exceeded in those time frames by expressing the probability that the accelerations will be met or exceeded in a shorter time frame. For example, a 10% probability that acceleration may be met or exceeded in 50 years is roughly equivalent to a 100% probability of exceedance in 500 years.

The 500-year map provides accelerations that are comparable to those derived from the UBC and from the deterministic analysis on the Green Mountain Segment of the South Granite Mountain Fault System. It was often used for planning purposes for average structures. Based on the 500-year map (ten percent probability of exceedance in 50 years), the estimated peak horizontal acceleration in the Permit Area is approximately 6.5%g, which is comparable to the acceleration expected in Seismic Zone 1 of the UBC (Figure 2.6-38). The estimated acceleration in the Permit Area is 20%g on the 2,500 year map.

Figure 2.6-38 Wyoming UBC Seismic Zones (Case, et. al, 2002a)

The USGS has recently generated new probabilistic acceleration maps for Wyoming (Case, 2000). Copies of the 500-year (10% probability of exceedance in 50 years), 1000-year (5% probability of exceedance in 50 years), and 2,500-year (2% probability of exceedance in 50 years) maps are attached. Until recently, the 500-year map was often used for planning purposes for average structures, and was the basis of the most current Uniform Building Code. Recently, the UBC has been replaced by the International Building Code (IBC), which is based upon probabilistic analyses. The new International Building Code, however, uses a 2,500-year map as the basis for building design. The maps reflect current perceptions on seismicity in Wyoming. In many areas of Wyoming, ground accelerations shown on the USGS maps can be increased due to local soil conditions. For example, if fairly soft, saturated sediments are present at the surface, and seismic waves are passed through them, surface ground accelerations will usually be greater than would be experienced if only bedrock was present. In this case, the ground accelerations shown on the USGS maps would underestimate the local hazard, as they are based upon accelerations that would be expected if firm soil or rock were present at the surface. Intensity values and descriptions can be found in Table 2.6-14.

Based upon the 500-year map (10% probability of exceedance in 50 years) (Figure 2.6-39), the estimated peak horizontal acceleration in the Permit Area would be 20%g which is comparable to an intensity VII earthquake (18%g – 34%g). Intensity VII earthquakes can result in slight to moderate damage in well-built ordinary structures and considerable damage in poorly built or badly designed structures, such as un-reinforced masonry. Chimneys may be broken during an intensity VII event.

Based upon the 1000-year map (5% probability of exceedance in 50 years) (Figure 2.6-40), the estimated peak horizontal acceleration in the Permit Area would be 10%g. This acceleration is comparable to intensity VI earthquakes (9.2%g – 18%g). Intensity VI earthquakes can result in fallen plaster and damaged chimneys.

Based upon the 2500-year map (2% probability of exceedance in 50 years) (Figure 2.6-41), the estimated peak horizontal acceleration in the Permit Area would be 6%g, which is comparable to an intensity V earthquake (3.9%g – 9.2%g). Intensity V earthquakes can result in cracked plaster and broken dishes.

As the historic record is limited, it is nearly impossible to determine when a 2,500-year event last occurred in the Permit Area. Because of the uncertainty involved, and based upon the fact that the new International Building Code utilizes 2,500-year events for building design, it is suggested that the 2,500-year probabilistic maps be used for the Permit Area analyses, unless the deterministic analysis on faults exceed the probabilistic analyses. This conservative approach is in the interest of public safety.

Table 2.6-14: Modified Mercalli Intensity and Peak Ground Acceleration

Modified Mercalli Intensity	Acceleration (%g) (PGA)	Perceived Shaking	Potential Damage
I	<0.17	Not felt	None
II	0.17 – 1.4	Weak	None
III	0.17 – 1.4	Weak	None
IV	1.4 – 3.9	Light	None
V	3.9 – 9.2	Moderate	Very Light
VI	9.2 – 18	Strong	Light
VII	18 – 34	Very Strong	Moderate
VIII	34 – 65	Severe	Moderate to Heavy
IX	65 – 124	Violent	Heavy
X	>124	Extreme	Very Heavy
XI	>124	Extreme	Very Heavy
XII	>124	Extreme	Very Heavy

Figure 2.6-39. 500-year probabilistic acceleration map, 10% probability of exceedance in 50 years (Wyoming State Geological Survey, 2002).

