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Acronyms and Abbreviations

µCi/kg	microCuries per kilogram
$\mu g/m^3$	micrograms per cubic meter
µmhos/cm	micromhos per centimeter
ACL	Alternate Concentration Limit
AEA	Atomic Energy Act
AERMOD	AMS/EPA Regulatory Model
ALARA	as low as reasonably achievable
AMS	American Meteorological Society
amsl	above mean sea level
AOR	Area of Review
API	American Petroleum Institute
ASOS	Automated Surface Observation Station
ASTM	ASTM International
ATV	all-terrain vehicle
AWWARF	American Water Works Association Research Foundation
BBS	breeding bird survey
bgs	below ground surface
BLM	Bureau of Land Management
BMP	best management practice
BNSF	Burlington Northern Santa Fe
BPT	best practicable technology
$CaCO^3$	calcium carbonate
CAD/GIS	computer aided drafting/geographic information system
CBR	Crow Butte Resources, Inc.
CESQG	conditionally exempt small-quantity generator
CFR	Code of Federal Regulations
cfs	cubic feet per second
cm/sec	centimeters per second
cm^2	square centimeters
CO	carbon monoxide
CO_2	carbon dioxide
COOP	Cooperative Observer Program
CPF	central processing facility
CPM	counts per minute
DAC	derived air concentration
dBA	A-weighted decibel
DDW	deep disposal well
DEM	Digital Elevation Model
DFIRM	Digital Flood Insurance Rate Map
DLG	Digital Line Graph
DOT	U.S. Department of Transportation
dpm	disintegrations per minute
DPS	Distinct Population Segment
DQO	data quality objective
DUSA	Dension Mines (USA)

EA	Environmental Assessment
Eh	oxidation-reduction potential
ELI	Energy Laboratories, Inc.
EPA	U.S. Environmental Protection Agency
ER	Environmental Report
ESA	Ecological Study Area
ESRI	Earth Sciences and Research Institute
ET	evapotranspiration
FEMA	Federal Emergency Management Agency
FESA	Federal Endangered Species Act
ft/day	feet per day
ft^2/day	square feet per day
GAM(NAT)	natural gamma
GEIS	Generic Environmental Impact Statement
GM	Geiger-Mueller
GNIS	Geographical Names Information System
gpd	gallons per day
gpm	gallons per minute
GPS	global positioning system
GR	gamma ray
H_2O_2	hydrogen peroxide
H_2S	hydrogen sulfide
HDPE	high-density polyethylene
HMR	Hazardous Materials Regulations
HSMS	Health and Safety Management System
HUC	hydrologic unit code
HUC12	12-digit hydrologic unit code
ICRP	International Commission on Radiological Protection
ISL	in-situ leach
ISR	in-situ recovery
IX	ion exchange
JFD	Joint Frequency Distribution
km^2	square kilometers
LAN	local area network
lbs	pounds
LLD	lower limit of detection
LSA	Low Specific Activity
LULC	land use and land cover data
Ma	million years
MBTA	Migratory Bird Treaty Act
MCL	Maximum Contaminant Level
md	millidarcies
MDC	Minimum Detectable Concentration
MEA	Marsland Expansion Area
meq	milliequivalents
meq/L	milliequivalents per liter
mg/cm^2	milligrams per square centimeter

mg/L	milligrams per liter
Mgal/da	million gallons per day
mi^2	square miles
MM	Modified Mercalli
mph	miles per hour
mR/hr	milli-Roentgens per hour
mRem/yr	millirems per year
MU	mine unit
Na_2S	sodium sulfide
NAAQS	National Ambient Air Quality Standards
$NaCO_3$	sodium carbonate
NAD 1927	North American Datum of 1927
$NaHCO_3$	sodium bicarbonate
NAIP	National Agriculture Imagery Program
NaOH	sodium hydroxide
NCDC	National Climate Data Center
NDA	Nebraska Department of Agriculture
NDED	Nebraska Department of Economic Development
NDEQ	Nebraska Department of Environmental Quality
NDHHS	Nebraska Department of Health and Human Services
NDNR	Nebraska Department of Natural Resources
NED	National Elevation Dataset
NEPA	National Environmental Policy Act
NFPA	National Fire Protection Association
NGPC	Nebraska Game and Parks Commission
NGS	National Geodetic Survey
NGWA	National Groundwater Association
NHD	National Hydrology Dataset
NHPA	National Historic Preservation Act
NLCD	National Land Cover Data
NMSS	Nuclear Material Safety and Safeguards
NNHP	Nebraska Natural Heritage Program
NNLP	Nebraska Natural Legacy Project
NOAA	National Oceanic and Atmospheric Administration
NOGCC	Nebraska Oil and Gas Conservation Commission
NOI	Notice of Intent
NOx	nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NRC	U.S. Nuclear Regulatory Commission
NRCS	Natural Resource Conservation Service
NREL	National Renewable Energy Laboratory
NRHP	National Register of Historic Places
NSHS	Nebraska State Historical Society
NTEA	North Trend Expansion Area
NTU	nephelometric turbidity units
NVLAP	National Voluntary Laboratory Accreditation Program
NWI	National Wetlands Inventory

NWS	National Weather Service
O_2	gaseous oxygen
OHSAS	Occupational Health and Safety Management System
OSHA	Occupational Safety and Health Administration
OSLD	optically stimulated luminescence dosimeter
PFYC	Potential Fossil Yield Classification
$PM_{2.5}$	particulate matter with a diameter less than 2.5 microns
PM_{10}	particulate matter with a diameter less than 10 microns
pCi/L	picoCuries per liter
PPE	personal protective equipment
ppm	parts per million
PPMP	preoperational/preconstruction monitoring program
PSD	prevention of significant deterioration
psi	pounds per square inch
PVC	polyvinyl chloride
QA	quality assurance
QAM	Quality Assurance Manual
QC	quality control
RCRA	Resource Conservation and Recovery Act
RES	Single Point Resistance
RFFA	reasonably foreseeable future actions
RG	Regulatory Guide
RL	reporting limit
RMP	Risk Management Program
RO	reverse osmosis
ROI	radius of influence
RSA	Resource Study Area
RSO	Radiation Safety Officer
RUSLE	Revised Universal Soil Loss Equation
S.U.	standard units
SCDA	Sequential Control and Data Acquisition
SCS	Soil Conservation Service
SDR-17	Standard Dimension Ratio 17
SEIS	Supplemental Environmental Impact Statement
SER	Safety Evaluation Report
SERP	Safety and Environmental Review Panel
SH	State Highway
SHEQMS	Safety, Health, and Environment Quality Management System
SHPO	State Historic Preservation Office
SO_2	sulfur dioxide
SOP	standard operating procedure
SP	spontaneous potential
SPCC	Spill Prevention, Control, and Countermeasure
SS	stainless steel
SSURGO	Soil Survey Geographic Database
SSPT	statistic spontaneous potential
SWMA	State Wildlife Management Area

SWPPP	Storm Water Pollution Prevention Plan
TCEA	Three Crow Expansion Area
TDS	total dissolved solids
TEDE	total effective dose equivalent
TLD	thermoluminescent dosimeter
TMDL	total maximum daily load
TSP	total suspended particulates
TSS	total suspended solids
UCL	upper control limit
UDC	uranyl dicarbonate
UIC	underground injection control
UMTRCA	Uranium Mill Tailings Radiation Control Act
USACE	U.S. Army Corps of Engineers
USBR	U.S. Bureau of Reclamation
USDA	U.S. Department of Agriculture
USDW	underground source of drinking water
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
USLE	Universal Soil Loss Equation
UTC	uranyl tricarbonate
VCD	voltage current direct
VOC	volatile organic compound
VRM	visual resource management
VTPD	vehicle trips per day
WFC	Wyoming Fuel Company
WRCC	Western Regional Climate Center
XRD	x-ray diffraction
yd^3	cubic yards
ZOEI	Zone of Endangering Influence

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1 INTRODUCTION OF THE ENVIRONMENTAL REPORT

1.1 Introduction

Crow Butte Resources, Inc. (CBR) submits this Environmental Report (ER) in support of a license amendment application to the United States Nuclear Regulatory Commission (NRC) for amendment of Radioactive Source Materials License SUA-1534. The amendment request concerns the proposed development of additional uranium in-situ recovery (ISR) mining resources located in Dawes County and Sioux County, Nebraska. The area proposed for use as a satellite facility to the main CBR Central Processing Facility (CPF) is referred to as the Marsland Expansion Area (MEA).

By letter dated November 27, 2007, CBR applied for a renewal of Source Materials License No. SUA-1534 for the CPF. This renewal will allow for the continued operation of the current CPF. The NRC issued a draft license by letter dated May 23, 2011. Following comments by CBR, the NRC issued a second draft of the CBR renewal license on August 11, 2011. As part of the licensing process, the NRC issued a Safety Evaluation Report (SER) for the license renewal dated December 2012 (NRC 2012). The SER documents the safety portion of the NRC staff's review of the license renewal application, as amended, and includes an analysis to determine CBR's compliance with these and other applicable 10 Code of Federal Regulations (CFR) Part 40 requirements, and applicable requirements set forth in 10 CFR Part 40, Appendix A (NRC 2012). The SER also evaluates CBR's compliance with applicable requirements in 10 CFR Part 20, "Standards for Protection against Radiation." An Environmental Assessment (EA) is also being prepared in parallel with the SER to address environmental impacts of the proposed action, which complies with the NRC's implementation regulations for the National Environmental Policy Act (NEPA; NRC 2012). While negotiations continue, the current license remains in effect.

This ER provides the supplemental information necessary to determine the environmental impacts of amending License No. SUA-1534 to allow uranium recovery in the MEA. The amendment application is submitted in accordance with the licensing requirements contained in 10 CFR Part 40 and provides the NRC staff with the necessary information to support the preparation of a Supplemental Environmental Impact Statement (SEIS) as required in 10 CFR Part 51.

The proposed MEA is located within the southern portion of Dawes County, which is within the Nebraska-South Dakota-Wyoming Uranium Milling Region identified in the NRC Generic Environmental Impact Statement for In-Situ Leach Uranium Milling Facilities (GEIS). The GEIS provides the NRC with a starting point for new ISR facilities, as well as for applications to amend or renew existing ISR licenses. The NRC will use the site-specific information provided in the CBR ER to determine whether the proposed activities and site characteristics are consistent with those evaluated in the GEIS. The NRC will then determine relevant sections, findings, and conclusions in the GEIS that can be incorporated by reference into an SEIS. When such conditions are met, the NRC will prepare an SEIS for the CBR amendment, fulfilling agency responsibilities under the NEPA.

This ER has been prepared using suggested guidelines and a standard format from NRC. The ER is presented primarily in the format provided in RG-1748, Environmental Review Guidance for Licensing Actions Associated with Nuclear Material Safety and Safeguards (NMSS) Programs

(August 2003). The pertinent guidance in RG-1748 was used to ensure that complete information is provided to NRC for review. In addition, NRC document RG-1569, Standard Review Plan for In Situ Leach Uranium Extraction License Applications (June 2003) was consulted to ensure that all necessary information is provided that will allow NRC Staff to complete their review of this amendment application.

1.1.1 Crow Butte Uranium Project Background

The original CBR was developed by Wyoming Fuel Company (WFC), which constructed an R&D Facility in 1986. The project was subsequently acquired (Ferret 1987) and operated by Ferret Exploration Company of Nebraska until May 1994, when the name was changed to CBR. This change was only a name change and not an ownership change. CBR is the owner and operator of the CPF.

The land (fee and leases) at the CPF is held by Crow Butte Land Company, which is a Nebraska corporation. All of the officers and directors of Crow Butte Land Company are U.S. citizens. Crow Butte Land Company is owned by CBR, which is the licensed operator of the facility. CBR, which does business as Cameco Resources, is also a Nebraska corporation. All of its officers are U.S. citizens, as are two thirds of its directors. CBR is owned by Cameco US Holdings, Inc., which is a U.S. corporation registered in Nevada. For Cameco US Holdings, three quarters of the officers are U.S. citizens, as are two thirds of the directors. Cameco US Holdings is held by Cameco Corporation, a Canadian corporation publicly traded on both the Toronto and New York Stock Exchanges.

The R&D Facility was located in N ½ SE ¼ of section 19, Township (T) 31 North (N), Range (R) 51 West (W). Operations at this facility were initiated in July 1986, and mining took place in two wellfields (WF-1 and WF-2). Mining in WF-2 was completed in 1987, and restoration of that wellfield has been completed. WF-1 was incorporated into Mine Unit (MU) 1 of the current operations.

The CPF is located in Section 19, T31N, R51W, Dawes County, Nebraska (**Figure 1.1-1**). The current license area occupies approximately 2,861 acres, and the surface area affected over the estimated life of the project is approximately 2,000 acres.

CBR has successfully operated the current processing area since commercial operations began in 1991. Production of uranium has been maintained at design quantities throughout that period with no adverse environmental impacts. Groundwater restoration for MU 1 has been completed and approved by the NRC and Nebraska Department of Environmental Quality (NDEQ), with NRC issuing the final approval on February 12, 2003. The operating history and timelines for the current production area are discussed in more detail in Section 1.1.3.

1.1.2 Site Location and Description

The proposed MEA project site is located within sections 26, 35, 36 of T30N, R51W; sections 1, 2, 11, 2, 13 of T29N R51W and sections 7, 18, 19, 20, 29, 30 of T29N, R50W (**Figure 1.1-2**). The project area occupies 4,622.3 acres. The Marsland satellite facility is located approximately 11.1 miles (17.9 km) south-southeast of the CPF (centerpoint of MEA satellite building to centerpoint of CPF processing building) and approximately 4.6 miles (7.4 km) northeast of the community of Marsland (centerpoint of MEA satellite building to centerpoint of Town of Marsland). **Figure 1.1-3** shows the locations of the current license area and the proposed MEA.

All mineral resources leased within the MEA are privately owned, with the exception of the SW ¼ section of section 36 of T30N, R51W. This quarter section is designated as State Trust Land and is a small part of the nearly 1,300,000 acres of land now held in trust for Nebraska's K-12 public schools (NBELF 2013). The surface and mineral rights are leased by Cameco from the State of Nebraska. There are no federal surfaces or minerals in the MEA license boundary. **Figure 1.1-4** shows land ownership in the proposed MEA.

1.1.3 Operating Plans, Design Throughput, and Processing

The CPF is licensed for a flowrate of 9,000 gallons per minute (gpm), excluding restoration flow, under License No. SUA-1534. Total annual production is limited to 2,000,000 pounds of yellowcake, per license condition 10.2 of License SUA-1534.

Uranium extracted from the Marsland wellfield will be processed at a satellite facility located within the MEA. The MEA will operate at an overall average production flowrate of 6,000 gpm (excluding 1,500 gpm for restoration). The anticipated bleed rate is assumed to be 0.5 to 2.0 percent of the total mining flow. The MEA will operate with an expected annual production rate of approximately 600,000 pounds (lbs) of U_3O_8. Indicated ore reserves as U_3O_8 for the MEA are 6,161,679 lbs, with an additional inferred estimate of 3,389,518 lbs. Total reserves for the MEA are currently estimated at 9,551,197 lbs. The uranium extracted from the MEA will be loaded onto ion exchange (IX) resin in the MEA satellite facility, which will then be transported by tanker truck to the main plant for elution, precipitation, drying, and packaging. Barren resin will be returned to the MEA satellite facility by tanker truck. The MEA operations are discussed in more detail in Section 1.3.2

The proposed MEA occupies approximately 4,622.3 acres. Over the life of the project, an estimated ~~1,753~~1,754 acres may be impacted.

Proposed Operating Timelines

1.1.3.1 Current Production Area

Sufficient reserves in the current license area have been estimated to allow mining operations to continue until the end of 2015. Completion of groundwater restoration in the current license area is scheduled for 2033, with site restoration to be completed by 2038. Projected production and restoration timelines for the CPF are shown on **Figure 1.1-5**. The current status of the 11 MUs are shown in **Table 1.1-1**. In 2010, the total annual production rate for the CPF was 751,632 lbs of U_3O_8, and in 2009 it was 734,047 lbs of U_3O_8. Additional MU plans are developed approximately 1 year prior to the planned commencement of new mining operations. For the current production area, production is ongoing in MUs 7, 8, 9, 10, and 11. MU 1 has been restored, and restoration is occurring in MUs 2, 3, 4, 5, and 6. The layout of the current and planned MUs in the current CPF license area is shown on **Figure 1.1-1**.

1.1.3.2 Marsland Expansion Area

The proposed MEA project site map and timeline are shown on **Figures 1.1-2** and **1.1-6,** respectively. There is a potential for 11 MUs, with construction for MU 1 to commence in 2014.

Production for the project (all MUs) will start in 2015 and terminate in 2033. Restoration in designated MUs will commence in the year 2020 and will be completed in 2039. Site reclamation will be completed in 2040.

The MEA will be subdivided into an appropriate number of MUs (**Figure 1.1-7**). Each MU will contain wellhouses where injection and recovery solutions from the satellite plant building are distributed to the individual wells. The injection and production manifold piping from the MEA satellite facility to the wellhouses will be either polyvinyl chloride (PVC) or high-density polyethylene (HDPE) with butt-welded joints or equivalent. Pressure switches will be installed to each injection manifold in the wellhouse to alert the plant and wellfield operators of increasing manifold pressures. Pressure gauges, pressure shutdown switches, and pressure transducers will be used to monitor and control trunkline pressures. Oxidizer will be added to the injection stream, and all injection lines off of the injection manifold will be equipped with totalizing flowmeters, which will be monitored in the satellite Control Room. The MEA wellfields will be designed consistent with the existing CPF wellfields. More detailed information about the site operations is discussed in Section 1.3.2.

1.1.3.3 Three Crow Expansion Area Timeline

On July 12, 2010, CBR submitted a Class III underground injection control (UIC) Application and Aquifer Exemption Petition to the NDEQ for the proposed Three Crow Expansion Area (TCEA), which will be used as a satellite facility supporting the CPF. On Aug. 3, 2010, CBR submitted a request to the NRC for an amendment to Source Materials License SUA-1534 for the development of the TCEA (Young 2010; ML102230170). By email dated April 14, 2011 (Leftwich 2011; ML11160020), Cameco requested that the NRC suspend review of the TCEA application so that the option of a pipeline to carry mine fluids directly to the main plant could be evaluated. By letter dated October 11, 2012 (Leftwich 2012; ML12299A211), Cameco advised the NRC that the pipeline option would not be pursued. CBR requested that NRC restart the application process for TCEA, with the project to be operated as a satellite facility to the main CBR operation located near Crawford, Nebraska. The major change in the originally proposed TCEA satellite facility is that surge/evaporation ponds are deemed to no longer be required to support project and associated deep disposal well (DDW) operations.

TCEA construction is planned for completion in 2016, with production from 2016 to 2032, restoration from 2023 to 2038, and completion of final site reclamation in 2039.

1.1.3.4 North Trend Expansion Area Timeline

The proposed North Trend Expansion Area (NTEA) will consist of a support satellite facility for the CPF. CBR has received approval from the NDEQ for a Class III UIC permit (NDEQ 2011a) and an aquifer exemption (NDEQ 2011b) that will allow for construction and operation of the satellite facility for ISR mining of the proposed NTEA. A radioactive source material license amendment (CBR 2007) for the NTEA is pending before the NRC for the proposed NTEA. Current plans are for this project to be constructed in 2023, with production from 2024 to 2032, and groundwater restoration activities ongoing from 2029 through 2039. Final site reclamation would be completed in 2041.

The locations of the CPF, TCEA, and, NTEA are shown on **Figure 1.1-3**.

1.2 Purpose and Need for the Proposed Action

NRC Source Materials License SUA-1534 authorizes CBR to conduct mining operations in the current license area. Based on current plans, mining timelines, and reserve estimates, CBR could continue production at the present annual levels of approximately 700,000 pounds of U_3O_8 until the end of 2014, when reserves would begin to significantly deplete. CBR estimates that by 2014, production in the current license area would decrease to the point where commercial operations would no longer be economical and would be discontinued. Groundwater restoration, surface reclamation, and decommissioning would become the primary activities.

CBR has developed commercially viable uranium resources in the area near the current license area. Development and recovery of these resources using satellite facilities will allow CBR to extend the operation of the existing CPF in the current license area. The use of satellite facilities in these areas will minimize the cost and environmental impact from construction activities.

The timely approval of uranium recovery activities in the MEA and NTEA will allow CBR to maintain uranium production at currently licensed quantities and provide a smooth transition of mining activities from the CPF license area to the satellite facility. CBR has developed a talented, qualified workforce mostly of local residents. If the MEA and NTEA are not developed, CBR estimates that some of these personnel (e.g., well drilling, well and wellfield construction) will no longer be required and workforce reduction will begin as early as 2013.

Failure to develop these additional resources would leave a large resource unavailable for energy production supplies. Although CBR is continuing to develop estimates of the reserves at MEA, the current indicated ore reserves as U_3O_8 for the MEA are 6,161,679 lbs, with an additional inferred estimate of 3,389,518 lbs. Total reserves for the MEA are currently estimated at 9,551,197 lbs. The MEA will operate with an expected annual production rate of approximately 600,000 lbs U_3O_8.

In 2012, total domestic U.S. uranium concentrate production was approximately 4,100,000 lbs of U_3O_8, of which more than 800,000 lbs (or approximately 20 percent) was produced at the CPF (EIA 2013a). During the same year, U.S. civilian nuclear power reactors purchased 58,000,000 lbs U_3O_8e (equivalent) from U.S. and foreign suppliers, with approximately 17 percent supplied by domestic producers (EIA 2013b). Foreign-origin uranium accounted for the remaining 83 percent of deliveries. The CPF (including the MEA, TCEA, and NTEA) represents an important source of new domestic uranium supplies essential to providing a continuing source of fuel to power generation facilities.

In addition to leaving a large deposit of valuable mineral resources untapped, a denial of this amendment request would result in the loss of a large investment in time and money made by CBR for the rights to and development of these valuable deposits.

Denial of the amendment request would have an adverse economic effect on the individuals that have surface leases with CBR and own the mineral rights in the MEA.