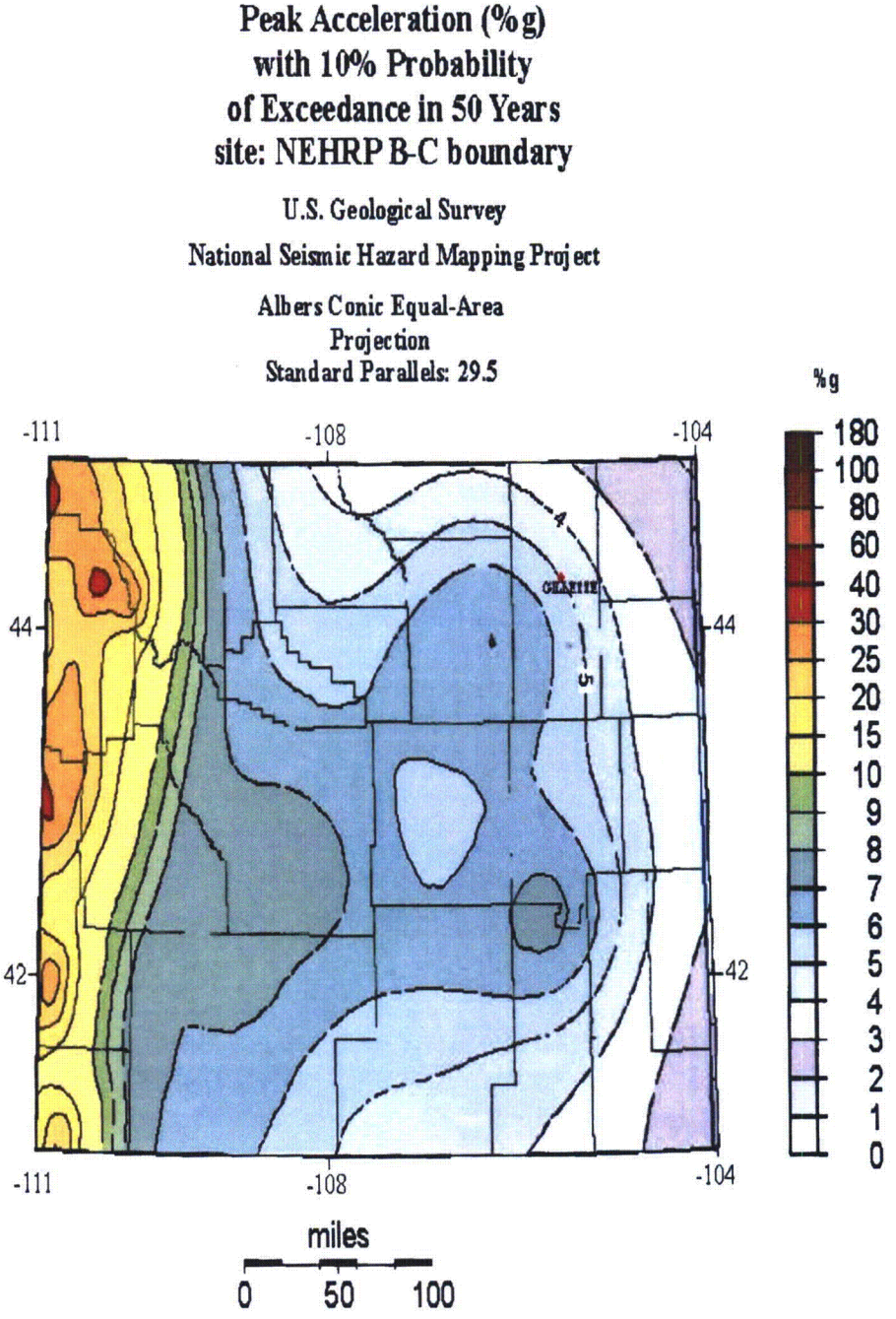


Figure 2.6-40. 1000-year probabilistic acceleration map, 5% probability of exceedance in 50 years (Wyoming State Geological Survey, 2002).

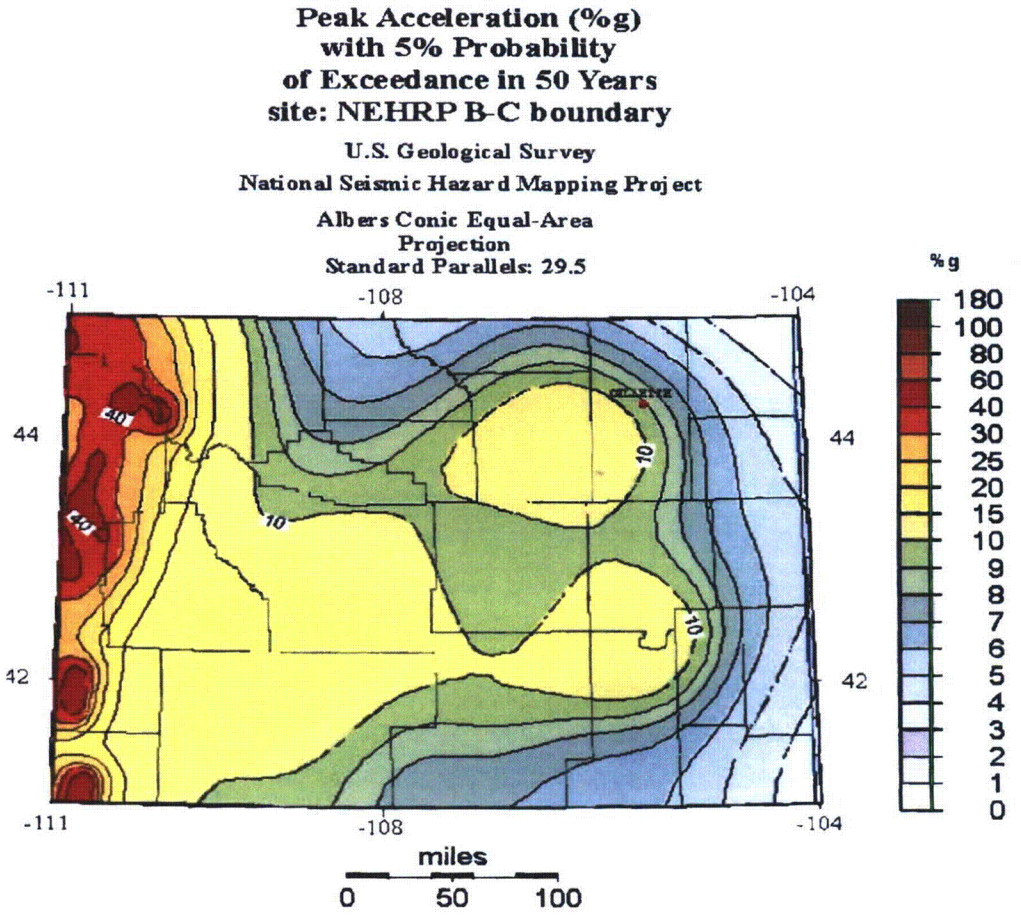
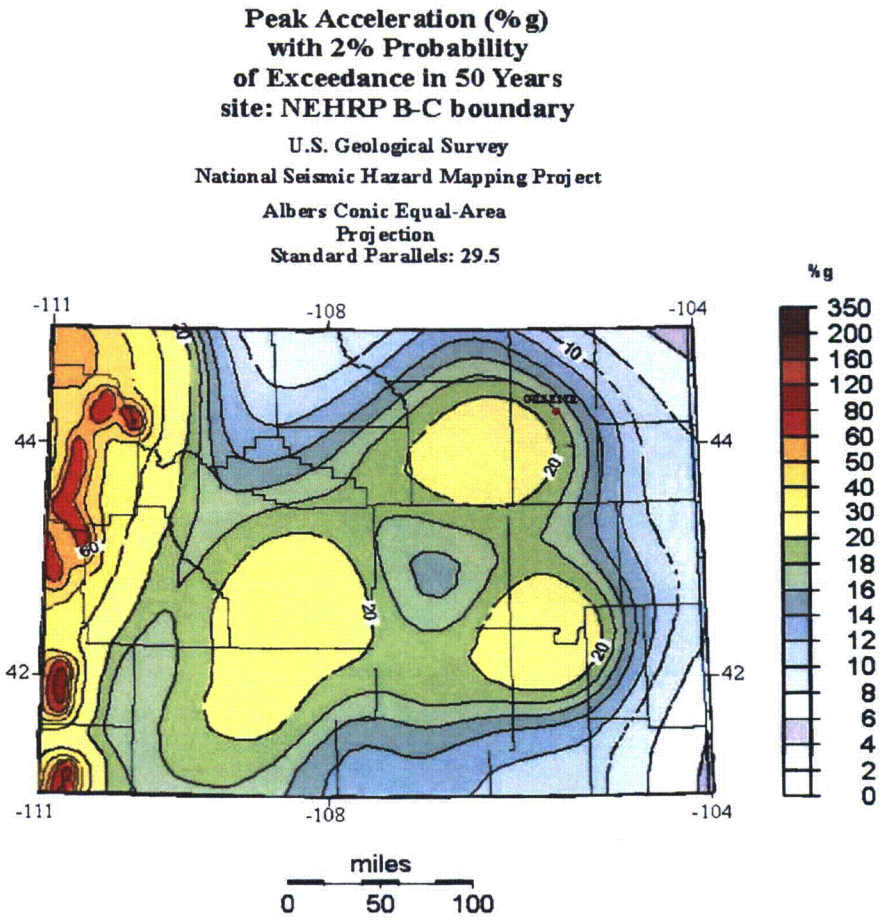