1.3 The Proposed Action

1.3.1 Site Location and Layout

The location of the current license area of the CPF is in sections 11, 12, 13, 24 of T31N, R52W and sections 18, 19, 20, 29, 30 of T31 N, R51W, Dawes County, Nebraska. The proposed MEA is located in sections 26, 35, 36 of T30N, R51W; sections 1, 2, 11, 12, 13 of T29N, R51W; and sections 7, 18, 19, 20, 29, 30 of T29N, R50W. The maps used in this and other sections of this amendment application are Vector 7.5-minute quad maps. These are computer-aided drafting/geographic information system (CAD/GIS) drawings where each road, stream, and contour line is an individual entity. The layers in these maps were derived from the U.S. Census Bureau's TIGER/Line data, U.S. Geological Survey (USGS) Digital Line Graph (DLG) Data, USGS Digital Elevation Model (DEM) data, Bureau of Land Management (BLM) Section Line data, National Geodetic Survey (NGS) Benchmark data, and USGS Geographical Names Information System (GNIS) data. 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.

The longitudes and latitudes for the site boundary vertices and satellite facility are summarized in **Table 1.3-1**. The datum on topographic maps presented in the application is North American Datum of 1983 (NAD 1983), and the geographic coordinate reference system (map projection) is:

NAD_1983_StatePlane_Nebraska_North_FIPS_2600 (US_Foot).

Figure 1.1-2 shows the general area surrounding the MEA project area, including the proposed MEA, Area of Review (AOR), and Zone of Endangering Influence (ZOEI).

Figure 1.1-1 shows the general project site layout and Restricted Areas for the current license area including the CPF building area, the Reverse Osmosis (RO) facility, the current MU boundaries, ~~the~~two DDWs, and the R&D and commercial evaporation ponds.

Figure 1.1-7 shows the proposed locations of the satellite facility, MUs, access roads, license boundary perimeter fencing, and six DDWs. within the MEA. The latitude and longitude for the license boundary and center of the satellite facility are provided in **Table 1.3-1**. The easting/northing and longitude/latitude for the proposed DDWs are provided in **Table 1.3-7.** The exact locations will be determined prior to construction.

Figure 1.1-3 shows the project location in relation to the CPF and the proposed MEA, NTEA, and TCEA projects. This figure shows topographical features, drainage and surface water features, nearby population centers, and political boundaries as well as principal highways, railroads, transmission lines, and waterways.

1.3.2 Description of Proposed Facility

Production of uranium by ISR mining techniques involves a mining step and a uranium recovery step. Mining is accomplished by installing a series of injection wells through which the leach solution is pumped into the ore body. Corresponding production wells and pumps promote flow through the ore body and allow for the collection of uranium-rich leach solution. Uranium is removed from the leach solution by IX, and then from the IX resin by elution. The leach solution can then be reused for mining. The elution liquid containing the uranium (the "pregnant" eluent) is then processed by precipitation, dewatering, and drying to produce a transportable form of uranium called yellowcake.

The MEA is being developed by CBR in conjunction with the CPF licensed under NRC Source Material License SUA-1534. The MEA will be developed by constructing independent wellfields and mining support facilities while employing existing processing equipment for uranium recovery. Transfer of recovered leach solutions from the area is prohibitive because of the distance over which a relatively large stream would have to be pumped. Therefore, a satellite facility will be constructed in the MEA to provide chemical makeup of leach solutions, recovery of uranium by IX, and restoration capabilities. The IX processes at the satellite facility recover the uranium from the leach solution in a form (loaded IX resin) that is relatively safe and simple to transport by tanker truck to the CPF, which will serve as the CPF for elution and further processing of recovered uranium. Regenerated resin is then transported back to the satellite facility for reuse in the IX circuit.

1.3.2.1 Solution Mining Process and Equipment

Ore body

In the CPF license area, uranium is recovered by ISR from the basal sandstone of the Chadron Formation at a depth that varies from 400 feet to 900 feet. The overall ore body width of the mineralized area varies from 1,000 feet to 5,000 feet. The ore body ranges in grade from less than 0.05 to more than 0.5 percent U_3O_8, with an average grade estimated at 0.27 percent U_3O_8. The layout of the ore body as determined to date is shown in **Figure 1.3-1**.

In the MEA, uranium will also be recovered via ISR from the basal sandstone of the Chadron Formation. The depth of the ore body in the MEA ranges from 800 to 1,250 feet below ground surface (bgs), and the width varies from approximately 1,000 feet to 4,000 feet. The ore body ranges in grade from 0.11 percent to 0.33 percent U_3O_8, with an average grade estimated at 0.22 percent U_3O_8. The ore-grade uranium deposits underlying the MEA are depicted on **Figure 1.3-1**.

Typical stratigraphic intervals to be mined by the ISR mining method are shown in the geologic cross-sections contained in Section 3.3. For ISR wellfields, the production zone is the geological sandstone unit where the leaching solutions are injected and recovered (i.e., basal sandstone of the Chadron Formation).

1.3.2.2 Well Construction and Integrity Testing

Three well construction methods and appropriate casing materials are used for the construction and installation of production and injection wells.

Well Materials of Construction

The well casing material will be PVC 5-inch Standard Dimension Ratio-17 (SDR-17). However, should a larger pump size be required, larger-diameter casing may be employed. The PVC casing joints are 20 feet long, and the bottom joint can be made either 10 or 20 feet long, depending on the casing depth. With SDR-17 PVC casing, each joint has a watertight O-ring seal and is held together with a high-strength nylon spline.

There are two types of well screen that will be used for development of the MEA: PVC and stainless steel (SS). Both types of screens have been used historically for the existing Crow Butte production, injection, and monitor wells. SS screens are more durable than PVC screens, are rated for greater depths than PVC screens, are easier to install, and can achieve better flow. The SS screens are significantly more expensive than the PVC screens. Currently, CBR primarily uses SS screens, but would maintain the option to use PVC screens as necessary at the satellite facility based on site conditions and purpose of the borehole. For example, PVC well screens are currently used in both shallow observation monitor wells and commercial production monitor wells. This practice will continue to be an option for the MEA. PVC screens are used for these types of wells primarily because they typically have much longer screen intervals than other types of wells. This results in employee safety issues due to the handling of the heavy SS screens. In addition, flowrate using PVC screens is less of a concern for these types of wells.

The PVC well screen consists of a perforated 3-inch PVC pipe. PVC rods run longitudinally along the sides of the pipe. Keystone-shaped PVC wire is helically wrapped around the outsides of the pipe and ribs and solvent-welded to the pipe. Spacing between consecutive wraps of the wire varies depending upon the screen ordered. Slot sizes from 0.010 to 0.020 inch have been used successfully at CBR. In most cases, a slot size of 0.020 inch is sufficient to prevent sand from entering the screens.

The SS well screen consists of longitudinal ribs of SS with an SS “V” shaped wire wrapped helically around the interior ribbing. The wire is welded to the circular rib array for support. As with PVC screens, slot sizes of 0.010 to 0.020 inch have been used historically at CBR.

Well Construction Methods

Pilot holes for monitor, production, and injection wells will be drilled through the target completion interval with a small rotary drilling unit using native mud and a small amount of commercial drilling fluid additive for viscosity control. The hole will be logged, reamed, casing set, and cemented to isolate the completion interval from all other aquifers. Three well construction methods are described. Any of these methods is appropriate for monitor wells and have been approved by the NDEQ under the current Crow Butte Class III UIC Permit and recently issued Class III UIC Permit for the NTEA satellite facility. All wells will be constructed in accordance with the provisions of this section.

Of the three methods, CBR routinely uses Method 1, shown on **Figure 1.3-2**. Method 2, shown on **Figure 1.3-3,** may be used by the CBR geologic staff when there is a need to study the geology of an area and to determine the best placement of the screens without having to attach screens to the casing string. Method 3, shown on **Figure 1.3-4,** is not routinely used, but is maintained as an option so that the method (including minor modifications) can be used if warranted for specific geological formations. All of these methods are appropriate for constructing monitor wells and have been approved by the NDEQ under the UIC Permit.

- Method 1

  For this method, the well is drilled to depth in the Pierre Shale and then logged. Based upon the e-log, geological staff will select a casing depth, and will then begin to review the local area wells for the best location (depth) to install the screened interval. The well is cased through the mining zone and cemented in place. Cement flows down the inside of the casing, exits out the bottom, and flows back up the annulus to the surface. Cement may be pushed out of the bottom of the casing by using a rubber cement plug pushed to the bottom, or may be displaced using fresh water. If the cement is displaced with water, a rig will need to drill the excess cement out of the casing prior to under-reaming and setting screens. If the cement is displaced using a cement plug, then nothing further is required prior to under-reaming. The under-reaming process begins with a rig tripping (inserting in borehole) a specialized drill bit into the depths to be screened. Blades on the bit open outward to cut away and remove the casing and cement grout from the area to be screened. When the interval to be screened has been cut away, the drill rig removes the drill pipe, and the hole is logged to make certain that the cut is accurate. If the cut-check depths are determined to be satisfactory, the rig is used to place the screen assembly at the selected depth and then develop the well.

Method 1 is the primary method used for all injection and production wells. A slight variation of this method is used for monitor wells. Monitor wells are cased to the top of the mining zone and cemented using water displacement. After allowing the cement to set up (harden), the excess cement is drilled out of the casing and the well is logged to determine where to place the well screens.

Method 1 is similar to Method 2, except that a plug and weep holes are not used.

- Method No. 2

Method 2 uses a screen telescoped down inside the cemented casing. A hole is drilled and geophysically logged to locate the desired screen interval. The hole is then reamed if necessary only to the top of the desired screen interval. Next, a string of casing with a plug at the lower end and weep holes just above the plug is set into the hole. Cement is then pumped down the casing and out the weep holes. It returns to the surface through the annulus. After the cement has cured, the residual cement in the casing and plug are drilled out, with the drilling continuing through the desired zone. The screen with a K-packer and/or shale traps is then telescoped through the casing and set in the desired interval. The packer and/or shale traps hold the screen in the desired position while acting as a fluid seal. Well development is again accomplished by airlifting or pumping. Minor variations from these procedures may be used as conditions require.

Method 2 is an improvement over Method 3 due to drilling only to the top of the mining zone. At that point, the well is cased and cemented. Because the drill hole does not penetrate through the mining zone, no cement basket must be used. A cement plug and weep holes are used to place the cement.

- Method No. 3

This method involves setting an integral casing/screen string. The method consists of drilling a hole to the Pierre Shale; geophysically logging the hole to define the desired screen interval; and reaming the hole, if necessary, to the desired depth and diameter. Next, a string of casing with the desired length of screen attached to the lower end is placed into the hole. A cement basket is attached to the blank casing just above the screen to prevent plugging of the screen interval during cementing. The cement is pumped down the inside of the casing to a plug set just below the cement basket. The cement passes out through weepholes in the casing and is directed by the cement basket back to the surface through the annulus between the casing and the drill hole. After the cement has sufficiently cured, the residual cement and plug are drilled out and the well is developed by airlifting or pumping.

For all three well completion methods, casing centralizers, located at a maximum spacing of 100 feet, are run on the casing to ensure that it is centered in the drill hole and that an effective cement seal is provided. The purpose of the cement is to stabilize and strengthen the casing and plug the annulus of the hole to prevent vertical migration of solutions. The volume of cement used in each well is determined by estimating the volume required to fill the annulus and ensure that cement returns to the surface. In almost all cement jobs, returns to the surface are observed. In rare cases, however, the drilling may result in a larger annulus volume than anticipated, and cement may not return all the way to the surface. In these cases, the upper portion of the annulus will be cemented from the surface to backfill as much of the well annulus as possible and stabilize the wellhead. This procedure is performed by placing a tremie hose from the surface as far down into the annulus as possible. Cement is pumped into the annulus until return to the surface is observed.

Screening

The exact size of the screen slot is determined by analyzing the formation samples brought to the surface during the drilling process, and is selected at the discretion of the CBR geology staff. The location and amount of drill screen to be set in a well is based upon the geologic and economic factors. Well screens are placed at a selected depth using the drilling rig. The screens are secured in place using a rubber K-packer and blank assembly attached to the top of the screens. The K-packer suspends the screens in the open portion of the well until well development creates a natural gravel pack surrounding the screen.

For injection and production wells, the screen interval is determined by the geology staff based on the location of sands and ore grade material. The zones to be mined are correlated and selected by reviewing geophysical logs, which also confirms that the screened intervals between wells are hydrologically connected. Typically, an interval of approximately 18 feet is screened; however, individual intervals may range from 6 feet to 35 feet in length.

For monitor wells, a slightly different process is followed for placement of the screens. When the monitor well is drilled, the total thickness of the production zone is calculated. The number of screens to be placed in the well must cover the production zone, and the screen-to-blank ratio must exceed 50 percent. Care should be taken to ensure that those zones impacted by nearby wells are covered by screens, and not left blank. A well completion report is documented for each well and submitted to the NDEQ. These data are kept available on site for review. All wells are constructed by a licensed/certified water well contractor, as defined by the Nebraska Health and Human Services System, Water Well Standards and Licensing Act, Article 46.

1.3.2.3 Cement/Grout Specifications

All cement will be ASTM International (ASTM) Type I, II or American Petroleum Institute (API) Class B or G and will meet the following criteria:

- The cement will have a density of no less than 11.5 lbs/gal.
- A bentonite grout shall be mixed as close as possible to a concentration of 1.5 lb. bentonite per gallon of water (1 quart polymer per 100 gallons of water may be premixed

to prevent the clays from hydrating prematurely) and shall have a density of 9.2 lbs./gal or higher.

1.3.2.4 Process Description

Uranium solution mining is a process that takes place underground, or in-situ, by injecting lixiviant (leach) solutions into the ore body and then recovering these solutions when they are rich in uranium. The chemistry of solution mining involves an oxidation step to convert the uranium in the solid state to a form that is easily dissolved by the leach solution. Hydrogen peroxide (H_2O_2) or gaseous oxygen (O_2) is typically used as the oxidant because both revert to naturally occurring substances. Carbonate species are also added to the lixiviant solution in the injection stream to promote the dissolution of uranium as a uranyl carbonate complex.

The reactions representing these steps at a neutral or slightly alkaline pH are:

Oxidation:

$$UO_{2\ (solid)} + H_2O_{2\ (in\ solution)} \rightarrow UO_{3\ (at\ solid\ surface)} + H_2O$$

$$UO_{2\ (solid)} + \tfrac{1}{2}\, O_{2\ (in\ solution)} \rightarrow UO_{3\ (at\ solid\ surface)}$$

Dissolution:

$$UO_3 + 2\ HCO_3^{-1} \rightarrow UO_2(CO_3)_2^{-2} + H_2O$$

$$UO_3 + CO_3^{-2} + 2HCO_3^{-1} \rightarrow UO_2(CO_3)_3^{-4} + H_2O$$

The principal uranyl carbonate ions formed as shown above are uranyl dicarbonate, $UO_2(CO_3)_2^{--2}$, (UDC), and uranyl tricarbonate $UO_2(CO_3)_3^{-4}$ (UTC). The relative abundance of each is a function of pH and total carbonate strength.

Solutions resulting from the leaching of uranium underground will be recovered through the production wells and piped to the satellite facility for extraction. The uranium recovery process employs the following steps:

1. Loading of uranium complexes onto an IX resin
2. Reconstitution of the leach solution by addition of carbon dioxide (CO_2) and/or sodium bicarbonate ($NaHCO_3$) and an oxidizer
3. Elution of uranium complexes from the resin
4. Precipitation of uranium

The first two steps will be performed at the satellite facility. Steps 3 and 4 will be performed at the CPF. The process flow sheet for the above steps is shown on **Figure 1.3-5**. The left side of **Figure 1.3-5** depicts the uranium extraction process completed at the satellite facility. The right side of the figure shows the uranium recovery steps that will be performed at the CPF. Once the IX resin at the satellite facility is loaded to capacity with uranium complexes, the resin will be transferred to the CPF for uranium recovery.

Uranium Extraction

The recovery of uranium from the leach solution in the satellite facility will take place in the IX columns. The uranium-bearing leach solution enters the pressurized downflow IX column and passes through the resin bed. The uranium complexes in solution are loaded onto the IX resin in the column. This loading process is represented by the following chemical reaction:

$$2\ R\ HCO_3 + UO_2(CO_3)_2^{-2} \rightarrow R_2UO_2(CO_3)_2 + 2HCO_3^{-1}$$

$$2\ RCl + UO_2(CO_3)_2^{-2} \longrightarrow R_2UO_2(CO_3)_2 + 2Cl^-$$

$$R_2SO_4 + UO_2(CO_3)_2^{-2} \longrightarrow R_2UO_2(CO_3)_2 + SO_4^{-2}$$

As shown in the reaction, loading of the uranium complex results in simultaneous displacement of chloride, bicarbonate, or sulfate ions.

The now barren leach solution passes from the IX columns to be reinjected into the formation. The solution is refortified with sodium and carbonate chemicals, as required, and pumped to the wellfield for reinjection into the formation. The expected lixiviant concentration and composition are shown in **Table 1.3-2.**

Resin Transport and Elution

Once the majority of the IX sites on the resin in an IX column are filled with uranium, the column will be taken out of service. The resin loaded with uranium will be transported by tanker truck to the CPF for elution and final processing. Once the resin has been stripped of the uranium by elution, it will be returned to the satellite facility for reuse in the IX circuit.

At the CPF, the loaded resin will be stripped of uranium by an elution process based on the following chemical reaction:

$$R_2UO_2(CO_3)_2 + 2Cl^- + CO_3^{-2} \longrightarrow 2\ RCl + UO_2(CO_3)_2^{-2}$$

After the uranium has been stripped, the resin is rinsed with a solution containing $NaHCO_3$. This rinse removes the high chloride eluent physically entrained in the resin and partially converts the resin to bicarbonate form. In this way, chloride ion buildup in the leach solution can be controlled.

Precipitation

When a sufficient volume of pregnant eluent is held in storage, it is acidified to destroy the uranyl carbonate complex ion. The solution is agitated to assist in removal of the resulting CO_2. The decarbonization can be represented as follows:

$$UO_2(CO_3)_3^{-4} + 6H^+ \longrightarrow UO_2^{++} + 3\ CO_2 + 3H_2O$$

Sodium hydroxide (NaOH) is then added to raise the pH to a level conducive for precipitating pure crystals.

H_2O_2 is then added to the solution to precipitate the uranium according to the following reaction:

$$UO_2^{++} + H_2O_2 + 2H_2O \longrightarrow UO_4 \bullet 2H_2O + 2H^+$$

The precipitated uranyl peroxide slurry is pH adjusted, allowed to settle, and the clear solution decanted. The decant solution is recirculated back to the barren makeup tank, sent to fresh salt brine makeup, or sent to waste. The thickened uranyl peroxide is further dewatered and washed. The solids discharge is either sent to the vacuum dryer for drying before shipping or is sent to storage for shipment as slurry to a licensed recovery or converting facility.

Wellfield and Process Wastes

All well development water will be captured in water trucks specifically labeled and dedicated for such purpose, and equipped with signage indicating that these trucks may only discharge their contents to the MEA wastewater system. The management of these wastewaters is discussed in Section 3.12.2.1..

The operation of the satellite facility will produce a production bleed stream continuously withdrawn from the recovered lixiviant stream at a rate that is expected to be 0.5 to 2.0 percent of the total volume of recovered lixiviant. The production bleed stream is taken following the recovery of uranium by IX and has the same chemical characteristics as the lixiviant. The production bleed waste stream will be managed by a DDW well injection, which will be constructed at the satellite facility.

The other source of wastewater resulting from uranium mining activities in the MEA is the eluent bleed stream at the CPF. This is an existing source of wastewater at the CPF currently produced at a rate of approximately 5 to 10 gpm. It is likely that the eluent bleed stream will increase by a maximum of 10 percent due to processing of IX resin from the satellite facility. The eluent bleed waste stream will be managed by reuse in the processing facility or disposal by DDW injection at the CPF.

All byproduct material produced as a result of the operation of the satellite facility will be disposed of at a licensed facility approved for disposal of 11e.(2) byproduct material, similar to provisions made for the byproduct material currently produced. All solid waste will be disposed of in an approved landfill in accordance with current practice. There will be no onsite disposal of these materials.

Based on the proposed project development schedule and the water balance of the MEA project, liquid waste disposal methods will be phased for the MEA operations. Initially, two DDWs will be used as the primary disposal option, and as flows increase over the years due the addition of new MUs and restoration activities, additional disposal options will be added. Liquid waste disposal operations and alternatives are discussed in more detail in Sections 2.3.1.3 (waste management), 3.12.2.1 (liquid waste disposal options), and 3.12.2.2 (project water balance).

1.3.2.5 Logging Procedures and Other Tests

Appropriate geophysical logs and other tests are conducted during the drilling and construction of new Class III wells. These are determined based on the intended function, depth, construction, and other characteristics of the well; availability of similar data in the area of the drilling site; and the need for additional information that may arise from time to time as the construction of the well progresses.

Logging Equipment

CBR currently owns three operational logging units. All were built by Century Geophysical Corporation in Tulsa, Oklahoma. These units are capable of logging drill holes to a depth of approximately 2,000 feet.

These trucks are capable of using a wide variety of tools. All of these tools (or probes, as used by CBR) measure Single Point Resistance (RES), static spontaneous potential (SSP), Natural

Gamma (GAM[NAT]), and Deviation. Some of the probes used by CBR are also capable of measuring temperature, 16-inch normal resistance, and 64-inch normal resistance (**Table 1.3-3**). Deviation with these units is measured using a slant angle and azimuth technique. Standardized procedures are used by trained personnel to carry out the logging tasks.

Groundwater Measurements

Groundwater sampling and water level measurements are two tests typically conducted for new wells. Results of the groundwater sampling and analysis are used to evaluate water quality baseline values for future restoration to groundwater standards, and water level measurements provide for a more detailed understanding of the hydraulic gradient within the MEA. Groundwater monitoring for new wells is discussed below.

Well Development

Following well construction (and before baseline water quality samples are taken for restoration and monitoring wells), the wells must be developed to restore the natural hydraulic conductivity and geochemical equilibrium of the aquifer. All wells are initially developed immediately after construction using airlifting or other accepted development techniques. This process is necessary to allow representative samples of groundwater to be collected. Well development removes water and drilling fluids from the casing, formation, and borehole walls along the screened interval. The primary goal for well development is to allow formation water to enter the well screen.

Initially, well development is performed by airlifting and cleanup with a drill rig. The well is developed until the water produced is clear. This can be determined visually or with a turbidimeter. During the final stages of initial development, water samples will be collected in a transparent or translucent container and visually examined for turbidity (i.e., cloudiness and visual suspended solids). Development continues until clear, sediment-free formation water is produced.

When the water begins to clear, the development flow will be temporarily stopped and/or the flowrate will be varied. Sampling and examination for turbidity will continue. When varying the development rate no longer causes the sample to become turbid, the initial development will be deemed complete.

Before obtaining baseline samples from monitor or restoration wells, the well must be further developed to ensure that representative formation water is available for sampling. Final development is performed by pumping the well or swabbing for an adequate period to ensure that stable formation water is present. pH and conductivity are monitored during this process to ensure that development activities have been effective. The field parameters must be stable at representative formation values before baseline sampling will begin.

Following well installation, all well development water will be captured in water trucks specifically labeled and dedicated for such purpose, and equipped with signage indicating that these trucks may only discharge their contents for injection into ~~the~~an onsite DDW (see additional discussions in Section 3.12.2.1). Alternatively, these fluids may be transported to the CPF evaporation ponds, but only if there are fluid separation equipment issues at the MEA satellite facility. Additional wellfield and process waste are discussed below. Section 4.2.1.1 discusses handling and disposal of well drilling fluids and well development water.

Well Integrity Testing

All wells (i.e., injection, production, and monitor) are field tested under pressure-packer tests to demonstrate the mechanical integrity of the well casing. Every well will be tested after well construction before it can be placed into service; after any workover with a drill rig or servicing with equipment or procedures that could damage the well casing; at least once every 5 years; and whenever there is any question of casing integrity. To ensure the accuracy of the integrity tests, periodic comparisons are made between the field pressure gauges and a calibrated test gauge. The mechanical integrity test procedure has been approved by the NDEQ and is currently contained in the Safety, Health, Environment and Quality Management System (SHEQMS) Volume III, Operating Manual. These same procedures will be used at the MEA.

The following general mechanical integrity test procedure is employed:

- The well is tested after well development and prior to the well being placed into service. The test consists of placement of two packers within the casing. The bottom packer is set just above the well screen and the upper packer is set at the wellhead. The packers are inflated with nitrogen, and the casing is pressurized with water to 125 percent of the maximum operating pressure (i.e., 125 pounds per square inch [psi]).
- The well is then "closed in" and the pressure is monitored for a minimum of 20 minutes.
- If more than 10 percent of the pressure is lost during this period, the well has failed the integrity test. When possible, a well that fails the integrity testing will be repaired and the testing repeated. If the casing leakage cannot be repaired or corrected, the well is plugged and reclaimed as described in Section 6.

CBR submits all integrity testing records to the NDEQ for review after the initial construction of an MU or wellfield. Test results are also maintained on site for regulatory review.

1.3.2.6 Wellfield Design and Operation

The proposed MEA MU timeline and MU map are shown on **Figures 1.1-6** and **1.1-7**, respectively. The preliminary map and mine timeline are based on current knowledge of the area. As the MEA is developed, the mine timeline and an MU map will be further developed. The MEA will be subdivided into an appropriate number of MUs. Each MU will contain wellhouses where injection and recovery solutions from the satellite facility building are distributed to the individual wells. The injection and production manifold piping from the satellite process facility to the wellhouses will be either PVC or HDPE with butt-welded joints or equivalent. Injection pressure will be monitored in the wellhouse manifolds. Oxidizer will be added to the injection stream, and all injection lines off of the injection manifold will be equipped with totalizing flowmeters, which will be monitored in the satellite Control Room. The MEA wellfield will be designed consistent with the existing CBR wellfields.

The wellfield injection/production pattern employed is based on a hexagonal seven-spot pattern, modified as needed to fit the characteristics of the ore body. The standard production cell for the seven-spot pattern contains six injection wells surrounding a centrally located recovery well.

The cell dimensions vary depending on the formation and the characteristics of the ore body. The injection wells placed in a normal pattern are expected to be between 65 and 150 feet apart. A typical wellfield layout is shown on **Figure 1.3-6**. The wellfield is a repeated seven-spot design, with the spacing between production wells ranging from 65 to 150 feet. Other wellfield designs include alternating single line drives.

All wells are completed so they can be used as either injection or recovery wells, so that wellfield flow patterns can be changed as needed to improve uranium recovery and restore the groundwater in the most efficient manner. During operations, leaching solution enters the formations through the injection wells and flows to the recovery wells. Within the monitor well ring, prior to stability monitoring, more water is produced than injected to create an overall hydraulic cone of depression in the production zone. Under this pressure gradient, the natural groundwater movement from the surrounding area is toward the wellfield, providing additional control of the leaching solution movement. The difference between the amount of water produced and injected is the wellfield "bleed". The minimum over-production or bleed rates will be a nominal 0.5 percent of the total wellfield production rate, and the maximum bleed rate typically approaches 2.0 percent. Bleed is adjusted as necessary to ensure that the perimeter ore zone monitor wells are influenced by the cone of depression until stability monitoring described in Section 5.4.1.5 begins.

Monitor wells will be placed in the basal sandstone of the Chadron Formation and overlying Brule Formation and Arikaree Group aquifers. All monitor wells will be completed by one of the three methods discussed above and developed prior to leach solution injection. The development process for monitor wells includes establishing baseline water quality before the initiation of mining operations. As the MEA is developed, the MU map showing the locations of monitor wells will be developed further.

Injection of solutions for mining will be at a rate of 6,000 gpm with a 0.5 to 2.0 percent production bleed stream. Production solutions returning from the wells to the production manifold will be monitored with a totalizing flowmeter. All pipelines and trunklines will be pressure checked for leaks and buried prior to production operations.

A water balance for the proposed satellite facility is shown on **Figure 1.3-7** and **Appendix T**. The liquid waste generated at the satellite facility will be primarily the production bleed which, at a maximum, is estimated at 1.2 percent of the production flow. At 6,000 gpm process flow, the maximum volume of liquid waste in the year 2024 would be approximately 31 gpm. CBR proposes to handle the liquid waste using DDW injections. Detailed discussions of the MEA water balance calculation and evaluation are discussed in Section 3.12.2.2.

Regional information, previous CBR license and permit submittals, and historical operational practices indicate that the minimum pressure that could initiate hydraulic fracture is 0.63 psi per foot of well depth. This value has historically and successfully been applied to CBR operations. Calculations for MEA result in a value of 0.53 psi. As such, the injection pressure for the MEA will be limited to less than 0.53 psi per foot of well depth. Injection pressures also will be limited to the pressure at which the well was integrity tested.

As discussed in Section 3.4.3.2, a regional pumping test has been conducted to assess the hydraulic characteristics of the basal sandstone of the Chadron Formation and overlying confining units. Pumping tests will also be performed for each MU not covered by the regional pump test to demonstrate hydraulic containment above the production zone, demonstrate communication among the production zone mining and exterior monitor wells, and to further evaluate the hydrologic properties of the basal sandstone of the Chadron Formation.

~~A full and detailed analysis of the potential impacts of the mining operations at the MEA on surrounding water users will be provided in an Industrial Groundwater Use Permit application. A similar permit application was submitted by Ferret Exploration of Nebraska (predecessor to CBR) in 1991.~~ The Industrial Groundwater Use Permit application for the exitisting pla~~application~~nt~~n~~ states that water levels in the City of Crawford (approximately 3 miles [4.8 km] northwest of the mining area) could potentially be impacted by approximately 20 feet by consumptive withdrawal of water from the basal sandstone of the Chadron Formation during mining and restoration operations (based on a 20-year operational period). In contrast, t~~T~~he nearest town to the MEA site is the community of Marsland, which is located approximately 4.6 miles (7.4 km) southwest of the MEA (centerpoint of Town of Marsland to centerpoint of MEA satellite building). There is no public water supply for the community of Marsland, with residences scattered throughout the MEA AOR being supplied with domestic water from private wells. Private well use is discussed in more detail in Section 3.4.1, and impacts to water levels are discussed in Section 4.14.3.6.

Although similar impacts to water levels in the basal sandstone of the Chadron Formation are expected at the MEA, ~~No~~ impacts to other users of groundwater are~~is~~ not expected because there is no documented existing use of the basal sandstone of the Chadron Formation in the proposed MEA or associated AOR.

Because the basal sandstone of the Chadron Formation (production zone) is a deep confined aquifer, no surface water impacts are expected. Based on available information, all water supply wells within the MEA and AOR are completed in the relatively shallow Arikaree and/or Brule Formation, with no domestic or agricultural use of groundwater from the basal sandstone of the Chadron Formation.

Further, the geologic and hydrologic data presented in Sections 3.3 and 3.4, respectively, demonstrate that (1) uranium mineralization is limited to the basal sandstone of the Chadron Formation, and (2) the basal sandstone of the Chadron Formation is isolated from underlying and overlying sands. Hence, the mining operations are expected to impact water quality only in the basal sandstone of the Chadron Formation, and restoration operations will be conducted in the basal sandstone of the Chadron Formation following completion of mining.

Based on a bleed of 0.5 to 2.0 percent, the potential impact from consumptive use of groundwater is expected to be minimal. A bleed of 0.5 to 1.5 percent has been successfully applied in the current licensed area. In this regard, the vast majority (on the order of 98 percent) of groundwater used in the mining process will be treated and re-injected (**Figure 1.3-7**). Potential impacts on groundwater quality due to consumptive use outside the license area are expected to be negligible.

The data were evaluated using a Theis semi-steady state analytical solution, which includes the following assumptions:

- The aquifer is confined and has apparent infinite extent.
- The aquifer is homogeneous and isotropic, and of uniform effective thickness over the area influenced by pumping.

- The piezometric surface is horizontal prior to pumping.
- The well is pumped at a constant rate.
- Water removed from storage is discharged instantaneously with a decline in head.
- The pumping well is fully penetrating.
- Well diameter is small, so well storage is negligible.

Based on a drawdown

response observed at the most distant observation well locations (Monitor 2 and Monitor 8), the ROI during the pumping test was estimated to be in excess of approximately 8,800 feet. More than 0.8 foot of drawdown was achieved during testing in all observation wells completed in the basal sandstone of the Chadron Formation, with a maximum drawdown of 23.40 feet observed in CPW-2010-1A (pumping well) during the test. Furthermore, during pumping and recovery periods, no discernible drawdown or recovery responses attributed to the test were observed in overlying Brule Formation observation wells, which supports the conclusion that adequate confinement exists between the overlying Brule Formation and the basal sandstone of the Chadron Formation. The results of the pumping test are provided in more detail in Section 3.4.3.2.

As discussed in Section 6 of this document, an extensive water sampling program will be conducted prior to, during, and following mining operations at the satellite facility to identify any potential impacts to water resources in the area.

The groundwater monitoring program is designed to establish baseline water quality prior to mining, detect excursions of lixiviant either horizontally or vertically outside of the production zone, and determine when the production zone aquifer has been adequately restored following mining. The program will include sampling of monitoring wells and private wells within and surrounding the license area to establish pre-mining baseline water quality. Water quality sampling will continue throughout the operational phase of mining for detection of excursions. Water quality will also be sampled during restoration, including stabilization monitoring at the end of restoration activities, to determine when baseline or otherwise acceptable water quality has been achieved.

During operation, the primary purpose of the wellfield monitoring program will be to detect and correct conditions that could lead to an excursion of lixiviant or detect such an excursion, should one occur. The techniques employed to achieve this objective include monitoring of production and injection rates and volumes, wellhead pressure, water levels, and water quality.

Monitoring of production (extraction) and injection rates and volumes will enable an accurate assessment of water balance for the wellfields. A bleed system will be employed that will result in less leach solution being injected than the total volume of fluids (leach solution and native groundwater) being extracted. A bleed of 0.5 to 2.0 percent will be maintained during production. Maintenance of the bleed will cause an inflow of groundwater into the production area and prevent loss of leach solution.

Injection pressures are monitored in the wellhouse at the manifold with an audible and visible alarm monitored 24 hours per day, 7 days per week in the control room. The alarms are set to prevent pressure in excess of 100 psi at the wellhouse manifold, below the 125 psi integrity test pressure. Due to line losses, pressures at the wellheads remain below that which is monitored at wellhouse manifold.

Each new production well (extraction and injection) will be pressure-tested to confirm the integrity of the casing prior to being used for mining operations. Wells that fail pressure testing will be repaired or abandoned and replaced as necessary.

Water levels will be routinely measured in the production zone and overlying aquifer. Sudden changes in water levels within the production zone may indicate that the wellfield flow system is out of balance. Flow rates would be adjusted to correct this situation. Increases in water levels in the overlying aquifer may indicate fluid migration from the production zone. Adjustments to well flowrates or complete shutdown of individual wells may be required to correct this situation. Increases in water levels in the overlying aquifer may also indicate casing failure in a production, injection, or monitor well. Isolation and shutdown of individual wells can identify wells causing the water level increases.

To ensure that the leach solutions are contained within the designated area of the aquifer being mined, the production zone and overlying aquifer monitor wells will be sampled once every 2 weeks as discussed in Section 6.2.2.

1.3.2.7 Central Processing Facility, Satellite Facility, and Chemical Storage Facilities – Equipment Used and Material Processed

The uranium recovery process described in the preceding section will be accomplished in two steps. The uranium will be recovered from the leach solution by IX at the satellite facility. The subsequent processing of the loaded IX resin to remove the uranium (elution), the precipitation of uranium, and the dewatering and packaging of solid uranium (yellowcake) will be performed at the existing CPF. The CPF has been expanded in response to the increase in the IX resin handling, elution, precipitation, thickening, and drying circuits to handle additional production from the proposed NTEA and TCEA. Depending on the mining timelines for the existing CPF wellfields and the MEA, it is possible that the belt filter and dryer capacity of the CPF may need to be increased.

Marsland Satellite Facility Equipment

Only the equipment proposed for the satellite facility is described in this section. The equipment and processes in the CPF are covered under the existing NRC Source Materials License Number SUA-1534. A general arrangement of equipment for the satellite facility is shown on **Figure 1.1-8**. The satellite facility equipment will be housed in a building approximately 130 feet long by 100 feet wide. The satellite facility equipment includes the following systems:

- IX
- Filtration
- Resin transfer
- Chemical addition

The satellite facility will be located within a 1.8-acre area in section 30, T31N, R52W. ~~The DDW will be located nearby.~~ **Figure 1.1-7** shows the plan view of these facilities.

The satellite facility will house the IX columns, water treatment equipment, resin transfer facilities, pumps for injection of lixiviant, wastewater tanks, and an employee lunch room/ break area. Bulk soda ash, CO_2, and O_2 in compressed form and/or H_2O_2 will be stored adjacent to the satellite facility or in the wellfield. $NaHCO_3$ and/or gaseous CO_2 are added to the lixiviant as the fluid leaves the satellite facility for the wellfields. O_2 is added to the injection line for each injection well at the wellhouses.

The IX system consists of eight fixed-bed IX columns. The IX columns will be operated as three sets of two columns in series with two columns available for restoration. The IX system is designed to process recovered leach solution at a rate of 6,000 gpm. Once a set of columns is loaded with uranium, the resin is transported by truck to the CPF. The downflow columns are pressurized, sealed systems so there is no overflow of water, O_2 stays in solution, and radon emissions are contained. Radon releases from the pressurized downflow columns only when the individual columns are disconnected from the circuit and opened to remove the resin for elution. One disadvantage of the downflow column is that there must be good pressure control. Exposure pathways associated with downflow columns to be used at MEA are discussed in Section 4.12.2.1.

After the IX process, the barren leach solution recovered from the wellfield is replenished with an oxidant and leaching chemicals (i.e., $NaHCO_3$ and/or CO_2). The injection filtration system consists of optional backwashable filters, with an option of installing polishing filters downstream. The lixiviant injection pumps are centrifugal type.

Areas in the proposed satellite facility where fumes or gases could be generated are discussed in Section 4.12.2. The potential sources are minimal in the satellite facility because the mining solutions contained in the process equipment are maintained under a positive pressure. Building ventilation in the process equipment area will be accomplished by the use of an exhaust system that draws in fresh air and sweeps the satellite facility air to the atmosphere.

Chemical Storage Facilities

Chemical storage facilities at the satellite facility will include both hazardous and non-hazardous material storage areas. Bulk hazardous materials, which have the potential to impact radiological safety, will be stored outside and segregated from areas where licensed materials are processed and stored. Other non-hazardous bulk process chemicals (e.g., $NaCO_3$) that do not have the potential to impact radiological safety may be stored within the satellite facilities.

Process Related Chemicals

Process-related chemicals stored in bulk at the satellite facility will include carbon dioxide (CO_2), oxygen (O_2), and/or hydrogen peroxide (H_2O_2). Sodium sulfide may also be stored for use as a reductant during groundwater restoration.

- CO_2

CO_2 is stored adjacent to the satellite facility, where it will be added to the lixiviant prior to leaving the satellite facility.

- O_2

O_2 is also typically stored at the satellite facility, or within wellfield areas (where it is centrally located) for addition to the injection stream in each wellhouse. Because O_2 readily supports combustion, fire and explosion are the principal hazards that must be controlled. The O_2 storage facility will be located a safe distance from the satellite facility and other chemical storage areas for isolation. The storage facility will be designed to meet industry standards in the National Fire Protection Act (NFPA-50; NFPA 1996).

O_2 service pipelines and components must be clean of oil and grease because O_2 will cause these substances to burn with explosive violence if ignited. All components intended for use with the O_2 distribution system will be properly cleaned following recommended methods in CGA G-4.1 (CGA 2000). The design and installation of O_2 distribution systems is based on CGA G-4.4 (CGA 1993).

- Sodium Sulfide

Hazardous materials typically used during groundwater restoration activities include the addition of a chemical reductant (i.e., sodium sulfide [Na_2S] or hydrogen sulfide [H_2S] gas). To minimize potential impacts to radiological safety, these materials are stored outside of process areas. Na_2S is currently used as the chemical reductant during groundwater restoration at the CPF. The material consists of a dry flaked product and is typically purchased on pallets of 55-pound bags or in super sacks of 1,000 pounds. The bulk inventory is stored outside process areas in a cool, dry, clean environment to prevent contact with any acid, oxidizer, or other material that may react with the product. H_2S gas has never been used at the CPF. In the event that CBR determines that use of H_2S as a chemical reductant is necessary, proper safety precautions will be taken to minimize potential impacts to radiological and chemical safety.

As part of the SHEQMS, a risk assessment was completed to identify potential hazards and risks associated with chemical storage facilities (and other processes) and to mitigate those risks to acceptable levels. The risk assessment process identified hydrochloric acid as the most hazardous chemical with the greatest potential for impacts to chemical and radiological safety. The hydrochloric acid storage and distribution system is located only at the existing CPF and will not be used at the satellite facility.

None of the hazardous chemicals used at the CPF are regulated under the U.S. Environmental Protection Agency (EPA) Risk Management Program (RMP) regulations. The RMP regulations require certain actions by covered facilities to prevent accidental releases of hazardous chemicals and minimize potential impacts to the public and environment. These actions include measures such as accidental release modeling, documentation of safety information, hazard reviews, operating procedures, safety training, and emergency response preparedness.

1.3.2.8 Non-Process Related Chemicals

Non-process related chemicals that will be stored at the satellite facility include petroleum (gasoline, diesel) and propane. Due to the flammable and/or combustible properties of these materials, all bulk quantities will be stored outside of process areas at the satellite facility. All gasoline and diesel storage tanks are located aboveground and within secondary containment structures to meet regulatory requirements.

1.3.2.9 Satellite Facility Instrumentation and Control

The wellhouses will be located remotely from the satellite facility building. A distribution system will be used to control the flow to and from each well in the wellfield. Wellfield instrumentation will measure total production and injection flow and indicate the pressure being applied to the injection trunklines. Wellhouses will be equipped with wet alarms to monitor the presence of liquids in the wellhouse sumps. The system is monitored 24 hours per day, 7 days per week by control room operators. The operators rely on visual and audible alarms from a variety of systems to control mine operations. Power failures, pressure exceedances, and flow disruption are some of the conditions for which alarm systems will be monitored.

Instrumentation will monitor the total flow into the satellite facility, the total injection flow leaving the facility, and the total waste flow leaving the facility. Instrumentation on the facility injection manifold will record an alarm in the event of any pressure loss that might indicate a leak or rupture in the injection system. The instruments used for flow measurement will include, but are not limited to, turbine meters, ultrasonic meters, variable area meters, electromagnetic flow meters, differential pressure meters, positive displacement meters, piezoelectric, and vortex flow meters.

The injection pumps are equipped with pressure-reducing valves so that they are incapable of producing pressures high enough to exceed design pressure of the injection lines or the maximum pressure demonstrated in each injection well. Pressure gauges, pressure shutdown switches, and pressure transducers will be used to monitor and control the trunkline pressures. During power failures, overpressurizing of wells is not possible, as all pump systems are shut down.

The basic control system at the satellite facility and associated wellfields will be built around a Sequential Control and Data Acquisition (SCDA) network. At the heart of this network is a series of programmable logic controllers. This system allows for extensive monitoring and control of all waste flows, wellfield flows, and facility recovery operations.

The SCDA system will be interconnected throughout the facility via a Local Area Network (LAN) to computer display screens. The software used to display facility processes and collect data incorporates a series of menus which allows the facility operators to monitor and control a variety of systems and parameters. Critical processes, pressures, and wellfield flows will have alarmed set-points that alert operators when any are out of tolerance.

In addition, each wellhouse will contain its own processor, which will allow it to operate independent of the main computer. Pressure switches will be fitted to each injection manifold in the wellhouse to alert the facility and wellfield operators of increasing manifold pressures. All critical equipment will be equipped with uninterruptible 30-minute power supply systems to be used in the event of a power failure.