Figure 2.6.-41. 2500-year probabilistic acceleration map, 2% probability of exceedance in 50 years (Wyoming State Geological Survey, 2002).



2.6.6.5 References

Case, James C, and Toner, Rachel N., and Kirkwood, Robert, *Basic Seismological Characterization for Fremont County, Wyoming,* (Wyoming State Geological Survey, September 2002)

Case, James C, and Toner, Rachel N., and Kirkwood, Robert, *Basic Seismological Characterization for Carbon County, Wyoming,* (Wyoming State Geological Survey, September 2002)

Case, James C, and Toner, Rachel N., and Kirkwood, Robert, *Basic Seismological Characterization for Sweetwater County, Wyoming,* (Wyoming State Geological Survey, September 2002)

Case, James C, and Toner, Rachel N., and Kirkwood, Robert, *Basic Seismological Characterization for Natrona County, Wyoming,* (Wyoming State Geological Survey, January 2003)

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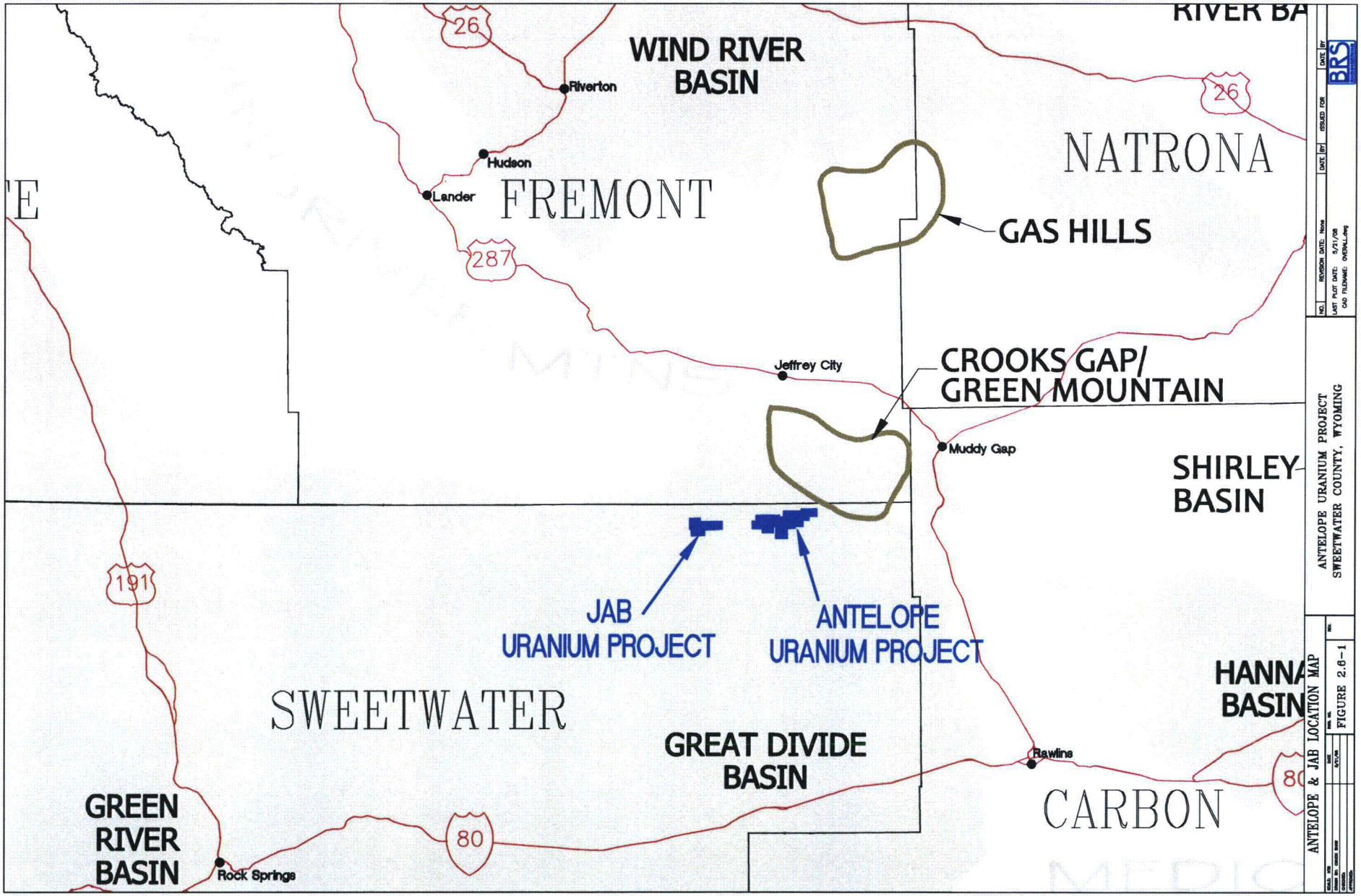
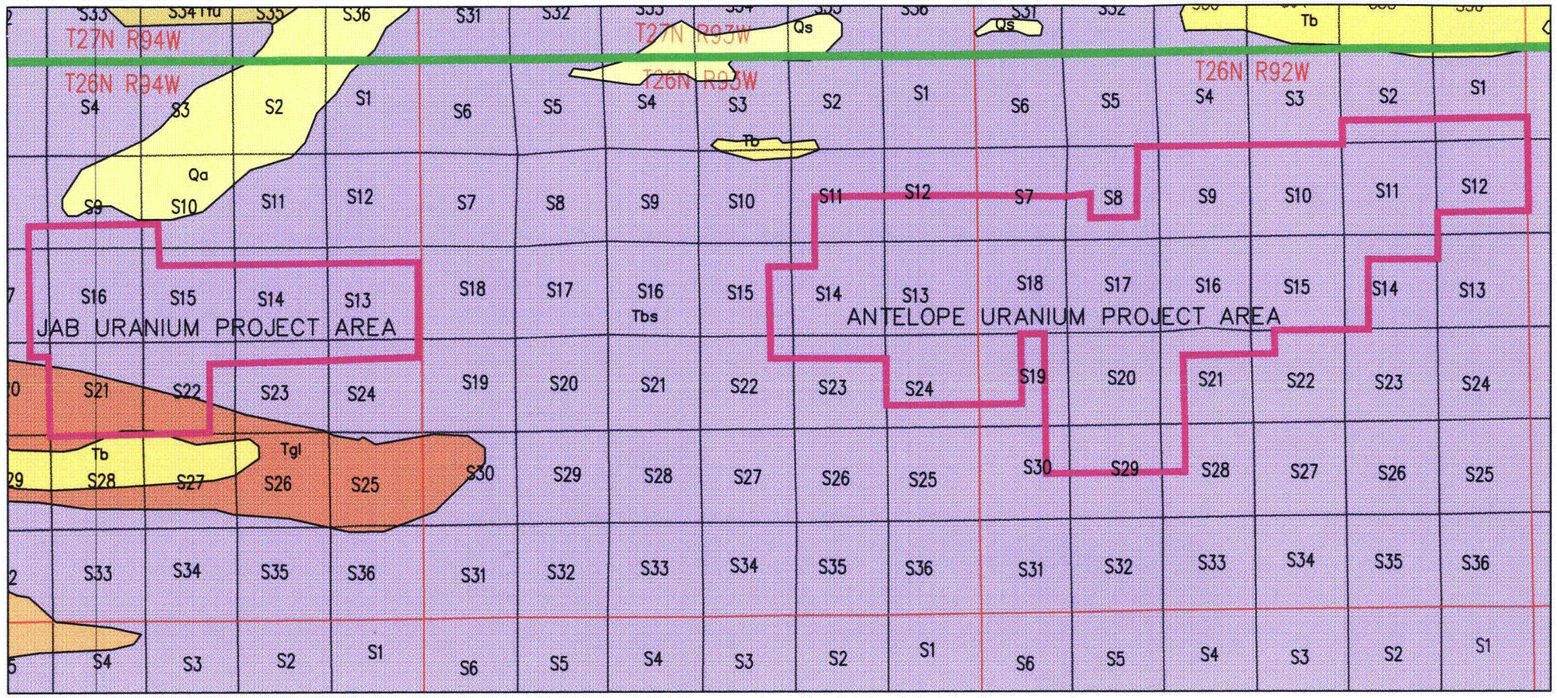
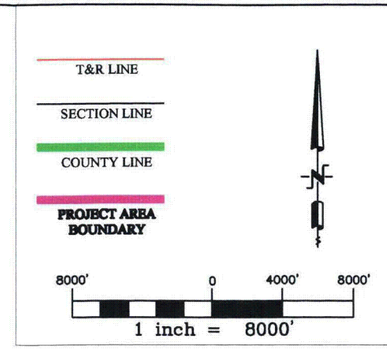
ADDENDUM 2.6-A