Through this system, not only will the facility operators be able to monitor and control every aspect of the operation in real time, but management will be able to review historical data to develop trend analysis for production operations. This will not only ensure an efficient operation, but will allow CBR personnel to anticipate problem areas and to remain in compliance with appropriate regulatory requirements.

In the process areas, tank levels are measured in chemical storage tanks as well as process tanks.

Detailed information on the instrumentation and controls will be developed as part of the final design activities prior to construction. This information will be made available to the NRC for review prior to any construction activities.

Handheld radiation detection instruments and portable samplers will be used to monitor radiological conditions at the satellite facility. Specifications for this equipment are included in the SHEQMS Volume IV, Health Physics Manual.

1.3.2.10 Gaseous and Airborne Particulate Control

This section describes the gaseous effluent control systems that will be installed in the MEA.

Tank and Process Vessel Ventilation Systems

A separate ventilation system will be installed for all indoor non-sealed process tanks and vessels where radon-222 or process fumes would be expected. The system will consist of an air duct or piping system connected to the top of each of the process tanks that could potentially produce radon-222 (i.e., resin transfer tank and wastewater tanks). Redundant exhaust fans will direct collected gases to discharge piping that will exhaust fumes to the outside atmosphere. The fans will be designed such that the system will be capable of limiting employee exposures with the failure of any single fan. Discharge stacks will be located away from building ventilation intakes to prevent introducing exhausted radon into the facility as recommended in Regulatory Guide (RG) 8.31. Airflow through any openings in the vessels will be from the process area into the vessel and the ventilation system, controlling any releases that occur inside the vessel. Separate ventilation systems may be used as needed for the functional areas within the satellite facility process building.

A tank ventilation system of this type is used in the CPF process area. Operational radiological in-plant monitoring for radon concentrations has proven this system to be effective for minimizing employee exposure.

Work Area Ventilation System

The ventilation system at the proposed MEA facilities would be similar to that used at the CPF. Exhaust fans would exhaust air within the building outside to the top of the building, drawing in fresh air. The discharge stacks will be located away from the building ventilation intakes and positioned on the leeward side of the satellite building (based on predominant wind direction) to prevent introducing exhausted emissions into the facility. These exhaust fans would be located at different levels to ensure that areas where radon could accumulate are ventilated sufficiently. The exhaust fans will create a negative flow, ensuring that air will not enter the process areas from vessels and systems within the satellite building. There will be redundant fans of the same size and capacity, which will operate only when the primary fans are inoperative due to maintenance or repair.

Storage tanks with the potential for radon emissions would also be vented to the outside of the building. Separate and independent local ventilation systems may be used temporarily as needed for non-routine activities such as maintenance. Radon daughter monitoring at the proposed satellite facility would be used to verify that radon daughters are maintained below the 25 percent derived air concentration (DAC) action level. Ongoing operations would ensure that the ventilation system operates satisfactorily and as designed through the use of standard operating procedures (SOPs).

Minor radon emissions may occur in a wellfield from wellheads and wellhouses. Vents will not be installed on wellhead enclosures, but SOPs will be followed when accessing a wellhead enclosure in order to ensure minimal exposures to personnel. Wellhouse buildings will be ventilated with either roof- or wall-mounted fans. When the buildings are accessed, the doors will be opened, allowing for additional ventilation of the building prior to entry by personnel. Radon emissions associated with wellfield operations will quickly disperse into the atmosphere.

Other emissions to the air are limited to exhaust and dust from limited vehicular traffic. No significant amounts of process chemicals will be used at the satellite facility. There are no significant combustion-related emissions from the process facility, as commercial electrical power is available at the site. The primary types of non-radiological pollutants that could occur during operations at the MEA site are discussed in Section 4.6.2. The satellite facility operational building would not house combustion devices, except for the propane heaters used for heating the building as needed.

Occupational and public exposures to radon emitted from the MUs and from the satellite processing facility were analyzed using the MILDOS-AREA computer model to ensure that the discharged amount would be within regulatory dose limits. The results of this modeling are presented in Section 4.12.2.3 through 4.12.2.6.

1.3.2.11 Liquid Waste

Sources of Liquid Waste

ISR mining produces several sources of liquid waste. The potential wastewater sources at the satellite facility will be similar to those currently generated and managed at the CPF. These sources include the following:

Water Generated during Well Development

This water is recovered groundwater and has not been exposed to any mining process or chemicals; however, the water may contain elevated concentrations of naturally occurring radioactive material if the development water is collected from the mineralized zone. Well development water will be captured in water trucks specifically labeled for such purpose and equipped with signage indicating that these trucks may only discharge their contents to the MEA wastewater disposal system.

Well development water will typically be transported to the MEA satellite building and transferred to the well workover fluid tank for eventual disposal in the DDWs. Use of this tank, as well as a backup option, are described in Section 3.12.2.1.

Liquid Process Waste

The operation of the satellite facility results in one primary source of liquid waste, a production bleed. This bleed will be routed to a wastewater tank in the satellite building and then pumped from the tank to ~~the~~an onsite DDW.

Waste Petroleum Products and Chemicals

Small quantities of waste petroleum products and chemicals typical of ISR facilities will be generated and will include items such as waste oil and out-of-date or partially used reagents/chemicals. All such wastes that are non-hazardous will be temporarily stored in appropriate sealed containers above ground prior to disposal by a contracted waste disposal entity. Additional discussions of the management of these products and chemicals are presented in Section 3.12.2.1.

Aquifer Restoration Waste

Following mining operations at MEA, restoration of the affected aquifer commences, which results in the production of wastewater. The current groundwater restoration plan consists of four activities:

1. Groundwater transfer
2. Groundwater sweep
3. Groundwater treatment
4. Wellfield circulation

Only the groundwater sweep and groundwater treatment activities will generate wastewater. During groundwater sweep, water is extracted from the mining zone without injection, causing an influx of baseline quality water to sweep the affected mining area. The extracted water must be sent to the wastewater disposal system during this activity.

Groundwater treatment activities involve the use of process equipment to lower the ion concentration of the groundwater in the affected mining area. An RO unit will be used to reduce the total dissolved solids (TDS) in the groundwater. The RO unit produces clean water (permeate) and brine. The permeate is either injected into the formation or disposed of in the waste disposal system. The brine is sent to the wastewater disposal system.

Stormwater Runoff

Stormwater may be contaminated by contact with industrial materials. Stormwater management is controlled under permits issued by the NDEQ. CBR is subject to stormwater National Pollutant Discharge Elimination System (NPDES) permitting requirements for industrial facilities and construction activities. The NDEQ NPDES regulatory program contained in Title 119 requires that procedural and engineering controls be implemented so that runoff will not pose a potential source of pollution. The design and engineering controls for the proposed MEA facilities will be such that any potentially contaminated stormwater runoff or snowmelt (e.g., any tankage diking, or curbing outside the satellite building) will be collected and disposed of in ~~the~~an onsite DDW. Engineering and procedural controls contained in a Stormwater Pollution Prevention Plan (SWPPP), in combination with the design of the project facilities, will ensure that stormwater runoff is not a potential source of pollution.

Domestic Sewage

Domestic sewage from the satellite facility restroom/toilets and lavatories and the sink in the lunchroom/break area will be disposed of in an approved septic system that meets the requirements of the State of Nebraska. These systems are in common use throughout the United

States, and the effect of the system on the environment is known to be minimal when the systems are designed, maintained, and operated properly. CBR currently maintains a Class V UIC Permit issued by the NDEQ for operation of the septic system at the CPF. A similar permit will be required for the Marsland satellite facility. Because the groundwater on the MEA site is not found at shallow depths, and the site is remote with a relatively small work force, impacts are expected to be minimal.

Chemical toilets may be temporarily located at the MUs and other drilling areas. These toilets will be maintained by a licensed contractor. No impacts associated with the use of chemical toilets are anticipated during site activities.

CBR will employee an estimated 10 to 12 employees at the proposed MEA satellite facility. Assuming 13 gallons per day (gpd) for each employee (based on estimate for industrial employees by EPA), a total of approximately 130 to 160 gpd of sanitary waste would be generated (EPA 2002). An assumed additional 50 gpd of miscellaneous sanitary wastewater (e.g., from restroom/toilets, lavatories, and the sink in the lunchroom/break area) would result in approximately 180 to 210 gpd of sanitary wastewater being discharged to the septic system.

The number of temporary construction employees for the proposed satellite facility is estimated at 10 to 15 personnel. An assumed average of five to 10 full-time employees during construction would result in a total of 15 to 25 employees onsite for some periods. This would result in approximately 200 to 325 gpd of sanitary waste generation. During initial construction, portable sanitary units will be provided and serviced by a third-party contractor.

The septic system will be designed, constructed, operated, and permitted per applicable NDEQ Title 124 regulations.

Laboratory Waste

There will be no laboratory located in the MEA satellite building.

Liquid Waste Disposal

CBR has operated a DDW at the CPF for more than 10 years with excellent results and no serious compliance issues. A second DDW was added in 2011. CBR expects that the liquid waste stream at the MEA site will be chemically and radiologically similar to the waste disposed of in the current DDW.

CBR plans to install DDWs at the MEA site as the primary liquid waste disposal method. CBR has found that permanent deep disposal is preferable to evaporation in evaporation ponds. All compatible liquid wastes at the MEA site will be disposed of in the planned DDWs.

Detailed discussions of liquid waste management and disposal are provided in Sections 2.3.1.3, 3.12.2.1 and 3.12.2.2.

1.3.2.12 Solid Waste

Solid waste generated at the MEA site is expected to include spent resin, resin fines, empty reagent containers, miscellaneous pipe and fittings, and domestic trash. The solid waste will be segregated based on whether it is clean or has the potential for contamination with 11(e).2 byproduct materials.

Non-contaminated Solid Waste

Non-contaminated solid waste is waste which is not contaminated with 11(e).2 byproduct material or which can be decontaminated and re-classified as non-contaminated waste. This type of waste may include trash, piping, valves, instrumentation, equipment, and any other items that are not contaminated or that may be successfully decontaminated. Release of contaminated equipment and materials is discussed in further detail in Section 5 of the Technical Report. Non-contaminated solid waste will be collected on the site in designated areas and disposed of in the nearest permitted sanitary landfill.

11(e).2 Byproduct Material

Solid 11(e).2 byproduct waste consists of solid waste contaminated with 11e.(2) byproduct material that cannot be decontaminated.

11(e).2 byproduct material generated at ISR facilities consists of filters, personal protective equipment (PPE), spent resin, piping, and other materials. These materials will be stored on site until a full shipment can be shipped to a licensed waste disposal site or licensed mill tailings facility. CBR currently maintains an agreement for waste disposal at a properly licensed facility as a license condition for SUA-1534. CBR is required to notify NRC in writing within 7 days if the disposal agreement expires or is terminated and to submit a new agreement for NRC approval within 90 days of the expiration or termination.

If decontamination is possible, surveys for residual surface contamination will be made prior to releasing the material. Decontaminated materials have activity levels lower than those specified in NRC guidance. An area will be maintained inside the restricted area boundary for storage of contaminated materials prior to their disposal.

Septic System Solid Waste

Domestic liquid wastes from the restroom toilets, lavatories, and a sink in the lunchroom/break area will be disposed of in an approved septic system that meets the requirements of the State of Nebraska. The satellite building will not have a laboratory. Solid materials collected in septic systems must be disposed of by companies or individuals licensed by the State of Nebraska. NDEQ regulations for control of these systems are contained in Title 124.

Hazardous Waste

The potential exists for any industrial facility to generate hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). In the State of Nebraska, hazardous waste is governed by the regulations contained in Title 128. Based on waste determinations conducted by CBR, as required in Title 128, CBR is a Conditionally Exempt Small Quantity Generator (CESQG). To date, CBR only generates universal hazardous wastes such as spent waste oil and batteries. CBR estimates that the proposed satellite facility would produce approximately 800 liters of waste oil per year. Waste oil is disposed of by a licensed waste oil recycler. CBR has management procedures in place in the SHEQMS Program Volume VI, Environmental Manual, to control and manage these types of wastes.

Additional discussions of solid wastes are presented in Sections 3.12.3 and 4.2.2.

1.3.2.13 Flooding and Erosion Potential

The potential for flooding or erosion that could impact the proposed in-situ MEA mining processing facilities and MUs has been assessed through two separate studies. The assessment is discussed in Section 4.3.1.1. The complete report of the hydrologic and erosion study, including tables and figures, is provided in **Appendix K-1** (ARCADIS 2012). The complete report of the hydrologic and flood study, including tables and figures, is provided in **Appendix K-2** (ARCADIS 2013). The studies addressed guidance in RG-1569 for an NRC licensee to assess the potential effects of erosion or surface water flooding on a proposed uranium in-situ facility. The ultimate objective of the studies was to determine whether the potential for erosion or flooding may require special design features or mitigation measures to be implemented.

The studies focused on catchment and watershed delineation, hydrologic characteristics, determination of areas most prone to flooding and erosion due to rainfall runoff, and determination of flood flow characteristics. The analysis presented in **Appendix K-1** identifies proposed wells and facilities in areas of moderate to high risk for erosion that may require mitigation measures. The analysis presented in **Appendix K-2** provides estimates of storm-related discharge rates and velocities within the MEA. Seven primary tasks comprise the comprehensive hydrologic and erosion analysis:

- Data collection and analysis: evaluating rainfall, digital elevation data, soil, and land use data
- Watershed delineation: dividing the project area basin into watersheds for detailed hydrologic analysis
- Hydrologic and erosion analysis: determining the flood routing characteristics of watersheds and generate the erosion risk map using hydrologic, land use, and soil data
- Erosion risk assessment: identifying MEA wells and other site facilities in locations of high erosion potential that may require erosion mitigation
- Flood discharge assessment: determining estimated storm-specific discharge rates within MEA watersheds
- Flood velocity assessment: determining estimated storm-specific flood velocities within MEA watersheds

Data Collection

Similar data collection processes were followed for the studies presented in **Appendix K-1** and **Appendix K-2**. The data necessary to complete the studies included digital terrain data or a DEM, existing floodplain maps, land use and land cover data (LULC), National Hydrography Dataset (USGS NHD) published stream network data, soil data, and rainfall data.

The terrain data were downloaded from the USGS National Elevation Dataset (NED) at a resolution of 30 meters. DEM data were used throughout the model domain to describe watershed topography and streams within the hydrologic model. The project area is in the watershed HUC12 101500020607 (Belmont Cemetery-Niobrara River Basin).

Floodplain maps in the form of Federal Emergency Management Agency (FEMA) Digital Flood Insurance Rate Maps (DFIRM) were downloaded from the FEMA Map Service Center (FEMA 2011). Land use data for the study area were the National Land Cover Data (NLCD) 2006, which were downloaded from the USGS seamless online Data Warehouse.

Supplementary data used to prepare and recondition the DEM include the USGS NHD published stream network, NHD Flowline (Simley and Carswell 2009) and the NRCS published 12-digit hydrologic unit code (HUC12) watershed delineation (NRCS 2009).

Soil data were downloaded from the NRCS geospatial data gateway, Soil Survey Geographic Database (SSURGO). Regional soil characteristics, most importantly the infiltration rate, were represented by the Soil Conservation Service (SCS) Curve Number Method. Meteorological data, including precipitation, evaporation, and runoff values, were collected from the National Ocean and Atmospheric Administration (NOAA), the National Weather Service (NWS), and the National Climate Data Center (NCDC).

Analysis Procedures

A detailed description of procedures used for watershed delineation and basin characteristics, hydrologic and soil erosion analysis, and modeling is presented in **Appendix K-1.** Procedures for analysis of flood potential are presented in **Appendix K-2**.

A GIS-based erosion model (Revised Universal Soil Loss Equation [RUSLE]).was used to investigate potential erosion in the project area. The model provides a fine spatial resolution of the model results. The RUSLE model is relatively simple and is one of the most practical methods to estimate soil erosion potential and the effects of different management practices. It was selected due to its wide acceptance, including for construction site management at the federal level in NPDES Phase II permitting (Wachal and Banks 2007, EPA 2000).

The RUSLE is the modified version of U.S. Department of Agriculture's Universal Soil Loss Equation (USLE), which has been used to measure soil loss from agriculture lands with relatively uniform slopes. The RUSLE modified certain factors in USLE to more accurately account for more complex terrain. The output of the RUSLE model is an annual rate of erosion and sedimentation in tons per acre per year, as opposed to erosion resulting from specific storm events. A detailed description of RUSLE is presented in **Appendix K-1.**

For the flood analysis, software developed by the U.S. Army Corps of Engineers Hydrologic Engineering Center was used to delineate watershed boundaries and approximate rainfall-runoff volumes. Detailed descriptions of models and modeling procedures used are presented in **Appendix K-2**. HEC-GeoRAS software was used to construct a hydraulic model to calculate flow velocity through the study area. Peak runoff calculated from the HEC-GeoHMS modeling was applied as the peak flow in the HEC-GeoRAS modeling.

Erosion Risk and Flood Analysis

MUs and other MEA facility locations were compared to the RUSLE map to evaluate erosion risk potential for each location. The proposed wellfield, the satellite building, and the areas adjacent to the satellite building were all evaluated for potential placement of the access road and DDWs. **Table 1.3-4** lists the risk of erosion for each wellfield, as well as the associated six DDWs. Maps displaying the average annual erosion potential as estimated by the RUSLE model in relation to the MUs and satellite facility location are provided in **Appendix K-1**.

MU A and MU 1 carry low or very low erosion risk throughout, while MU C, MU D, MU E, and MU F carry very low erosion risk throughout. MU 5 has multiple locations of moderate erosion risk. MU 2, MU 3, MU 4, and MU B have locations of moderate and high erosion risk. Although MU 2, MU 3, MU 4, and MU B have areas of high erosion risk, only 2 to 7 percent of the area within the units is at a moderate to high risk. Placement of well locations around areas of moderate and high potential erosion should be feasible in these units, particularly in MU 3, where only 2 percent of the land is at an increased risk of erosion. In comparison, 11 percent of MU 5 carries a moderate risk of erosion. Though the overall risk of MU 5 is lower than in other units, it may be more difficult to place wells without additional mitigation measures due to the widespread risk of erosion in the unit.

If wells cannot be placed outside of areas within the wellfields deemed to have moderate to high risks, mitigation measures (e.g., berms) can be implemented to minimize the potential for flooding and erosion. The mitigation measures can be defined during final engineering and prior to any construction. Model results indicate that the risk of erosion is low or very low at the satellite facility, satellite facility access road, and the nearby DDW-M1. Therefore, the probable need for erosion mitigation in this area is low.

As part of the concentrated flow analysis, drainage lines (i.e., channels, gulleys, or areas of concentrated flow) and DFIRM floodplain extents were compared to MU locations. Although drainage lines are the primary contributor to increased erosion risk as part of the RUSLE analysis, the model was unable to accurately define erosion rates in these areas of concentrated flow during flood events. Thus, published FEMA DFIRM 100-year floodplain extents were compared to MUs in the area. MU locations within the 100-year floodplain should be considered at risk to flooding, as well as erosion caused by flood events. Further analysis, mitigation measures, or modification of well locations should be considered for those wells near concentrated flow routes or in the 100-year floodplain during the final engineering phase and prior to well installation and construction activities.

Figures 22 through **27** of **Appendix K-1** display the drainage lines and floodplain extents relative to the MU and satellite facility locations. Drainage line 21 (NRCS HUC number 149152245) runs generally north-to-south and crosses MUs 2, 3, 4, and 5. Well locations in these MUs will be positioned outside of the floodplain or will include flood protection measures in the final engineering plans. Drainage line 24 (NRCS HUC number 149157281) crosses the proposed access road to the satellite facility. However, the proposed access road and satellite facility are not within the 100-year floodplain. The access road will be constructed with consideration to the location of the drainage and potential for concentrated runoff and erosion to occur. Drainage line 21 is predicted to accumulate notably more surface runoff than other drainages and therefore has a higher potential for flooding and erosion. Further analysis, mitigation measures, or modification of well locations will be considered for those wells near concentrated flow routes during the final engineering phase and prior to well installation and construction activities.

Flood Risk Analysis

The hydrologic and flood study presented in **Appendix K-2** divides the MEA into two study areas based on drainage characteristics: Hydrologic Project South and Hydrologic Project East.

Hydrologic Project South contains the majority of sub-basins and drainages where project facilities and activities would occur (e.g., wellfields, ~~and~~ satellite facility, and DDWs). Drainage lines 21 and 24 described above in Erosion and Risk Analysis above are both located within Hydrologic Project South. Peak discharge rates and flood velocities were calculated for storms with return intervals of 10, 25, 50, and 100 years and are provided in **Appendix K-2**. Model results for the 100-year storm event are described below.

Peak discharge rates for the main drainages where they exit the MEA license boundary are summarized in **Tables 1.3-5 and 1.3-6**. The peak discharge for Hydrologic Project South during a 100-year storm is estimated to be 1,455 cubic feet per second (cfs), whereas the peak discharge for Hydrologic Project East during the same storm is estimated to be 2,659 cfs. These discharge values are almost double the rates expected for storms with a 10-year recurrence interval.

In order to determine the potential risk of project facilities and infrastructure due to flooding, the velocity of flood waters within MEA drainages during a 100-year storm were calculated using the HEC-RAS model. For the western tributary within Hydrologic Project South (drainage line 24 of **Appendix K-2**), the maximum flow velocity is estimated to be 5.8 ft/s. For the main stem drainage within Hydrologic Project South (drainage line 21 of **Appendix K-2**), the maximum flow velocity is estimated to be 6.3 ft/s upstream of the confluence with the western tributary and 6.5 ft/s downstream of the confluence. The maximum flow velocity for the main stem drainage within Hydrologic Project East is estimated to be 8.9 ft/s.

Although not within FEMA-designated flood zones, portions of the MEA may be subject to concentrated water flow during storm runoff and may also be at risk of damage. FEMA-designated flood zones supersede any estimated flood widths presented in **Appendix K-2**. For locations within or adjacent to the drainages assessed in this study, but beyond the FEMA flood zones, model results can be used as described below to estimate areas potentially affected under these circumstances, in addition to peak discharge rates and flood velocity. For example, the location where the access road to the proposed satellite facility crosses drainage line 24 (**Appendix K-2**) is outside of a FEMA-designated flood zone. However, model results indicate that runoff velocity within that drainage during a 100-year storm is estimated to be between 2.8 and 3.3 ft/s. Model results also indicate that the total width of flowing water at the access road crossing during a 100-year storm would be between approximately 140 and 220 feet.

Flood Risk Planning

CBR will use the results of the two hydrologic and erosion studies in support of current and future planning and additional project design and layout. Once more detailed engineering commences, the results of these studies will be used to assess the potential for erosion and flooding that may require implementation of special design features or mitigation measures (e.g., berms around areas of MUs, strategically located drainage channels, culverts on roadways). Additional hydrologic and erosion analysis may be required during specific phases of site grading and engineering design to supplement the current studies. For example, specific phases requiring additional analysis may include the final design of MUs (locations of buildings, wells, and piping), DDWs, or the satellite facility building and associated structures.

1.3.2.14 Surface Water Management and Erosion Control

In general, CBR will carry out tasks including the following in regard to surface water management and erosion control.

CBR will use ditches, diversions, culverts, and other best management practices (BMPs) to control surface water flow within the license boundary.

An erosion and sediment control plan will be developed and implemented during construction, operation, and reclamation activities in order to reduce soil losses within the license area and to protect surface and subsurface assets.

Using the results of erosion and flood analyses, CBR will construct facilities outside of these flood-prone boundaries in order to avoid potential impacts to facilities from flooding and potential impacts to major ephemeral drainages, and the Niobrara River in the event of any potential spills or leaks. When possible, CBR will locate surface structures/wells outside of the 100-year flood zone boundaries. Any facilities that will have to be built within the 100-year flood zone boundaries will be protected from flood damage by the use of control measures such as diversion/collection ditches, channels, storm drains, slope drains, and/or berms.

Pipelines will be buried below the frost line, and pipeline valve stations will be located outside of the 100-year flood zone in order to avoid damage due to potential surface flooding.

Efforts will be made to avoid placement of production, injection wells, ~~and~~ monitor wells, and DDWs in potential flood-prone areas (using results of erosion and flood risk analyses), but if it is necessary to place such wells in these areas, surface water control measures (e.g., diversion or erosion control structures) will be used. Wellheads in these areas can be built so that the casing extends above grade and is mounted in a concrete pad. In addition, an aboveground protective housing can be used to protect the well casing in the event of flooding. CBR currently uses an anchored metal or plastic protective housing (similar to a 55-gallon drum with the ends cut out), which affords protection in the event of flooding. As applicable, well heads will be sealed in order to withstand brief periods of submergence.

CBR will carry out all construction tasks in compliance with applicable NPDES stormwater general permit requirements.

Sections 4.4.1 and 4.4.2 describe mitigation measures to protect surface water from potential spills and leaks. Section 4.4.3 describes mitigation measures to protect groundwater from potential spills and leaks.

1.3.2.15 Erosion Control During Construction and Decommissioning

The greatest potential for erosion and sedimentation will be during the construction and decommissioning phases of the MEA project. Land management and farming techniques will be used by CBR in order to minimize the erosion of disturbed, reclaimed, and native areas. Mitigation measures are discussed in Section 5.1. CBR will typically prepare and seed ground areas that are disturbed as soon as possible in order to minimize the potential for erosion. As discussed above, erosion controls will be used in order to reduce overland flow velocity, reduce runoff volume, and minimize the transport of sediment into drainages. Examples include, runoff control diversion structures, storm drains, slope drains, channels, mulch, cover crops, rip-rap, sediment fences, and other controls. Construction of the MUs will be sequenced so that only part of the site is affected at one time. This sequencing coordinates the timing of land-disturbing activities and the installation of erosion and sediment control measures (EPA 2013). This will assist with the erosion and sediment control because it helps to ensure that BMPs are installed where necessary and when appropriate (EPA 2013).

The need to control sediment will be most critical during wellfield construction and immediately after redistributing topsoil. Sediment control features that may be required include silt fences, sediment basins, sediment traps, vegetation buffers, and other features. CBR will use existing roads when possible and limit the various access road widths, which will minimize the surface disturbance to soil and vegetation. Traffic will be limited to established roadways to the extent possible.

Erosion and sediment controls will be developed prior to commencement of construction, at a time when site disturbance activities are clearly defined.

1.4 Security

CBR security measures for the current operation are specified in the Security Plan and Security Threat chapter in Volume VIII, Emergency Manual. CBR is committed to:

- Providing employees with a safe, healthful, and secure working environment
- Maintaining control and security of NRC licensed material
- Ensuring the safe and secure handling and transporting of hazardous materials
- Managing records and documents that may contain sensitive and confidential information

The NRC requires licensees to maintain control over licensed material (i.e., natural uranium [source material] and byproduct material defined in 10 CFR §40.4). 10 CFR 20, Subpart I, Storage and Control of Licensed Material, requires the following:

§20.1801 Security of Stored Material

The licensee shall secure from unauthorized removal or access licensed materials that are stored in controlled or unrestricted areas.

§20.1802 Control of Material Not in Storage

The licensee shall control and maintain constant surveillance of licensed material that is in a controlled or unrestricted area and that is not in storage.

Stored licensed material at the CPF would include uranium packaged for shipment from the facility or byproduct materials awaiting disposal. Examples of material not in storage would include yellowcake slurry or loaded IX resin removed from the restricted area for transfer to other areas.

At the MEA, licensed stored material would typically include loaded IX resin and byproduct waste awaiting disposal. Lixiviant would be found in production piping in the wellfield and wellhouses, production trunkline to the satellite facility, and within piping located in the satellite building. Loaded IX resin would be placed in a transport truck and temporarily stored in the vehicle until the truck is filled and ready for delivery to the CPF.

1.4.1 Marsland Satellite Facility Security

Entrance to the MEA will be via Squaw Mound Road west of the facility. The entrance to the site will be posted indicating that permission is required prior to entry. A gate on the access route will be locked when not in use. The satellite facility site within the license area will be properly posted in accordance with 10 CFR § 20.1902 (e). The primary and alternate access routes to the satellite facility are shown in **Figure 1.4.-1** and discussed in Section 4.2.

Security at the MEA site will be consistent with policies and procedures used at the CBR current operating site. The security systems used at the current site and proposed for the MEA site are sufficient to prevent unauthorized entry into a) controlled areas and b) restricted areas. As defined in 10 CFR 20.1003, a "controlled area" refers to an area outside a restricted area but within the site boundary, to which the licensee can limit access for any reason. A "restricted area" refers to any area to which access is controlled for the protection of individuals from exposure to radiation and radioactive materials. Appropriate signage will be placed on all fencing advising of access restrictions.

CBR's security program has acceptable passive controls (such as perimeter fencing for wellfields) and active controls (such as daily inspections and locks on facility buildings). These security measures have been demonstrated to prevent unauthorized entry in controlled areas in accordance with 10 CFR Part 20, Subpart I.

Restricted area at the satellite facility refers to *"…an area where access to is limited by the licensee for the purpose of protecting individuals against undue risks from exposure to radiation and radioactive materials"* (10 CFR 20.1003). Proposed restricted areas for the satellite facility are shown on **Figure 1.1-8**. Each radiation area will be posted with a conspicuous sign or signs bearing the radiation symbol and the words "CAUTION, RADIATION AREA" (10 CFR 20.1902). Radiological warnings are posted based upon actual or likely conditions. Actual conditions are determined through area monitoring. Likely conditions are identified based on professional judgment or experience regarding the probability of a radiological condition. When evaluating the likelihood of specific conditions, normal and unique situations that can reasonably be expected to occur will be considered.

All visitors, contractors, or inspectors entering the satellite facility site will be required to register at the facility office and will not be permitted inside the facility or wellfield areas without proper authorization. All visitors needing safety equipment, such as hardhats and safety glasses, will be issued the items by company personnel. Inexperienced visitors will be escorted within the controlled area of the facility unless they are frequent visitors who have been instructed regarding the potential hazards in various site areas. All appropriate and necessary safety or radiological training will be provided and documented by the Radiation Safety Officer (RSO) or designee. Training requirements associated with visitors and contractors are discussed in Section 5.5 of the MEA Technical Report.

The satellite facility will routinely operate 24 hours per day and 7 days per week so that CBR employees will normally be on site except for occasional shutdowns. The satellite facility structure will be equipped with locks to prevent unauthorized access. All facility personnel are instructed to immediately report any unauthorized persons to their supervisors. The supervisor will contact the reported unauthorized person and make sure that they have been authorized for entry. If the person is unauthorized, they will be escorted to the main entrance for departure.

Access by unauthorized personnel to the stored and non-stored licensed materials (pregnant lixiviant solution, loaded IX resin, and byproduct material awaiting disposal) would be controlled by perimeter access gates with locks and site personnel. This would include piping, process vessels, tankage, and any truck vehicle containing loaded IX resin and parked within or near the satellite facility building.

Wellhouses where pregnant lixiviant solutions would be present in the production piping would be kept locked. Only authorized personnel would have keys to the wellhouses. The production trunk line conveying pregnant lixiviant from the wellhouses to the satellite building would be located within perimeter fencing that only authorized personnel would be allowed to enter. Gates associated with perimeter fencing enclosing any operating wellfield would be kept locked when operators and workers are not present (e.g., remote from the satellite facility). Security may be increased by installing continuous video surveillance of outside areas.

CBR maintains and enforces requirements of the SHEQMS, Volume IV Health Physics Manual, which specify access controls and security issues applicable to visitors, contractors, and employees; radiological posting; and radiological survey and monitoring requirements associated with activities at the site.

Even without consideration of reduced exposures due to the security measures discussed above, the highest estimated total effective dose equivalent (TEDE), as determined using methods described in Sections 3.11.2.2 and 4.12.2.3 through 4.12.2.6, for a downwind receptor near the MEA is 93 millirems per year (mRem/yr). This is based on an occupancy factor of 100 percent or 8,760 hours per year. If the routine visitor were on site for 10 hours per month, the visitor would receive an annual dose of 3 mRem/yr. It is unlikely that even frequent visitors to the MEA could receive annual doses near the 100 mRem public dose limit.

1.4.2 Transportation Security

CBR routinely receives, stores, uses, and ships hazardous materials as defined by the U.S. Department of Transportation (DOT). In addition to the packaging and shipping requirements contained in the DOT Hazardous Materials Regulations (HMR), 49 CFR 172, Subpart I, Security Plans, requires that persons that offer for transportation or transport certain hazardous materials develop a Security Plan. Shipments may qualify for this DOT requirement under the following categories:

§172.800(b) (4) A shipment of a quantity of hazardous materials in a bulk package having a capacity equal to or greater than 13,248 L (3,500 gallons) for liquids or gases or more than 13.24 cubic meters (468 cubic feet) for solids;

§172.800(b) (5) A shipment in other than a bulk packaging of 2,268 kg (5,000 pounds) gross weight or more of one class of hazardous material for which placarding of a vehicle, rail car, or freight container is required for that class under the provisions of subpart F of this part;

§172.800(b) (7) A quantity of hazardous material that requires placarding under the provisions of subpart F of this part.

DOT requires that Security Plans assess the possible transportation security risks and evaluate appropriate measures to address those risks. All hazardous materials shippers and transporters subject to these standards must provide personnel security by screening applicable job applicants, prevent unauthorized access to the hazardous materials or vehicles being prepared for shipment and provide for en route security. Companies must also train appropriate personnel in the elements of the Security Plan.

Transport of licensed/hazardous material by CBR employees will generally be restricted to moving IX resin from a satellite facility to the CPF or transferring contaminated equipment between company facilities. This transport generally occurs over short distances through remote areas. Therefore, the potential for a security threat during transport in a CBR vehicle is minimal. The goal of the driver, cargo, and equipment security measures is to ensure the safety of the driver and the security and integrity of the cargo from the point of origin to the final destination by:

- Clearly communicating general point-to-point security procedures and guidelines to all drivers and non-driving personnel
- Providing the means and methods of protecting the drivers, vehicles, and customer cargo while on the road
- Establishing consistent security guidelines and procedures that shall be observed by all personnel

For the security of all tractors and trailers, the following will be adhered to:

- If material is stored in the vehicle, access must be secured at all openings with locks and/or tamper indicators.
- Off-site tractors will always be secured when left unattended with windows closed, doors locked, the engine shut off, and no keys or spare keys in or on the vehicle.
- The vehicle is to be kept visible by an employee at all times when left outside a restricted area.

The security guidelines and procedures apply to all transport assignments. All drivers and non-driving personnel are expected to know and adhere to these guidelines and procedures when performing any load-related activity.

1.4.3 Contamination Control Program

CBR will perform surveys for surface contamination in operating and clean areas of the satellite facility in accordance with the guidelines contained in RG 8.30. Surveys for total alpha contamination in clean areas will be conducted weekly. In designated clean areas, such as lunchrooms, offices, change rooms, and respirator cabinets, the target level of contamination is nothing detectable above background. If the total alpha survey indicates contamination that exceeds 250 disintegrations per minute (dpm)/100 square centimeters (cm^2) (25 percent of the removable limit) a smear survey must be performed to assess the level of removable alpha activity. If smear test results indicate removable contamination greater than 250 dpm/100 cm^2, the area will be promptly cleaned and resurveyed.

All personnel leaving a restricted area will be required to perform and document alpha contamination monitoring. In addition, personnel who could come in contact with potentially contaminated solutions outside a restricted area such as in the wellfields will be required to monitor themselves prior to leaving the area. All personnel receive training in surveys for skin and personal contamination. All contamination on skin and clothing is considered removable, so the limit of 1,000 dpm/100 cm^2 is applied to personnel monitoring. Personnel will also be allowed to conduct contamination monitoring of small, hand-carried items for use in wellfield and controlled areas as long as all surfaces can be reached with the instrument probe and the item does not originate in yellowcake areas. All other items are surveyed as described below.

The RSO, the radiation safety staff, or properly trained employees perform surveys of all items removed from the restricted areas with the exception of small, hand-carried items described above. Due to the distance separating the satellite facility and the CPF, where the RSO and radiation staff are based, it would be more efficient to have properly trained full-time personnel at the MEA site available to perform surveys for releasing items from the restricted area. Such a person would be the Lead Operator or a facility/wellfield operator trained by the RSO or radiation staff in the use of applicable radiation survey instruments and procedures. These staff members would have received training as operators and the required radiation safety training. They would also be subject to additional hands-on training as to the survey instruments and procedures. The release limits are set by the Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct or Source Materials (NRC 1987).

Surveys are performed with the following equipment:

1. Total surface activity will be measured with an appropriate alpha survey meter. A Ludlum Model 2241 scaler or a Ludlum Model 177 Ratemeter with a Model 43-65 or Model 43-5 alpha scintillation probe, or equivalent, will be used for the surveys.
2. Portable Geiger-Mueller (GM) survey meter with a beta/gamma probe with an end window thickness of not more than 7 milligrams per square centimeter (mg/cm^2), a Ludlum Model 3 survey meter with a Ludlum 44-38 probe or equivalent.
3. Swipes for removable contamination surveys as required.

Survey equipment is calibrated annually or at the manufacturer's recommended frequency, whichever is more frequent. Surface contamination instruments are checked daily when in use. Alpha survey meters for personnel surveys are response checked before each use, with other checks performed weekly.

As recommended in RG 8.30, CBR conducts quarterly unannounced spot checks of personnel to verify the effectiveness of the surveys for personnel contamination. A spot check of the employees assigned to the satellite facility will be conducted, concentrating on facility operators and maintenance personnel. The purpose of the surveys is to ensure that employees are adequately surveying and decontaminating themselves prior to exiting the restricted areas.

The contamination control program for the satellite facility will be implemented in accordance with the SHEQMS Volume IV, Health Physics Manual.

As noted earlier, Cameco is evaluating the implications of short-lived beta-emitting isotopes to contamination control, for both personal contamination and for free release of objects at the CPF, and will incorporate the results of that evaluation, as appropriate, into the Radiation Protection Program for both the CPF and the MEA.

1.5 Applicable Regulatory Requirements, Permits, and Required Consultations

1.5.1 Environmental Approvals for the Current Licensed Area

As discussed previously, this is an amendment application for Radioactive Source Materials License SUA-1534, originally submitted in September of 1987 and renewed in 1998. A license renewal application for continued operation of the CPF was submitted to the NRC on November 27, 2007. NRC approval is pending. A license amendment for the addition of the proposed NTEA satellite facility was submitted to the NRC on May 30, 2007. NRC approval is pending.

All other required permits for the existing CPF have been obtained and maintained as required by applicable regulatory requirements. The NDEQ has approved a Class III UIC permit and the NDEQ/EPA has approved the Petition for Aquifer Exemption for the proposed NTEA. A summary of the relevant permits and authorizations for the CPF license area is given in **Table 1.5-1**. Permits and authorizations anticipated for the satellite facility are shown in **Table 1.5-2**.

1.5.1.1 Environmental Approvals and Permits

The MEA will be subject to permitting requirements similar to the CPF. **Table 1.5-2** contains a summary list of the type of permit or authorization, the granting authority, and the status.

1.5.1.2 Licensing and Permitting Consultations

During the preparation of this License Amendment application and the NDEQ Class III UIC Application for MEA, the following agency officials were contacted:

U.S. Nuclear Regulatory Commission

Mr. Ronald Burrows, Project Manager
Decommissioning and Uranium Recovery Licensing Directorate
Davison of Waste Management and Environmental Protection
Office of Federal and State Materials and Environmental Management Programs
Mailstop T8-5
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Nebraska Department of Environmental Quality

Ms. Jenny Coughlin
Nebraska Department of Environmental Quality
Suite 400, The Atrium
1200 North N Street
P.O. Box 98922
Lincoln, NE 68509-8922

1.5.2 Environmental Consultations

During the preparation of this license amendment application, several agencies were consulted for information required for various sections of the application:

1.5.2.1 Land Use (Section 3.1)

Elaine Connelly
Nebraska Maps & More
School of Natural Resources
101 Hardin Hall
3310 Holdrege Street
Lincoln, NE 68583-0961

Echo Clark
Tax Assessor
Dawes County
451 Main St.
Chadron, NE 69337
308-432-0103

1.5.2.2 Surface Water (Section 3.4.2)

Assistance was requested in providing available surface water flow and water quality data for the Niobrara River in the proposed project area:

Tom Hayden
Supervisor
Water Field Office Operations
Nebraska Department of Natural Resources
Bridgeport Field Office

Guy H. Lindeman, P.E.
Nebraska Department of Natural Resources
301 Centennial Mall So.
PO Box 94676
Lincoln, NE. 68509

Dave Ihrie
Planning Section, Water Division
Nebraska Department of Environmental Quality
1200 "N" Street, Suite 400
Lincoln, NE 68509-8922
402-471-0283

Bill Peck
U.S. Reclamation Bureau
Field Office
1706 West 3rd St.
McCook, NE 69001

1.5.2.3 Ecological Resources (Section 3.5)

Preparation of the ecology discussion (Section 2.8) required consultations with the following individuals and agencies:

Greg Schenbeck
Wildlife Manager
Pine Ridge Field Office
Nebraska Game and Parks Commission
Chadron, NE

1.5.2.4 Historic, Scenic and Cultural Resources (Section 3.8)

Preparation of the historic, scenic, and cultural resources discussion required consultations with the following individuals and agencies:

Teresa Fatemi
Nebraska State Historical Society
State Historic Preservation Office
1420 P Street
Lincoln, NE 68508

Trisha Nelson
Archaeological Collections Manager
Nebraska State Historic Society
P.O. Box 82554
Lincoln, NE 68501

1.5.2.5 Population Distribution (Section 3.10)

Preparation of the population distribution discussion (Section 3.10) required consultations with the following individuals and agencies:

T. Vogl, School Clerk, Crawford Public Schools

1.5.2.6 Groundwater Quality Restoration, Surface Reclamation, and Facility Decommissioning (Section 3.4.3 and 6.0)

Ms. Jenny Coughlin
Nebraska Department of Environmental Quality
Suite 400, The Atrium
1200 North N Street
P.O. Box 98922
Lincoln, NE 68509-8922

Table 1.1-1 Current Crow Butte Production Area Mine Unit Status

Table 1.1-1 Current Crow Butte Production Area Mine Unit Status

Mine Unit	Production Initiated	Current Status
Mine Unit 1	April 1991	Groundwater Restored
Mine Unit 2	March 1992	Groundwater Restoration
Mine Unit 3	January 1993	Groundwater Restoration
Mine Unit 4	March 1994	Groundwater Restoration
Mine Unit 5	January 1996	Groundwater Restoration
Mine Unit 6	March 1998	Groundwater Restoration
Mine Unit 7	July 1999	Production
Mine Unit 8	July 2002	Production
Mine Unit 9	October 2003	Production
Mine Unit 10	August 2007	Production
Mine Unit 11	November 2010	Production

Table 1.3-1 Latitude and Longitude and Coordinates for Marsland Permit Boundary and Satellite Facility

Table 1.3-1 Latitude and Longitude and Coordinates for Marsland License Boundary and Satellite Facility