GEOLOGY FIGURES and TABLE


WIND RIVER BASIN
Riverton
Hudson
Lander
FREMONT
NATRONA
GAS HILLS
26
287
Jeffrey City
CROOKS GAP/
GREEN MOUNTAIN
Muddy Gap
SHIRLEY BASIN
191
JAB
URANIUM PROJECT
ANTELOPE
URANIUM PROJECT
SWEETWATER
GREAT DIVIDE BASIN
Rawlins
HANNA BASIN
CARBON
GREEN RIVER BASIN
Rock Springs
80
ANTELOPE URANIUM PROJECT
SWEETWATER COUNTY, WYOMING
ANTELOPE & JAB LOCATION MAP
FIGURE 2.6-1
BRS



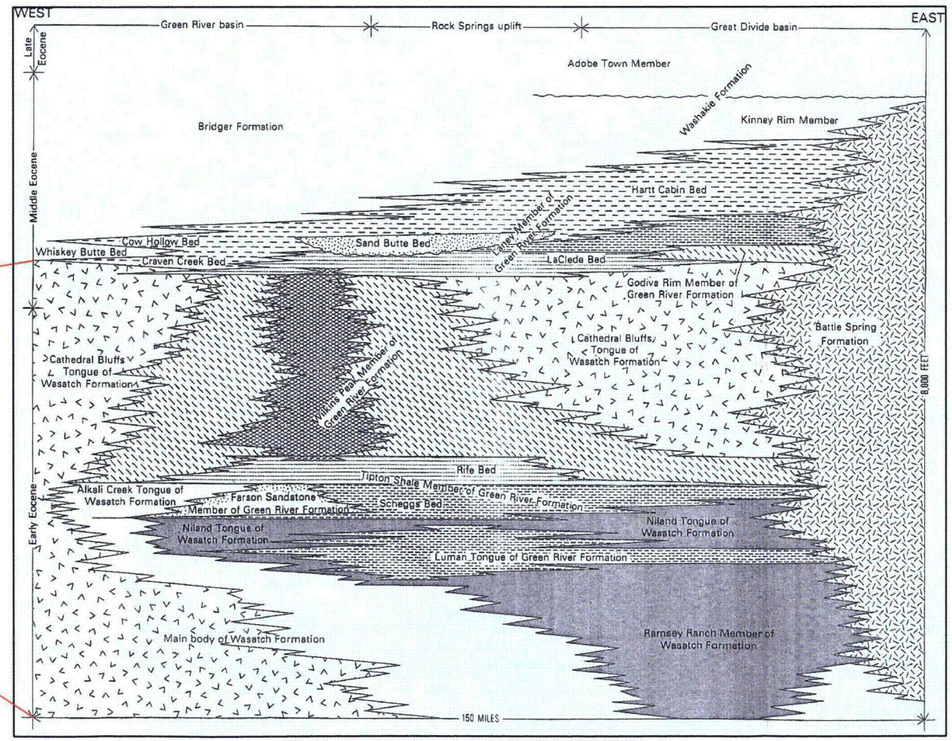
GREAT DIVIDE BASIN



Key to Geologic Formations

Quaternary alluvium	Qa
Quaternary Dune Sand and Loess	Qs
Bridger Formation	Tb
Laney Member, Green River Formation	Tgl
Tipton Shale Member, Green River Fm	Tgt
Battle Spring Formation	Tbs
Fort Union Formation	Tfu

ERA	PERIOD	EPOCH	
CENOZOIC	TERTIARY	PLEISTOCENE	POST-OLIGOCENE UNITS REMOVED BY EROSION
		PLIOCENE	
		MIOCENE	
		OLIGOCENE	WHITE RIVER FORMATION
		EOCENE	WASATCH FORMATION / BATTLE SPRINGS FORMATION
		PALEOCENE	FORT UNION FORMATION
MESOZOIC	CRETACEOUS		LANCE FORMATION
			FOX HILLS FORMATION
			MESAVERDE (WEST SIDE OF BASIN) OTHER CRETACEOUS UNITS CLOVERLY FORMATION AND INYAN KARA GROUP



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ANTELOPE AND JAB URANIUM PROJECT
SWEETWATER COUNTY, WYOMING

GEOLOGIC MAP & STRATIGRAPHIC COLUMN

SCALE: 1"=8000' (GEOLOGIC MAP)
DRAWN BY: CAS
CHECKED:
APPROVED:
DATE:
DWG. NO.
REV.