Layer	Geographic Projection: NAD 83 (Degrees)		Geographic Projection: NAD 27 (Degree)		NAD1983 StatePlane Nebraska North FIPS 2600(US Foot)		NAD1927 StatePlane Nebraska North FIPS 2601(US Foot)	
	Latitude	Longitude	Latitude	Longitude	Northing	Easting	Northing	Easting
A	42.4959	-103.2345	42.4959	-103.2340	986214	768453	440230	1128008
A	42.4957	-103.2345	42.4957	-103.2340	986145	768451	440161	1128006
A	42.4957	-103.2296	42.4957	-103.2291	986095	769765	440111	1129321
A	42.4884	-103.2299	42.4884	-103.2294	983444	769586	437459	1129139
A	42.4885	-103.2250	42.4885	-103.2245	983427	770914	437441	1130468
A	42.4809	-103.2248	42.4810	-103.2243	980670	770852	434685	1130405
A	42.4810	-103.2296	42.4810	-103.2291	980731	769563	434746	1129115
A	42.4739	-103.2297	42.4739	-103.2293	978161	769430	432176	1128981
A	42.4740	-103.2149	42.4741	-103.2144	978059	773427	432071	1132978
A	42.4666	-103.2151	42.4666	-103.2146	975348	773274	429360	1132823
A	42.4599	-103.2149	42.4599	-103.2144	972907	773242	426919	1132790
A	42.4591	-103.2173	42.4591	-103.2168	972635	772574	426647	1132122
A	42.4591	-103.2245	42.4591	-103.2241	972703	770633	426716	1130180
A	42.4591	-103.2295	42.4591	-103.2290	972750	769297	426765	1128845
A	42.4665	-103.2295	42.4666	-103.2290	975471	769397	429485	1128946
A	42.4665	-103.2344	42.4666	-103.2339	975519	768070	429534	1127619
A	42.4741	-103.2345	42.4741	-103.2341	978271	768138	432286	1127689
A	42.4740	-103.2443	42.4741	-103.2438	978352	765502	432369	1125052
A	42.4810	-103.2443	42.4811	-103.2438	980907	765597	434925	1125149
A	42.4811	-103.2496	42.4811	-103.2492	980966	764164	434985	1123716
A	42.4887	-103.2494	42.4887	-103.2489	983740	764329	437759	1123882
A	42.4886	-103.2544	42.4887	-103.2539	983778	762998	437797	1122551
A	42.4956	-103.2542	42.4956	-103.2537	986289	763143	440309	1122697
A	42.4954	-103.2647	42.4954	-103.2642	986336	760312	440357	1119866
A	42.5065	-103.2644	42.5065	-103.2639	990378	760549	444400	1120105
A	42.5064	-103.2692	42.5065	-103.2687	990402	759254	444424	1118811
A	42.5097	-103.2690	42.5098	-103.2686	991603	759327	445626	1118884
A	42.5097	-103.2739	42.5097	-103.2734	991631	758025	445654	1117582
A	42.5099	-103.2739	42.5100	-103.2734	991725	758032	445749	1117589
A	42.5172	-103.2738	42.5172	-103.2733	994360	758153	448384	1117712
A	42.5171	-103.2835	42.5171	-103.2831	994421	755527	448446	1115085
A	42.5244	-103.2835	42.5244	-103.2830	997082	755635	451107	1115195
A	42.5463	-103.2834	42.5463	-103.2829	1005052	755961	459078	1115525
A	42.5465	-103.2639	42.5465	-103.2634	1004932	761230	458955	1120795
A	42.5465	-103.2637	42.5465	-103.2632	1004932	761272	458955	1120838
A	42.5389	-103.2637	42.5389	-103.2633	1002164	761161	456187	1120724
A	42.5312	-103.2638	42.5312	-103.2633	999351	761048	453374	1120610
A	42.5314	-103.2545	42.5314	-103.2540	999330	763551	453351	1123113
A	42.5248	-103.2544	42.5249	-103.2539	996960	763475	450981	1123036
A	42.5246	-103.2544	42.5246	-103.2539	996874	763473	450895	1123033
A	42.5243	-103.2544	42.5244	-103.2539	996770	763469	450790	1123030
A	42.5244	-103.2492	42.5244	-103.2487	996740	764875	450760	1124436
A	42.5100	-103.2492	42.5100	-103.2487	991491	764681	445510	1124239
A	42.5100	-103.2440	42.5101	-103.2436	991461	766067	445480	1125625
A	42.5100	-103.2392	42.5101	-103.2387	991410	767368	445428	1126926
A	42.5031	-103.2393	42.5031	-103.2388	988886	767250	442903	1126807
A	42.5031	-103.2344	42.5031	-103.2340	988839	768558	442855	1128115
A	42.4959	-103.2345	42.4959	-103.2340	986214	768453	440230	1128008
B	42.5013	-103.2555	42.5013	-103.2550	988395	762875	442416	1122430

Notes:

A = Marsland Permit Boundary

B = Center of Satellite Facility

Revised December 2013

Table 1.3-2 Typical Lixiviant Concentrations

Table 1.3-2 Typical Lixiviant Concentrations

SPECIES	RANGE (in mg/l)	
	Low	**High**
Na	≤ 400	6,000
Ca	≤ 20	500
Mg	≤ 3	100
K	≤ 15	300
CO_3	≤ 0.5	2,500
HCO_3	≤ 400	5,000
Cl	≤ 200	5,000
SO_4	≤ 400	5,000
U_3O_8	≤ 0.01	500
V_2O_5	≤ 0.01	100
TDS	≤ 1650	12,000
pH	≤ 6.5	10.5

NOTE: The above values represent the concentration ranges that could be found in barren lixiviant or pregnant lixiviant and would include the concentration normally found in "injection fluid".

Table 1.3-3 Background Information for Logging Probes used at the Marsland Expansion Area

Table 1.3-3 Background Information for Logging Probes Used at the Marsland Expansion Area

Logging Tool	Tool Specifications
9060	Natural gamma, Spontaneous Potential, Single Point Resistance
9055	Vertical Deviation, Natural Gamma, Neutron Detector, Neutron Porosity, Spontaneous Potential, Single Point Resistance
9144	Natural Gamma, 64 in. Normal Resistivity, 16 in. Resistivity, Fluid Resistivity, Lateral Resistivity 48 in., Spontaneous Potential, Single Point Resistance, Temperature and Delta Temperature, Slant Angle and Aximuth.
9057	Natural Gamma, 64 in. Normal Resistivity, 16 in. Normal Resistivity, Neutron-Neutron, Lateral Resistivity 48 in., Spontaneous Potential, Single Point Resistance, Temperature and Delta Temperature, Slant Angle and Azimuth

Table 1.3-4 Summary of Risk of Erosion for Proposed MEA Mine Units

Table 1.3-4 Summary of Risk of Erosion for Proposed MEA Mine Units

Mining Unit	MU Maximum Soil Loss (ton/acre/year)	MU Maximum Erosion Risk	Percent MU Area of Moderate to High Erosion Risk	Drainage Lines Crossing MU
MU-A[a]	3.3	Low	N/A	N/A
MU-1[a]	3.4	Low	N/A	N/A
MU-2[b]	18.7	High	5	21
MU-3[c]	22.2	High	2	21
MU-4[d]	24.5	High	7	21
MU-5[e]	13.5	Moderate	11	21
MU-B[f]	20.0	High	6	N/A
MU-C	2.7	Very Low	N/A	N/A
MU-D	0.9	Very Low	N/A	30
MU-E	1.1	Very Low	N/A	N/A
MU-F	0.7	Very Low	N/A	N/A

[a] DDW-M6 associated with MU-A and MU-1.

[b] DDW-M5 associated with MU-2.

[c] DDW-M3 associated with MU-3.

[d] DDW-M1 associated with MU-4.

[e] DDW-M2 associated with MU5.

[f] DDW-M4 associated with MU-B.

Note: MU and DDW locations are shown in Figure 1.1-7.

Revised April 2014

Table 1.3-5 The Peak Flow for Hydrologic Project South

Table 1.3-5 The Peak Flow for Hydrologic Project South

Return Periods		100-year		50-year		25-year		10-year	
Hydrologic Element	**Drainage Area (Km^2)**	**Peak Discharge (M^3/S)**	**Peak Discharge (Ft^3/S)**	**Peak Discharge (M^3/S)**	**Peak Discharge (Ft^3/S)**	**Peak Discharge (M^3/S)**	**Peak Discharge (Ft^3/S)**	**Peak Discharge (M^3/S)**	**Peak Discharge (Ft^3/S)**
W310	0.65	2.5	88	2.1	74	1.7	60	1.2	42
W300	0.45	2.9	102	2.5	88	2.1	74	1.6	57
W290	0.36	2.5	88	2.1	74	1.7	60	1.2	42
W280	0.49	2.1	74	1.8	64	1.4	49	1.1	39
W270	1.50	4.9	173	4.1	145	3.4	120	2.5	88
W260	1.20	4.5	159	3.8	134	3.1	109	2.2	78
W250	0.87	4.0	141	3.4	120	2.8	99	2.0	71
W240	1.94	8.3	293	7.0	247	5.7	201	4.2	148
W230	0.78	5.8	205	5.0	177	4.2	148	3.2	113
W220	0.66	6.4	226	5.5	194	4.6	162	3.5	124
W210	4.18	10.9	385	9.1	321	7.5	265	5.7	201
W200	0.74	6.2	219	5.3	187	4.4	155	3.3	117
W190	1.39	8.9	314	7.6	268	6.4	226	4.8	170
W180	0.48	4.8	170	4.1	145	3.4	120	2.5	88
W170	2.12	12.0	424	10.2	360	8.5	300	6.4	226
Outlet S	17.82	41.7	1473	34.8	1229	28.8	1017	22.1	780
R40	2.60	12.6	445	10.7	378	9.0	318	6.8	240
R80	1.44	8.9	314	7.6	268	6.4	226	4.9	173
R90	4.73	17.3	611	14.6	516	12.2	431	9.3	328
R110	12.29	38.1	1345	31.9	1127	26.6	939	20.3	717
R120	14.36	38.9	1374	32.5	1148	27.0	953	20.6	727
R140	16.35	41.6	1469	34.8	1229	28.7	1014	22.0	777
R160	17.16	41.2	1455	34.4	1215	28.5	1006	21.9	773

Km^2 – square kilometer M^3/S – cubic meter per second Ft^3/S – cubic feet per second

Table 1.3-6 The Peak Flow for Hydrologic Project East

Table 1.3-6 The Peak Flow for Hydrologic Project East

Return Periods		100-year		50-year		25-year		10-year	
Hydrologic Element	Drainage Area (Km^2)	Peak Discharge (M^3/S)	Peak Discharge (Ft^3/S)	Peak Discharge (M^3/S)	Peak Discharge (Ft^3/S)	Peak Discharge (M^3/S)	Peak Discharge (Ft^3/S)	Peak Discharge (M^3/S)	Peak Discharge (Ft^3/S)
W127490	3.01	7.4	261	6.1	215	5.0	177	3.8	134
W127480	0.03	0.2	7	0.2	7	0.1	4	0.1	4
W127470	0.99	4.7	166	4.0	141	3.3	117	2.5	88
W127460	0.06	0.3	11	0.2	7	0.2	7	0.1	4
W127450	1.40	10.4	367	8.9	314	7.5	265	5.7	201
W127440	0.70	3.7	131	3.1	109	2.6	92	1.9	67
W127430	1.23	6.4	226	5.4	191	4.6	162	3.4	120
W127420	0.70	5.7	201	4.8	170	4.0	141	3.0	106
W127410	0.28	2.3	81	1.9	67	1.6	57	1.1	39
W127400	1.50	5.7	201	4.8	170	4.0	141	3.1	109
W127390	1.52	10.0	353	8.6	304	7.2	254	5.5	194
W127380	1.19	8.6	304	7.3	258	6.2	219	4.6	162
W127370	1.38	9.2	325	7.9	279	6.7	237	5.0	177
W127360	1.87	11.1	392	9.4	332	7.9	279	5.9	208
W127350	3.24	17.7	625	15.0	530	12.6	445	9.4	332
W127340	0.79	5.8	205	4.9	173	4.1	145	3.0	106
W127330	1.79	10.1	357	8.6	304	7.2	254	5.4	191
W127320	0.45	3.3	117	2.8	99	2.3	81	1.7	60
W127310	0.59	4.1	145	3.5	124	2.9	102	2.2	78
W127300	2.13	11.2	396	9.5	335	7.9	279	5.9	208
W127290	1.17	9.6	339	8.1	286	6.8	240	5.1	180
W127280	2.21	11.5	406	9.7	343	8.1	286	6.1	215
W127270	2.18	13.1	463	11.1	392	9.3	328	7.0	247
Outlet E	30.42	75.3	2659	63.2	2232	52.7	1861	40.9	1444
R127080	4.34	20.2	713	17.1	604	14.3	505	10.8	381
R127100	3.35	18.1	639	15.4	544	12.9	456	9.7	343
R127110	6.58	28.4	1003	24.0	848	20.1	710	15.2	537
R127120	11.31	45.0	1589	38.0	1342	31.7	1119	24.2	855
R127140	16.42	59.9	2115	50.4	1780	42.1	1487	32.3	1141
R127160	18.99	66.1	2334	55.6	1963	46.5	1642	35.8	1264
R127180	20.79	69.4	2451	58.5	2066	48.8	1723	37.7	1331

Table 1.3-6 The Peak Flow for Hydrologic Project East

Return Periods		100-year		50-year		25-year		10-year	
Hydrologic Element	Drainage Area (Km^2)	Peak Discharge (M^3/S)	Peak Discharge (Ft^3/S)	Peak Discharge (M^3/S)	Peak Discharge (Ft^3/S)	Peak Discharge (M^3/S)	Peak Discharge (Ft^3/S)	Peak Discharge (M^3/S)	Peak Discharge (Ft^3/S)
R127200	22.99	72.6	2564	61.1	2158	51.0	1801	39.4	1391
R127220	24.92	75.4	2663	63.5	2242	52.9	1868	41.0	1448
R127240	25.97	76.9	2716	64.8	2288	54.0	1907	41.8	1476
R127260	27.41	71.3	2518	59.9	2115	50.0	1766	38.8	1370

Km^2 – square kilometer M^3/S – cubic meter per second Ft^3/S – cubic feet per second

Table 1.3-7 Marsland Deep Disposal Well Locations and Radius of Influence Estimates

Table 1.3-7 Marsland Deep Disposal Well Locations and Radius of Influence Estimates

Well ID	Easting (ft) [a]	Northing (ft) [a]	Longitude [b]	Latitude [b]
DDW-M1	1122855	442699	-103 15' 14.107"	42 30' 7.640"
DDW-M2	1125071	440487	-103 14' 43.417"	42 29' 46.632"
DDW-M3	1121709	445318	-103 15' 30.739"	42 30' 33.053"
DDW-M4	1126255	437786	-103 14' 26.254"	42 29' 20.423"
DDW-M5	1120001	447497	-103 15' 54.639"	42 30' 53.923"
DDW-M6	1119617	450473	-103 16' 1.293"	42 31' 23.149"

[a] Nebraska State Plane, NAD 1927, Nebraska North FIPS 2601
[b] NAD 83

Assumptions:

Years of Operation	17
Formation Thickness	200
Formation Porosity	0.25

Average Flow Rate (gpm)	Radius of Emplaced Fluid (ft)
400	1745
300	1510
250	1380
200	1235
150	1070
100	873
50	617
25	437

Source: Cameco 2014 April 2014

Table 1.5-1 Environmental Approvals for Crow Butte Project

Table 1.5-1 Environmental Approvals for Crow Butte Project

Issuing Agency	Permit Description
U.S. Nuclear Regulatory Commission Washington, DC 20555	Source Materials License SUA-1534 Issued: December 29, 1989 Renewed: February 28, 1998 Source Materials License SUA – 1534 Amendment to Increase Flow Issued: November 30, 2007 Source Material License SUA – 1534 License Renewal request by CBR Submitted: November 27, 2007 NRC Approval: Pending Source Material License SUA – 1534 Amendment for New Satellite Facility: North Trend Expansion Area Submitted: May 30, 2007 NRC Approval: Pending
U.S. Environmental Protection Agency 1200 Pennsylvania Avenue, NW Washington, DC 20460	Aquifer Exemption Approval Effective: June 22, 1990
Nebraska Department of Environmental Quality PO Box 98922 Lincoln, NE 68509-8922	Underground Injection Control Class III Authorization NE0122611 Approved: April 24, 1990 Amended to increase flow on August 16, 2007
	Aquifer Exemption Approval Effective: March 23, 1984
	Aquifer Exemption North Trend Expansion Area Submitted: August 15, 2007 Approved: April 18, 2011
	Underground Injection Control Class III Permit Application North Trend Expansion Area Submitted: August 15, 2008 (re-submittal) Approval: August 11, 2011
	Underground Injection Control Class I Authorization NE0206369 Approved: September 9, 1994 Replaced: July 2, 2004
	Underground Injection Control Class I Authorization NE0210825 Additional Class I well Approved: November 24, 2010
	National Pollutant Discharge Elimination System Permit NE0130613 Approved: September 27, 2011
	Mineral Exploration Permit NE0209317 Approved: June 3, 2003 Replaced: August 19, 2009 with NE0210824
	Mineral Exploration Permit NE0210679 Approved: July 16, 2007

Table 1.5-1 Environmental Approvals for Crow Butte Project

<table>
<tr><th>Issuing Agency</th><th>Permit Description</th></tr>
<tr><td rowspan="6">Nebraska Department of Environmental Quality
PO Box 98922
Lincoln, NE 68509-8922</td><td>Mineral Exploration Permit NE0210678
Approved: July 16, 2007</td></tr>
<tr><td>Mineral Exploration Permit NE0210680
Approved: July 18, 2007</td></tr>
<tr><td>Mineral Exploration Permit NE0210824
Approved: August 19, 2009</td></tr>
<tr><td>Underground Injection Control Class V Authorization NE0207388
Approved: November 6, 2000</td></tr>
<tr><td>Evaporation Pond Design
Approved: July 21, 1988</td></tr>
<tr><td>Construction Stormwater NPDES General Permit NER 100000
Authorization #NER105203
Approved: December 19, 2006</td></tr>
<tr><td>Nebraska Department of Natural Resources
301 Centennial Mall South
Lincoln, NE 68509-4676</td><td>Industrial Ground Water Permit
Approved: August 7, 1991</td></tr>
<tr><td>Nebraska Department of Health and Human Services Regulation and Licensure
PO Box 95007
Lincoln, NE 68509-5007</td><td>Class IV Public Water Supply Permit NE3121024
Approved: April 12, 2002</td></tr>
</table>

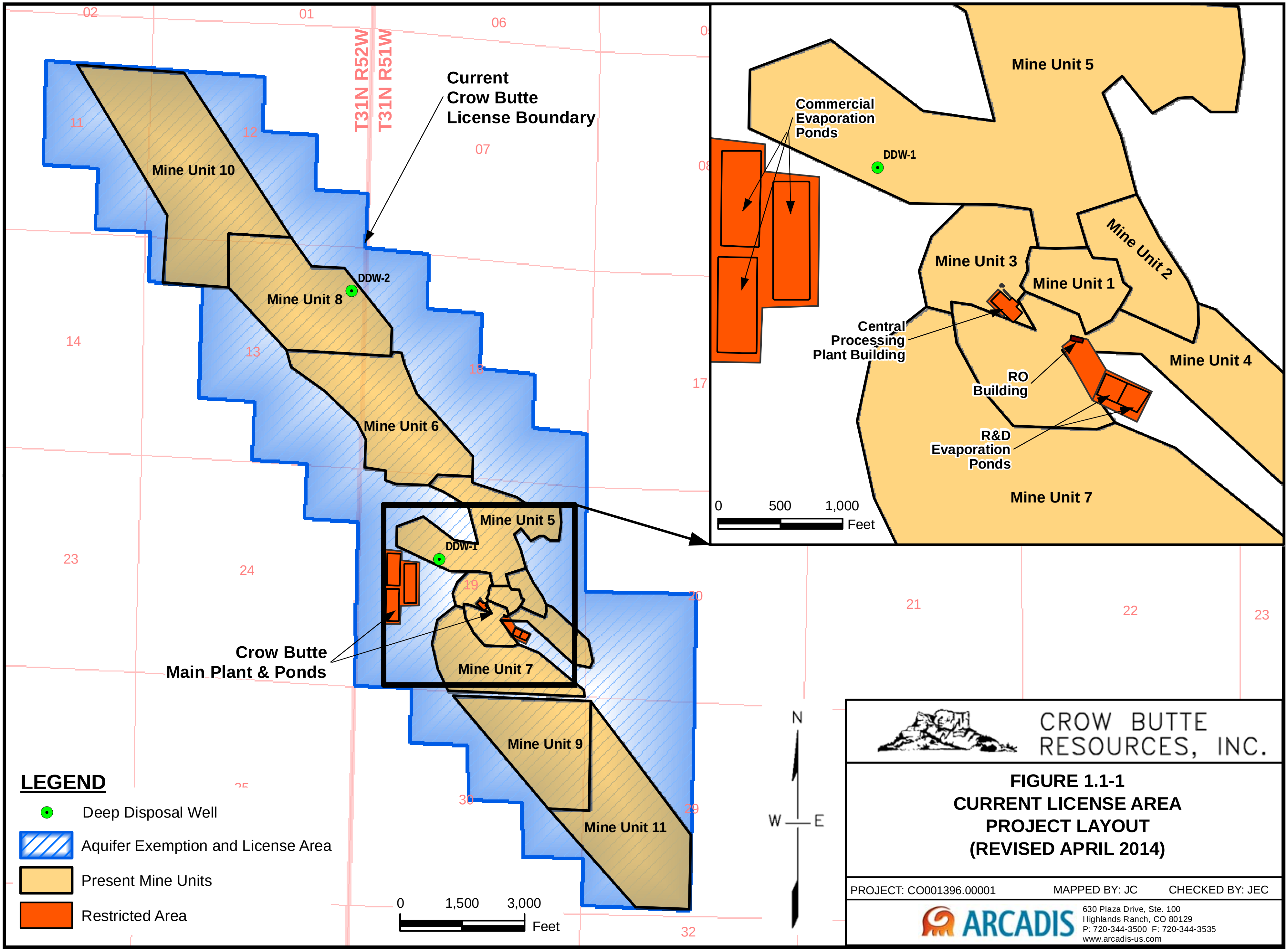
Table 1.5-2 Environmental Approvals for Proposed Marsland Expansion Area

Table 1.5-2 Environmental Approvals for Proposed Marsland Expansion Area

Issuing Agency	Description	Status
U.S. Nuclear Regulatory Commission Washington, DC 20555	Amendment to Source Materials License SUA-1534 (10 CFR 40)	The document containing this table has been submitted as a License Amendment for the Marsland Expansion Area
U.S. Environmental Protection Agency 1200 Pennsylvania Ave, NW Washington, DC 20460	Aquifer exemption application forwarded to EPA following NDEQ action	Aquifer exemption application forwarded to EPA by NDEQ following NDEQ action
Nebraska Department of Environmental Quality PO Box 98922 Lincoln, NE 68509-8922	Underground Injection Control Class III Permit (NDEQ Title 122)	Class III UIC Permit application submitted to NDEQ in July 2012 (approval pending)
	Aquifer Exemption (NDEQ Title 122)	Aquifer exemption application submitted to NDEQ in July 2012 (approval pending)
	Underground Injection Control Class I (NDEQ Title 122)	Class I UIC Permit application submitted to NDEQ in April 2013
	Industrial Stormwater NPDES Permit (NDEQ Title 119)	An Industrial Stormwater NPDES may not be required for a satellite facility depending on processes included and the final facility design. If required, an application will be submitted as per NDEQ requirements.
	Construction Stormwater NPDES Permit (NDEQ Title 119)	Construction Stormwater NPDES authorizations are applied for and issued annually under a general permit based on projected construction activities. The Notice of Intent will be filed at least 30 days before construction activities begin in accordance with NDEQ requirements.
	Mineral Exploration Permit (NDEQ Title 135)	Mineral Exploration Permit NE0209317 Approved: June 3, 2003 Replaced: July 16, 2007
	Underground Injection Control Class V (NDEQ Title 122)	The Class V UIC Permit will be applied for following installation of an approved site septic system during facility construction.
Nebraska Department of Natural Resources 301 Centennial Mall South Lincoln, NE 68509-4676	Industrial Ground Water Permit (NDNR Title 456)	The Industrial Groundwater Permit application will be prepared for submittal to NDNR; will be submitted following approval of Class III UIC permit.