FIGURE 2.6-2

THIS PAGE IS AN OVERSIZED DRAWING OR FIGURE,

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D-04

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D-05

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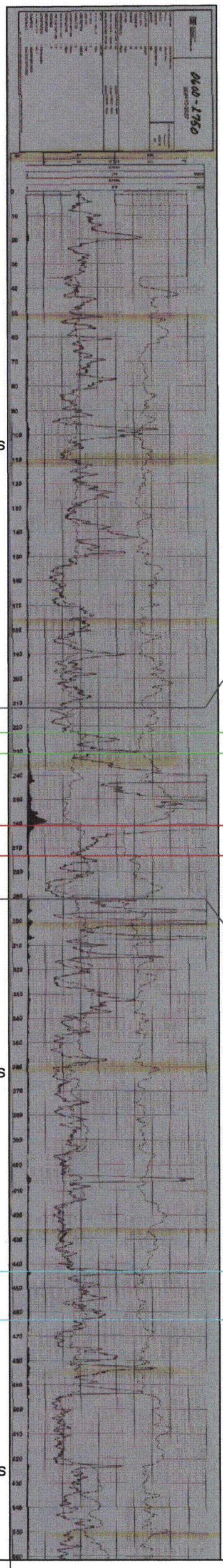
D-07

JAB TYPE LOG

2694–15–2027



Overlying Undifferentiated Units	Sandstone, v.fn–v.crs, arkosic, with interbedded shales and mudstones
Overlying Sand	Sandstone, fn–v.crs, light green to gray–green, arkosic
Overlying Confining Unit	Shale, dark green, with thinly interbedded sandy zones
Production Sand	Sandstone, fn–v.crs, grayish green, arkosic, minor limonite, with thinly interbedded mudstones
Underlying Confining Unit	Carbonaceous shale, black–dark gray
Underlying Sand	Sandstone, fn–v.crs, grayish blue–light green, arkosic, with thinly interbedded shales and mudstones
Underlying Undifferentiated Units	Sandstone, v.fn–v.crs, arkosic, with interbedded shales and mudstones
Underlying Confining Unit	Shale, light orange, with thinly interbedded sandy zones
Underlying Undifferentiated Units	Sandstone, v.fn–v.crs, arkosic, with interbedded shales and mudstones

JAB TYPE LOG			
SCALE: NTS	DATE	DWG. NO.	REV.
DRAWN BY: CMS	5/21/2008	FIGURE 2.6–7	
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JAB URANIUM PROJECT
SWEETWATER COUNTY, WYOMING

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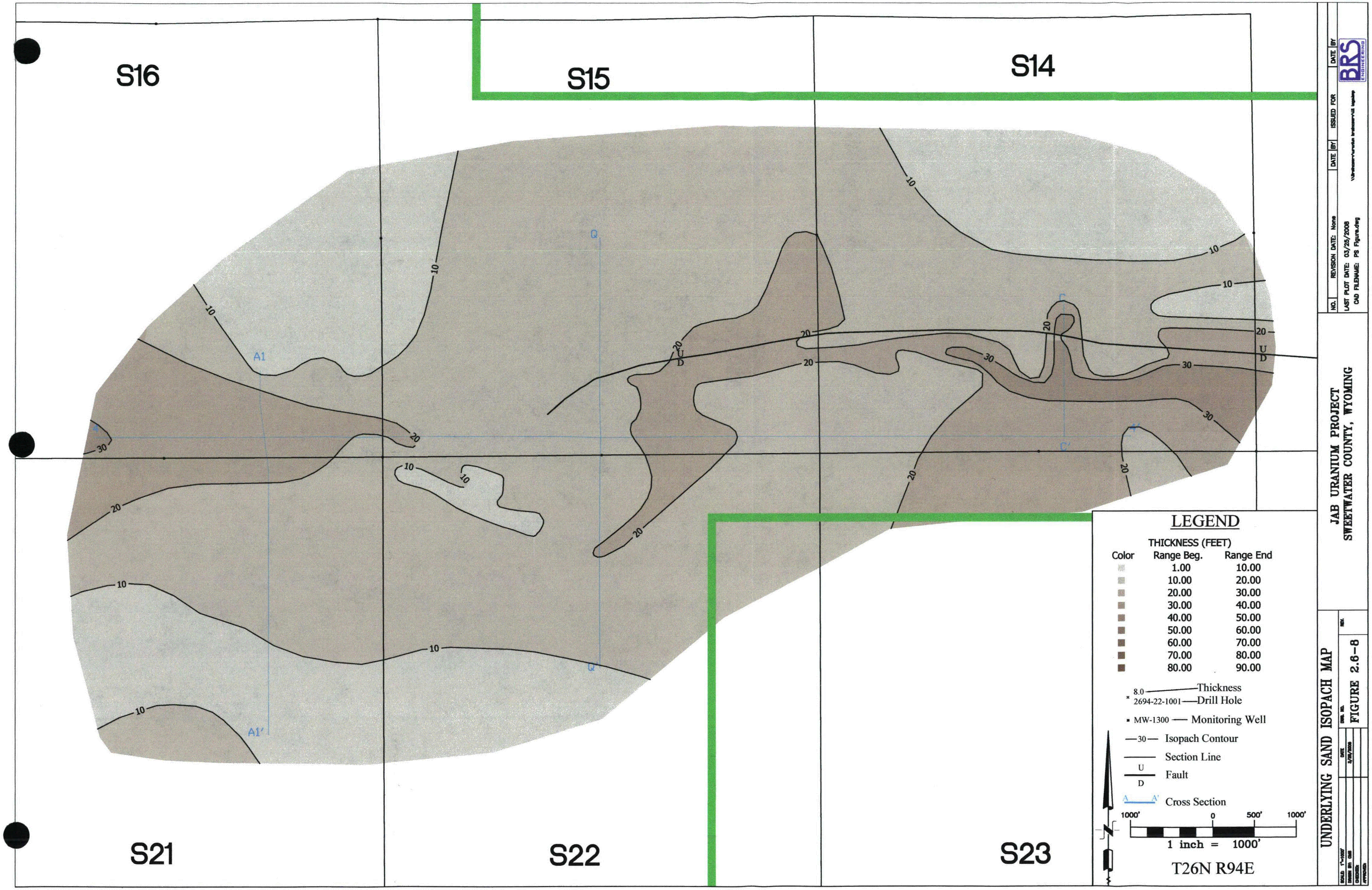