Figure 1.1-1 Current License Area Project Layout

Document Path: C:\Users\jchen\Documents_PROJECTS\K_CBR_Projects\CO001396_ThreeCrow\2_GIS\ArcMaps\0004_ER\ER Fig_1_1-1 Current Project Layout.mxd



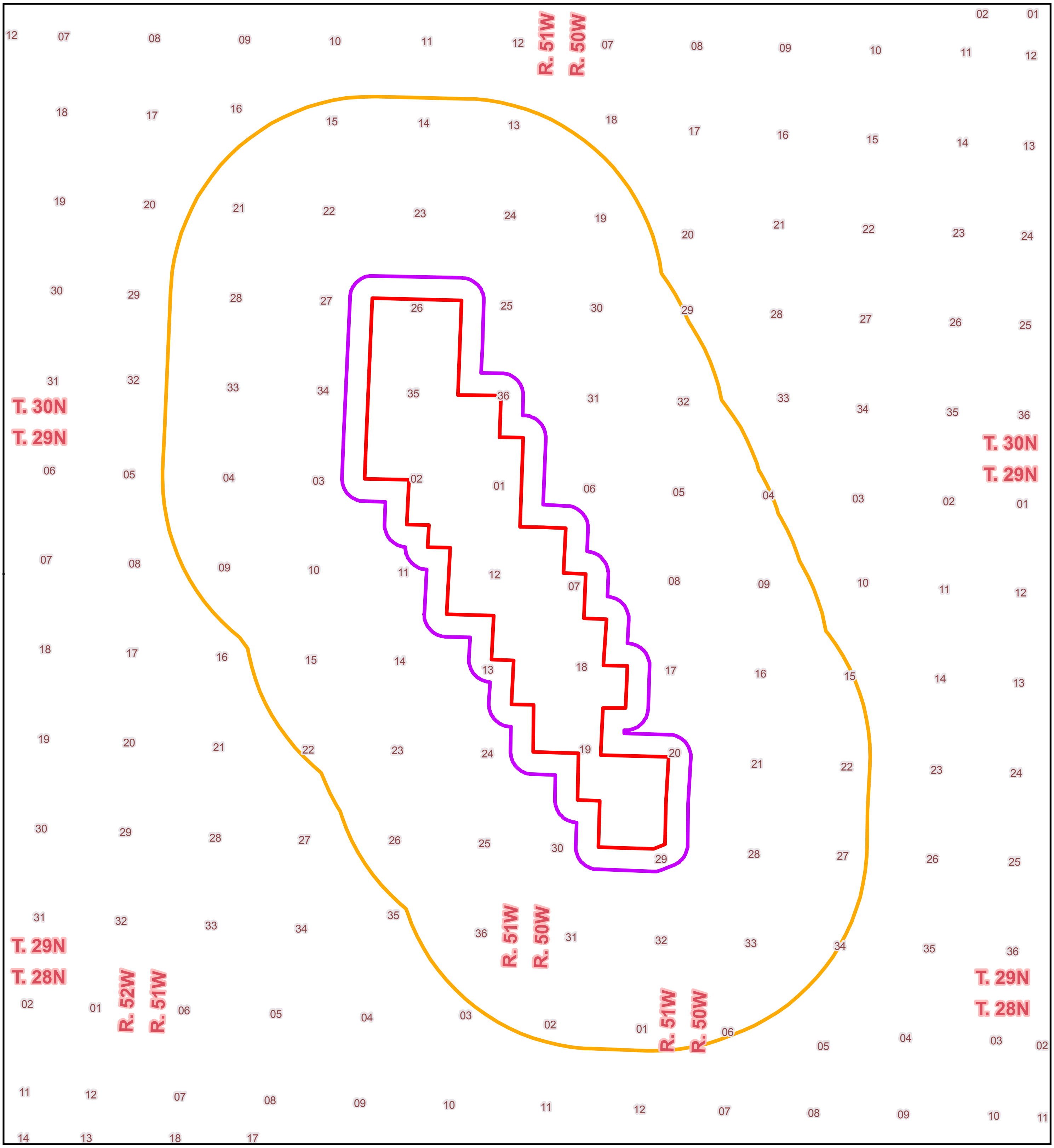
CROW BUTTE RESOURCES, INC.

FIGURE 1.1-1
CURRENT LICENSE AREA
PROJECT LAYOUT
(REVISED APRIL 2014)

PROJECT: CO001396.00001 MAPPED BY: JC CHECKED BY: JEC

ARCADIS
630 Plaza Drive, Ste. 100
Highlands Ranch, CO 80129
P: 720-344-3500 F: 720-344-3535
www.arcadis-us.com

Figure 1.1-2 Project Location Map ZOEI and AOR



LEGEND

- Proposed Marsland Expansion Area
- ZOEI Boundary (1/4-mile fixed radius)
- AOR Boundary (2-mile fixed radius)

ZOEI = Zone of Endangering Influence

AOR = Area of Review

N

0 4,000 8,000

Feet

PROJECTION: NAD 1927,
STATE PLANE NEBRASKA NORTH, FIPS 2601
SOURCES: US TOPO MAPS, SERVICED
BY ESRI ARCGIS ONLINE

FIGURE 1.1-2
PROJECT LOCATION MAP
ZOEI AND AOR

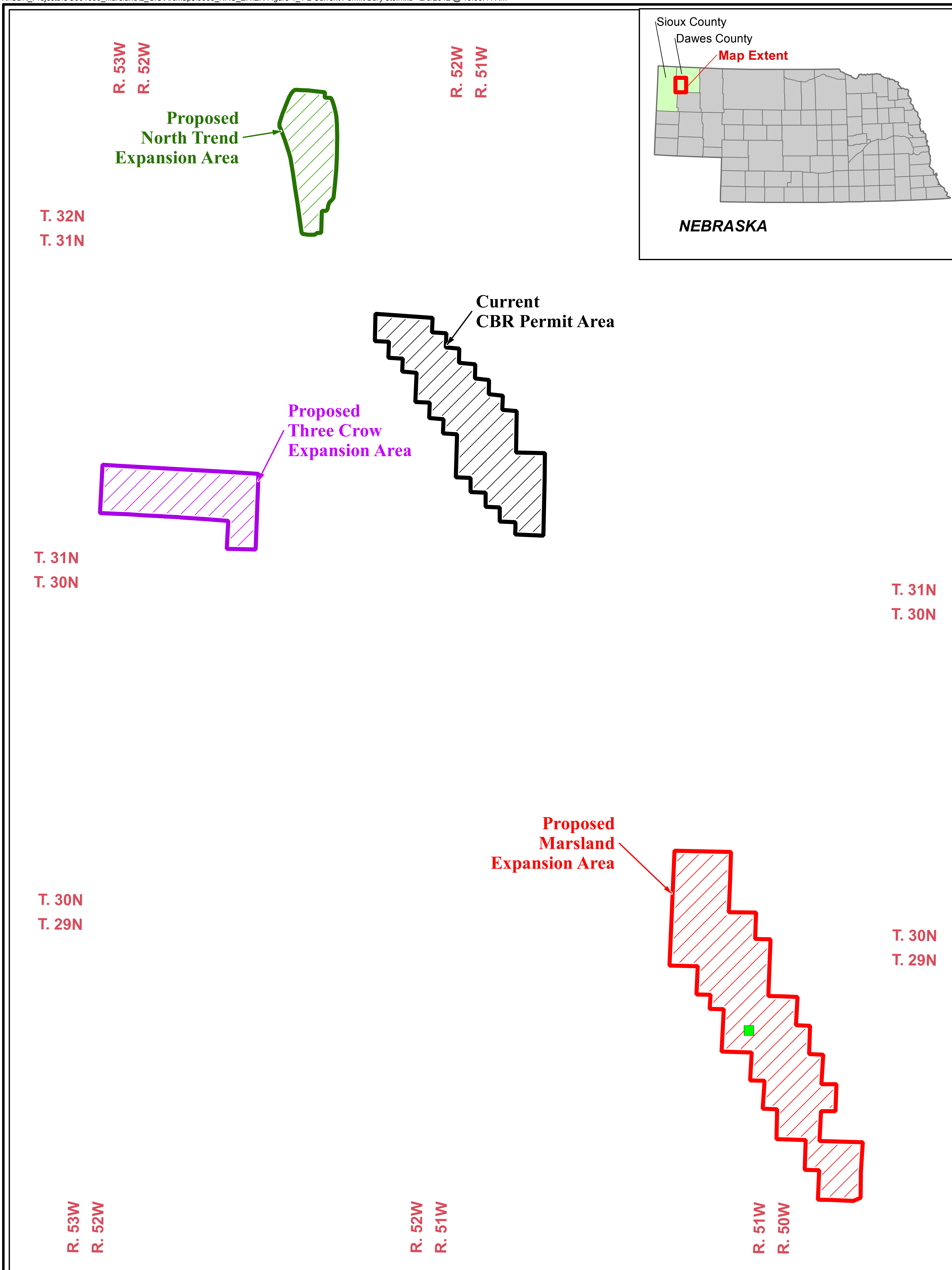
PROJECT: CO001636 MAPPED BY: JC CHECKED BY: J. CEARLEY

630 Plaza Drive, Ste. 100
Highlands Ranch, CO 80129
P: 720-344-3500 F: 720-344-3535
www.arcadis-us.com

K:\CBR_Projects\CO001636_Marsland\2_GIS\ArcMaps\0005_NRC_ER\ER Figure 1_1-5 Project Loc_ ZOEI and AOR.mxd - 3/21/2012 @ 10:44:50 PM

Figure 1.1-3 Crow Butte Resources Inc. Current Permit Area and Proposed Expansion Areas

K:\CBR_Projects\CO001636_Marsland\2_GIS\ArcMaps\0005_NRC_ER\ER Figure 1_1-2 Current Permit Bdry etc.mxd - 2/6/2012 @ 10:30:41 AM



LEGEND

- Proposed Marsland Satellite Facility Site
- Proposed Marsland Expansion Area
- Proposed Three Crow Expansion Area
- Proposed North Trend Expansion Area
- Current CBR Permit Area

N

0 1 2
Miles

PROJECTION: NAD 1927,
STATE PLANE NEBRASKA NORTH, FIPS 2601
SOURCES: US TOPO MAPS, SERVICED
BY ESRI ARCGIS ONLINE

FIGURE 1.1-3
CROW BUTTE RESOURCES INC.
CURRENT PERMIT AREA
AND PROPOSED EXPANSION AREAS

PROJECT: CO001636 MAPPED BY: JC CHECKED BY: J. CEARLEY

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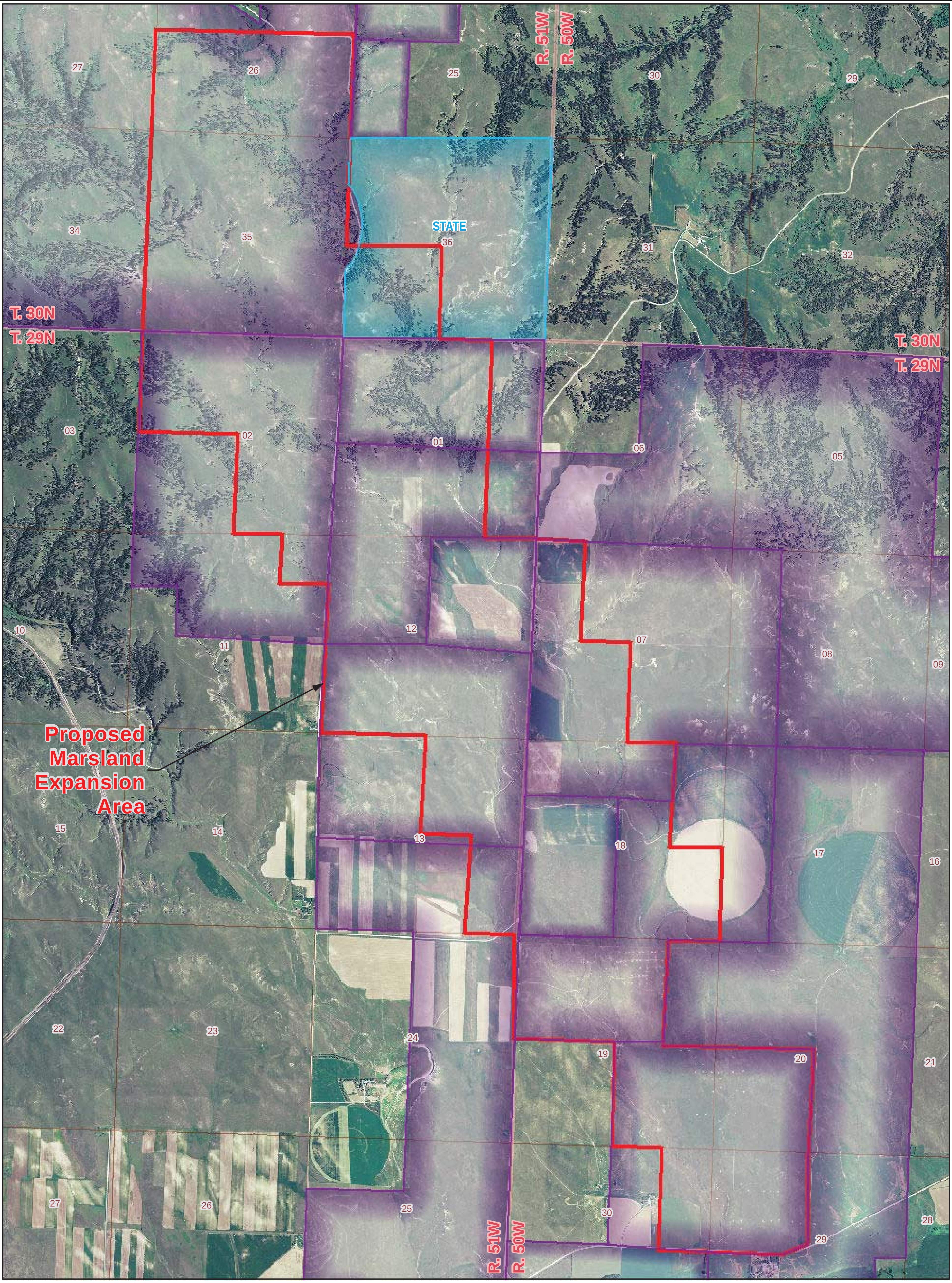
Figure 1.1-4 Marsland Expansion Area Land Ownership

K:\CBR_Projects\CO001636_Marsland\2_GIS\ArcMaps\0005_NRC_ER\ER Figure 1_1-4 MEA Land Ownership Map.mxd - 5/13/2012 @ 2:05:47 AM



LEGEND

- Proposed Marsland Expansion Area
- Private Land
- State Land

N

0 1,250 2,500
Feet

PROJECTION: NAD1927,
STATE PLANE NEBRASKA NORTH, FIPS 2601
SOURCES: USDA NAIP IMAGERY 2010

CROW BUTTE RESOURCES, INC.

FIGURE 1.1-4
MARSLAND EXPANSION AREA
LAND OWNERSHIP

PROJECT: CO001636 MAPPED BY: JC CHECKED BY: MS

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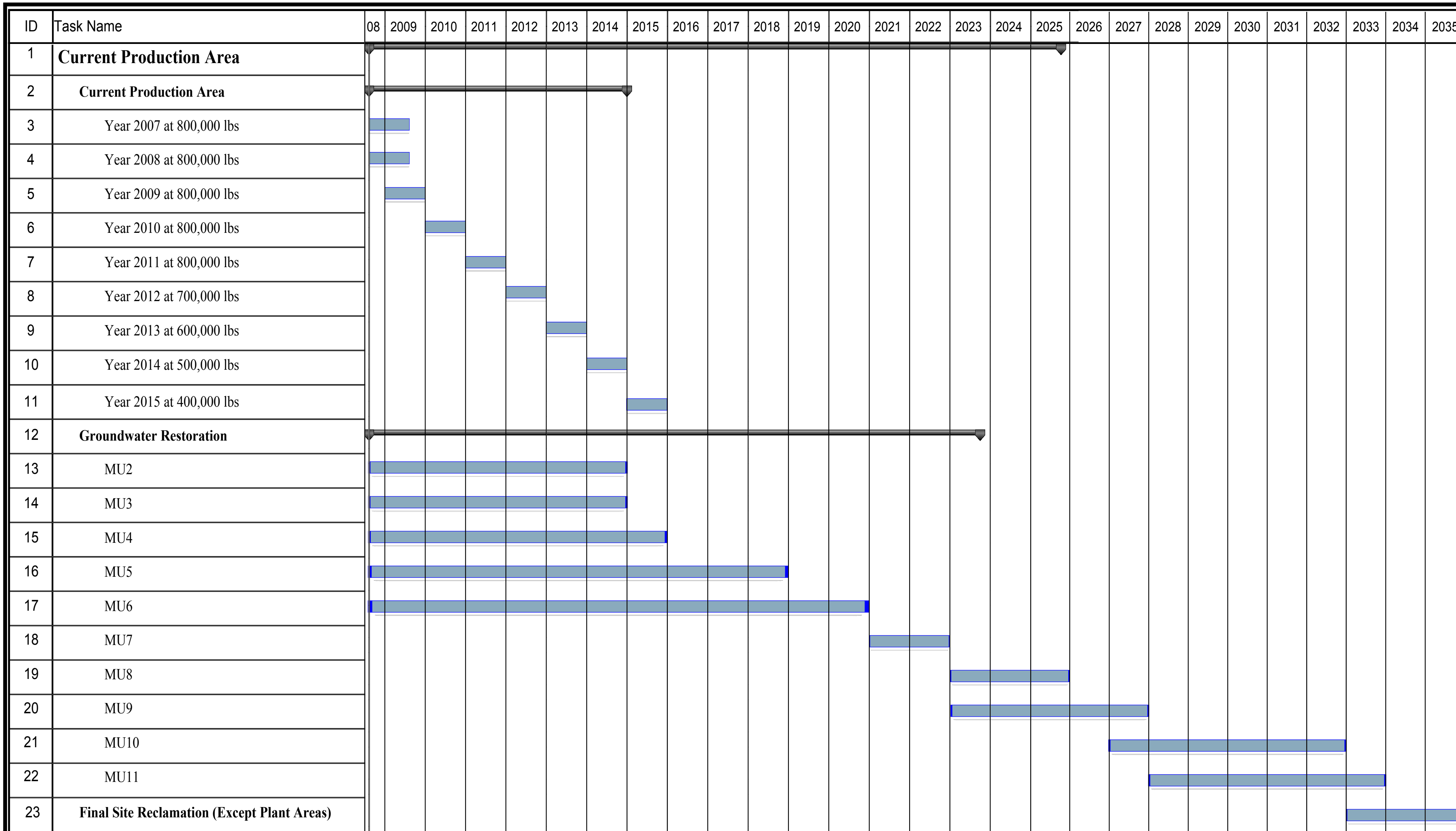
Figure 1.1-5 Current Production Area Mine Unit Timeline



Task

Group By Summary

CROW BUTTE RESOURCES, INC.