S16
S15
S14
S21
S22
S23
10
20
30
U
D
A1
A1'
Q
Q'
C
C'
A'
LEGEND
THICKNESS (FEET)
Color Range Beg. Range End
1.00 10.00
10.00 20.00
20.00 30.00
30.00 40.00
40.00 50.00
50.00 60.00
60.00 70.00
70.00 80.00
80.00 90.00
8.0 Thickness
2694-22-1001 Drill Hole
MW-1300 Monitoring Well
30 Isopach Contour
Section Line
U D Fault
A A' Cross Section
1000' 0 500' 1000'
1 inch = 1000'
T26N R94E
JAB URANIUM PROJECT
SWEETWATER COUNTY, WYOMING
UNDERLYING SAND ISOPACH MAP
FIGURE 2.6-8
BRS ENGINEERING

S16

S15

S14

S21

S22

S23

A1

A1'

Q

Q'

C

C'

4

4'

10

20

30

U
D

LEGEND

THICKNESS (FEET)

Color	Range Beg.	Range End
	1.00	10.00
	10.00	20.00
	20.00	30.00
	30.00	40.00
	40.00	50.00
	50.00	60.00
	60.00	70.00
	70.00	80.00
	80.00	90.00

8.0 — Thickness
2694-22-1001 — Drill Hole
MW-1300 — Monitoring Well
—30— Isopach Contour
Section Line
U / D Fault
A — A' Cross Section

1000' 0 500' 1000'

1 inch = 1000'

T26N R94E

JAB URANIUM PROJECT
SWEETWATER COUNTY, WYOMING

UNDERLYING CONFINING ISOPACH MAP

FIGURE 2.6-9

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BRS ENGINEERING

S16

S15

S14

S21

S22

S23

A

A'

B

B'

C

C'

D

D'

U
D

40
30
20
50
60

LEGEND

THICKNESS (FEET)

Color	Range Beg.	Range End
	1.00	10.00
	10.00	20.00
	20.00	30.00
	30.00	40.00
	40.00	50.00
	50.00	60.00
	60.00	70.00
	70.00	80.00
	80.00	90.00

8.0 — Thickness
2694-22-1001 — Drill Hole
MW-1300 — Monitoring Well
30 — Isopach Contour
Section Line
U / D — Fault
A — A' Cross Section

1000' 0 500' 1000'
1 inch = 1000'

T26N R94E

JAB URANIUM PROJECT
SWEETWATER COUNTY, WYOMING

PRODUCTION SAND ISOPACH MAP

FIGURE 2.6-10

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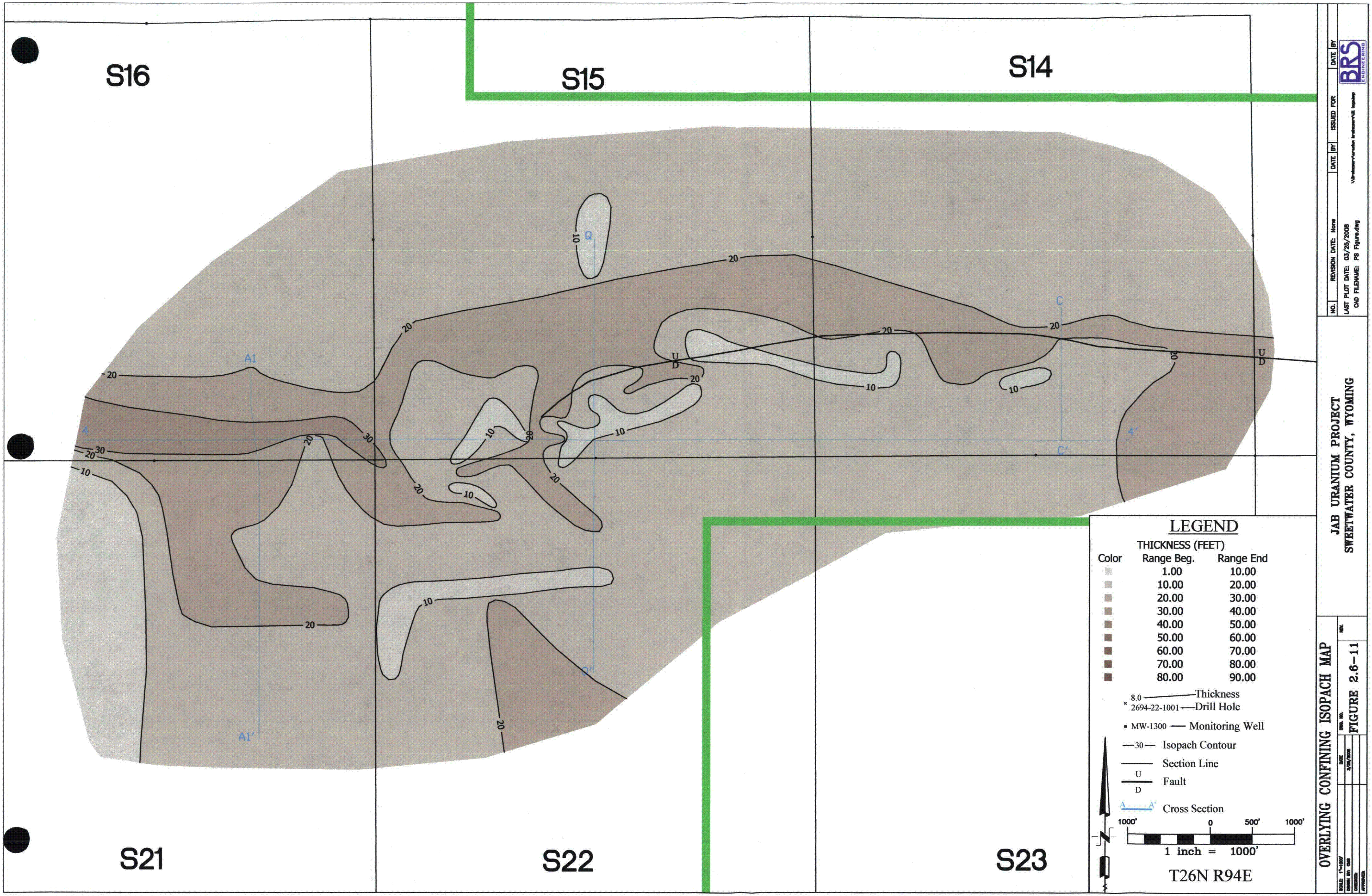
S16
S15
S14
S21
S22
S23
LEGEND
THICKNESS (FEET)
Color Range Beg. Range End
1.00 10.00
10.00 20.00
20.00 30.00
30.00 40.00
40.00 50.00
50.00 60.00
60.00 70.00
70.00 80.00
80.00 90.00
8.0 Thickness
2694-22-1001 Drill Hole
MW-1300 Monitoring Well
30 Isopach Contour
Section Line
U D Fault
A A' Cross Section
1000' 0 500' 1000'
1 inch = 1000'
T26N R94E
JAB URANIUM PROJECT
SWEETWATER COUNTY, WYOMING
OVERLYING CONFINING ISOPACH MAP
FIGURE 2.6-11
REVISION DATE: None
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S16

S15

S14

S21

S22

S23

A1

A1'

Q

Q'

C

C'

4

4'

U
D

10

20

LEGEND

THICKNESS (FEET)

Color	Range Beg.	Range End
	1.00	10.00
	10.00	20.00
	20.00	30.00
	30.00	40.00
	40.00	50.00
	50.00	60.00
	60.00	70.00
	70.00	80.00
	80.00	90.00

8.0 — Thickness

2694-22-1001 — Drill Hole

MW-1300 — Monitoring Well

30 — Isopach Contour

Section Line

U / D — Fault

A — A' Cross Section

1000' 0 500' 1000'

1 inch = 1000'

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SWEETWATER COUNTY, WYOMING

OVERLYING SAND ISOPACH MAP

FIGURE 2.6-12

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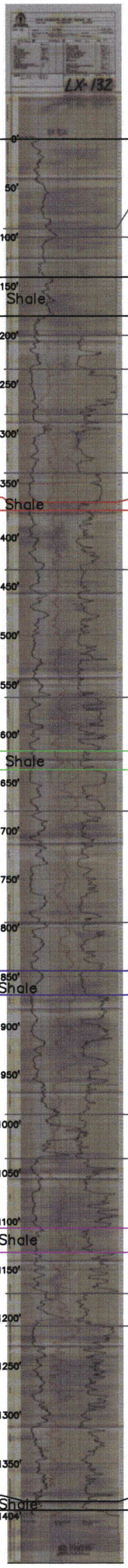

Sandstone, v.fn – crs
with abund fn sand and silt

Shale, micaceous, pale purple
with yellow clays and silts

Sandstone, fn–v.crs, arkosic
with minor silts & yellow clay

Shale, pale purple, micaceous
with yellow clays and silts

Sandstone, fn–v.crs, arkosic with minor silt

Shale, yellow and pale purple,
with minor fn–med arkosic sand

Sandstone, f–v.crs, arkosic,
pebble cgl at base, greenish tint

Shale, greenish–gray with minor
fn–med sand

Sandstone, v.fn–v.crs, arkosic w/minor chert, pyrite

Greenish– gray shale

Sandstone, v.fn–v.crs, arkosic with
minor pyrite, greenish–gray shale

Sandstone, v.fn–v.crs, arkosic with
moderate pyrite, greenish–gray shale

Sandstone, v.fn–v.crs, arkosic with minor
black chert

Greenish–gray shale

Sandstone, v.fn–v.crs, arkosic with minor
black chert

Sandstone, v.fn–crs, quartzose with
minor felds, pyrite, interbedded greenish–gray
shale and siltstn

Sandstone, v.fn–crs, qtzos, with
minor felds, with abundant pyrite,
minor shale & siltstn

Green–gray shale and siltstone

Sandstone, v.fn–crs, qtzos, with
minor felds, with abundant pyrite,
minor shale & siltstn

Shale, greenish–gray, with minor
pale–purple shale, minor sand v.fn–pebble
arkosic

Sandstone, v.fn–crs, arkosic, with
abund pyrite, minor green–gray shale
and siltstone

Green–gray shale and siltstone

Sandstone, v.fn–crs, arkosic, with
abund pyrite, minor green–gray shale
and siltstone

Silty sandy shale

Sandstone, v.fn–crs, arkosic, with
abund pyrite, minor green–gray shale
and siltstone

Green–gray shale and siltstone

ANTELOPE TYPE LOG				ANTELOPE URANIUM PROJECT SWEETWATER COUNTY, WYOMING						
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D-08 THROUGH D-18

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D-19 THROUGH D-32

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D-33 THROUGH D-39