FIGURE 1.1-5
CURRENT PRODUCTION AREA
MINE UNIT TIMELINE
EFFECTIVE AS OF JULY 1, 2013

PROJECT: CO001636.00001 MAPPED BY: JC CHECKED BY: JEC

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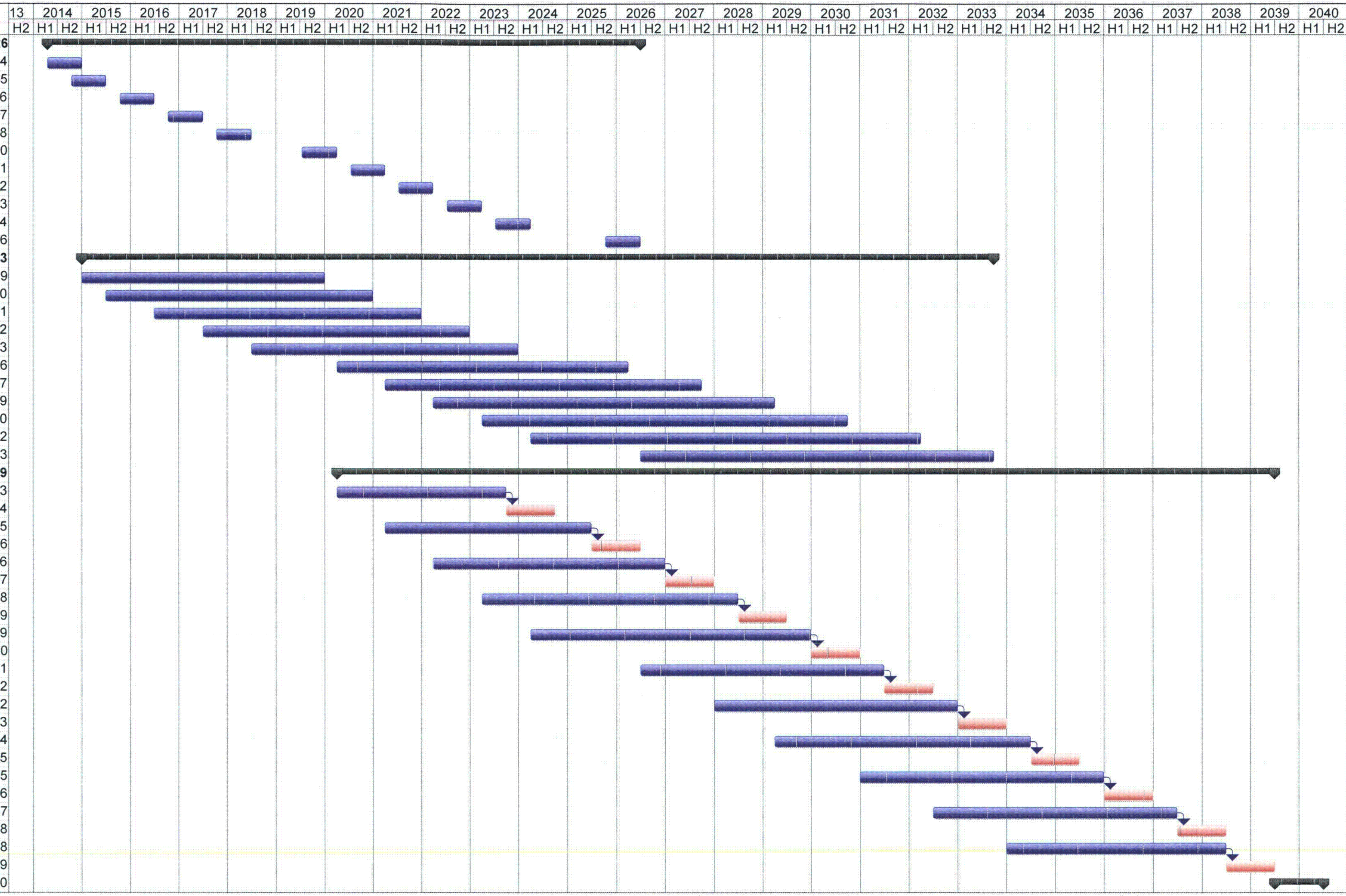
K:\CBR_Projects\CO001636_Marsland\3_IMAGES\Illustrator\TR Figure 1_7-1 Current Production Area Schedule_v10012013.ai @ 10/01/2013

Figure 1.1-6 Marsland Expansion Area Mining and Restoration Timeline

Figure 1.1-6 Marsland Expansion Area Mining and Restoration Timeline

ID	Task Name	Duration	Start	Finish
1	**Facility Construction**	**3184 days**	**Thu 4/17/14**	**Tue 6/30/26**
2	MU-1	185 days	Thu 4/17/14	Wed 12/31/14
3	MU-2	185 days	Wed 10/15/14	Tue 6/30/15
4	MU-3	186 days	Thu 10/15/15	Thu 6/30/16
5	MU-4	186 days	Fri 10/14/16	Fri 6/30/17
6	MU-5	186 days	Fri 10/13/17	Sat 6/30/18
7	MU-A	186 days	Tue 7/16/19	Tue 3/31/20
8	MU-B	185 days	Thu 7/16/20	Wed 3/31/21
9	MU-C	186 days	Thu 7/15/21	Thu 3/31/22
10	MU-D	186 days	Fri 7/15/22	Fri 3/31/23
11	MU-E	186 days	Fri 7/14/23	Sun 3/31/24
12	MU-F	186 days	Tue 10/14/25	Tue 6/30/26
13	**Production**	**4892 days**	**Thu 1/1/15**	**Fri 9/30/33**
14	MU-1	1304 days	Thu 1/1/15	Tue 12/31/19
15	MU-2	1437 days	Wed 7/1/15	Thu 12/31/20
16	MU-3	1436 days	Fri 7/1/16	Fri 12/31/21
17	MU-4	1435 days	Mon 7/3/17	Sat 12/31/22
18	MU-5	1435 days	Mon 7/2/18	Sun 12/31/23
19	MU-A	1565 days	Wed 4/1/20	Tue 3/31/26
20	MU-B	1696 days	Thu 4/1/21	Thu 9/30/27
21	MU-C	1826 days	Fri 4/1/22	Sat 3/31/29
22	MU-D	1956 days	Mon 4/3/23	Mon 9/30/30
23	MU-E	2088 days	Mon 4/1/24	Wed 3/31/32
24	MU-F	1893 days	Wed 7/1/26	Fri 9/30/33
25	**Groundwater Restoration**	**5022 days**	**Wed 4/1/20**	**Thu 6/30/39**
26	MU-1	913 days	Wed 4/1/20	Sat 9/30/23
27	Stabilization Sampling	261 days	Mon 10/2/23	Mon 9/30/24
28	MU-2	1108 days	Thu 4/1/21	Mon 6/30/25
29	Stabilization Sampling	261 days	Tue 7/1/25	Tue 6/30/26
30	MU-3	1240 days	Fri 4/1/22	Thu 12/31/26
31	Stabilization Sampling	261 days	Fri 1/1/27	Fri 12/31/27
32	MU-4	1370 days	Mon 4/3/23	Fri 6/30/28
33	Stabilization Sampling	260 days	Mon 7/3/28	Fri 6/29/29
34	MU-5	1500 days	Mon 4/1/24	Sun 12/30/29
35	Stabilization Sampling	261 days	Tue 1/1/30	Tue 12/31/30
36	MU-A	1304 days	Wed 7/1/26	Mon 6/30/31
37	Stabilization Sampling	262 days	Tue 7/1/31	Wed 6/30/32
38	MU-B	1305 days	Mon 1/3/28	Fri 12/31/32
39	Stabilization Sampling	260 days	Mon 1/3/33	Sat 12/31/33
40	MU-C	1370 days	Mon 4/2/29	Fri 6/30/34
41	Stabilization Sampling	260 days	Mon 7/3/34	Sat 6/30/35
42	MU-D	1304 days	Wed 1/1/31	Mon 12/31/35
43	Stabilization Sampling	262 days	Tue 1/1/36	Wed 12/31/36
44	MU-E	1304 days	Thu 7/1/32	Tue 6/30/37
45	Stabilization Sampling	261 days	Wed 7/1/37	Wed 6/30/38
46	MU-F	1173 days	Mon 1/2/34	Wed 6/30/38
47	Stabilization Sampling	261 days	Thu 7/1/38	Thu 6/30/39
48	**Site Reclamation**	261 days	Fri 7/1/39	Sat 6/30/40



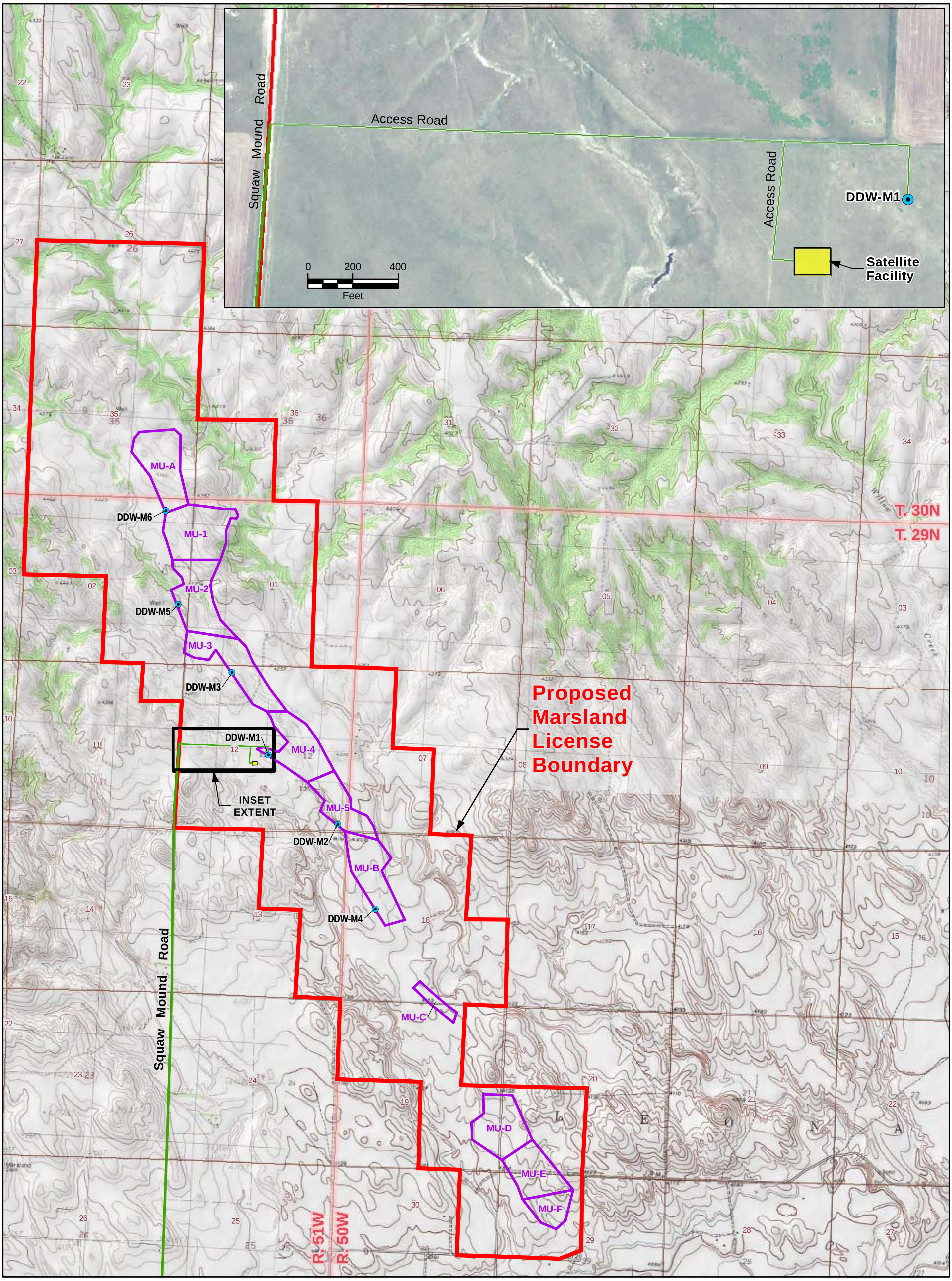
Project: Marsland Expansion Area
Date: Wed 5/22/13

Task · Split · Milestone · Summary · Project Summary · External Tasks · External Milestone · Inactive Task · Inactive Milestone · Inactive Summary · Manual Task · Duration-only · Manual Summary Rollup · Manual Summary · Start-only · Finish-only · Progress · Deadline

Revised July 2013

Figure 1.1-7 General Arrangement Satellite Facility View

Path: C:\Users\jchen\Documents_PROJECTS\K_CBR_Projects\CO001636_Marsland\2_GIS\ArcMaps\005_NRC_ER\ER Figure 1_1-7 General Arrangement - Satellite Facility View.mxd | Last Saved By: jchen | Last Saved On: 4/24/2014



LEGEND

- Proposed Deep Disposal Well
- Squaw Mound Road
- Access Road
- Satellite Facility (Restricted Area)
- Mine Unit
- Proposed Marsland License Boundary

N

0 1,500 3,000
Feet

PROJECTION: NAD 1983, STATE PLANE NEBRASKA NORTH, FIPS 2600
SOURCES: US TOPO MAPS, SERVICED BY ESRI ARCGIS ONLINE

CROW BUTTE RESOURCES, INC.

FIGURE 1.1-7
GENERAL ARRANGEMENT
SATELLITE FACILITY VIEW
(REVISED APRIL 2014)

PROJECT: CO001636 MAPPED BY: JC CHECKED BY: JEC

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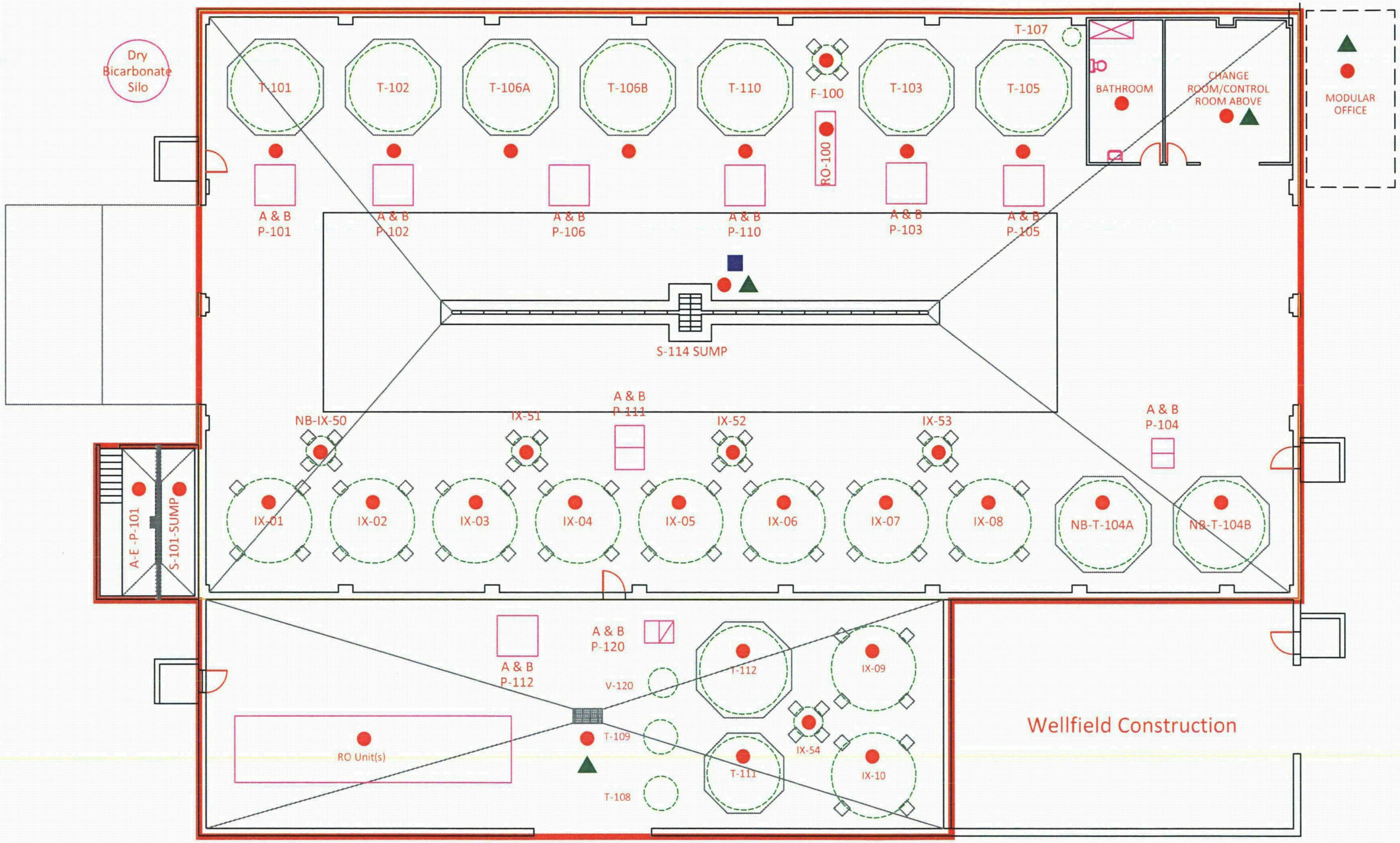
Figure 1.1-8 Marsland Expansion Area Satellite Building Layout



Tank (# Each)	Description
IX-01 through 08	Ion Exchange
IX-50 through 54	Ion Exchange Resin Trap
IX-09 through 10	Restoration IX Column
T-101	Bicarbonate Mix
T-102	Bicarbonate Storage
T-103	Reverse Osmosis Feed
T-104A	Resin Transfer
T-104B	Resin Transfer
T-105	Water supply/Make-up Water
T-106A	Wastewater
T-106B	Wastewater
T-107	Water Pressure Tank
T-108	Sodium Sulfide Day
T-109	Sodium Sulfide Mix
T-110	Well Work Over Fluid
T-111	RO Cleaning Tank
T-112	Permeate Tank
PV-119 through 122	RO Filter
V-120	Degaser
F-100	Sock filters
A-E-P-101	Injection pumps on trunk lines to wellfield

Legend:

- Gamma Survey Location
- Radon Testing Location
- Airborne Particulate Survey Location
- Restricted Area

Notes:

1. Illustration only, not to scale.
2. Adapted from Cameco Resources, 2011.

CROW BUTTE RESOURCES, INC.

FIGURE 1.1-8
MARSLAND EXPANSION AREA
SATELLITE BUILDING LAYOUT

PROJECT: CO001636 MAPPED BY: JC CHECKED BY: JEC

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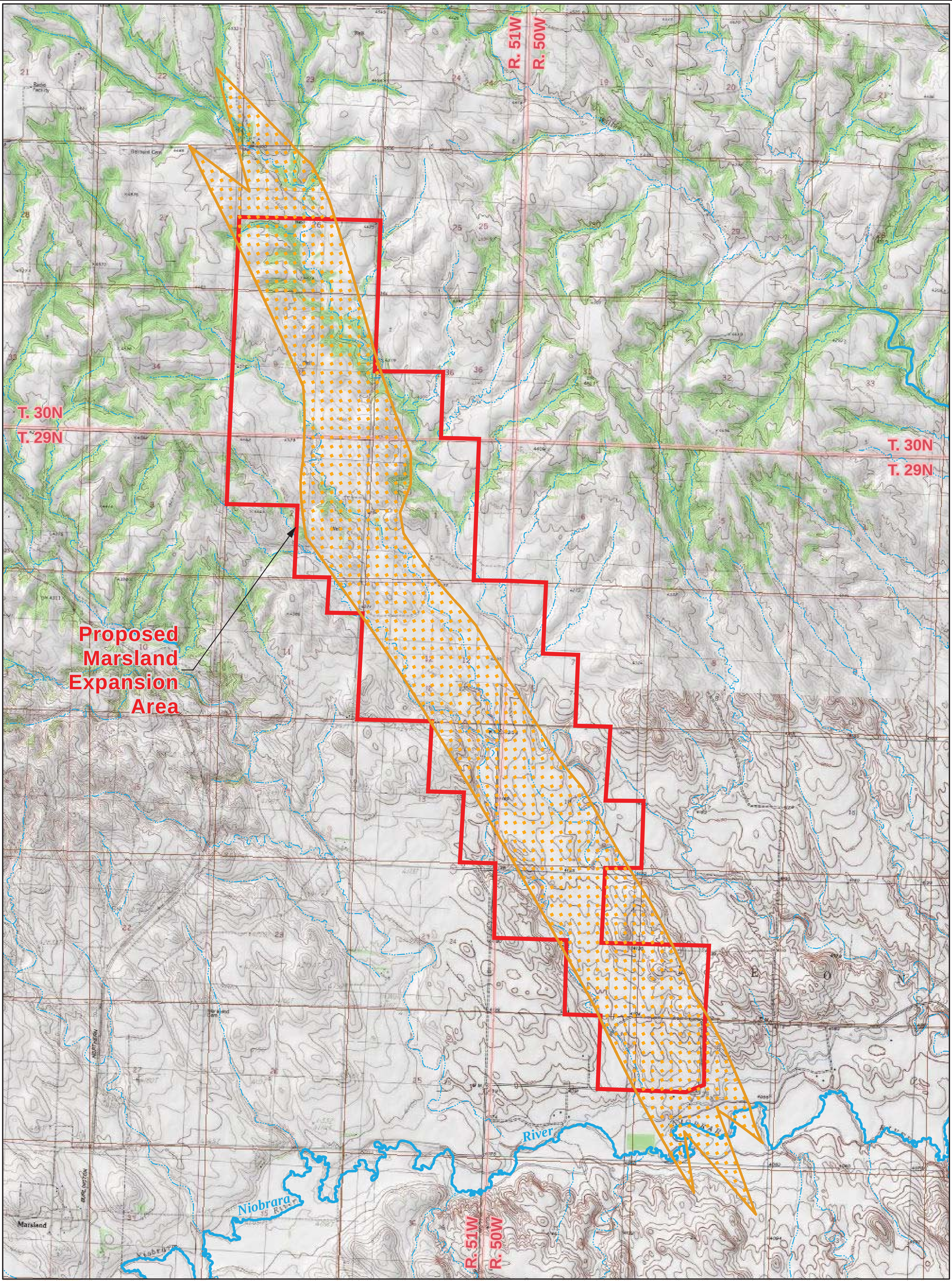
Figure 1.3-1 Marsland Expansion Area Estimated Ore Body

K:\CBR_Projects\CO001636_Marsland\2_GIS\ArcMaps\0005_NRC_ER\ER Figure 1_3-1 Marsland Expansion Area Ore Body.mxd - 5/13/2012 @ 2:00:48 AM



LEGEND

- Estimated Ore Body
- Proposed Marsland Expansion Area
- Perennial Stream/River
- Intermittent Stream/River

N

0 1,750 3,500

Feet

PROJECTION: NAD1927,
STATE PLANE NEBRASKA NORTH, FIPS 2601
SOURCES: USA TOPO MAPS, SERVICED
BY ESRI ARCGIS ONLINE

CROW BUTTE RESOURCES, INC.

FIGURE 1.3-1
MARSLAND EXPANSION AREA
ESTIMATED ORE BODY

PROJECT: CO001636 | MAPPED BY: JC | CHECKED BY: MS

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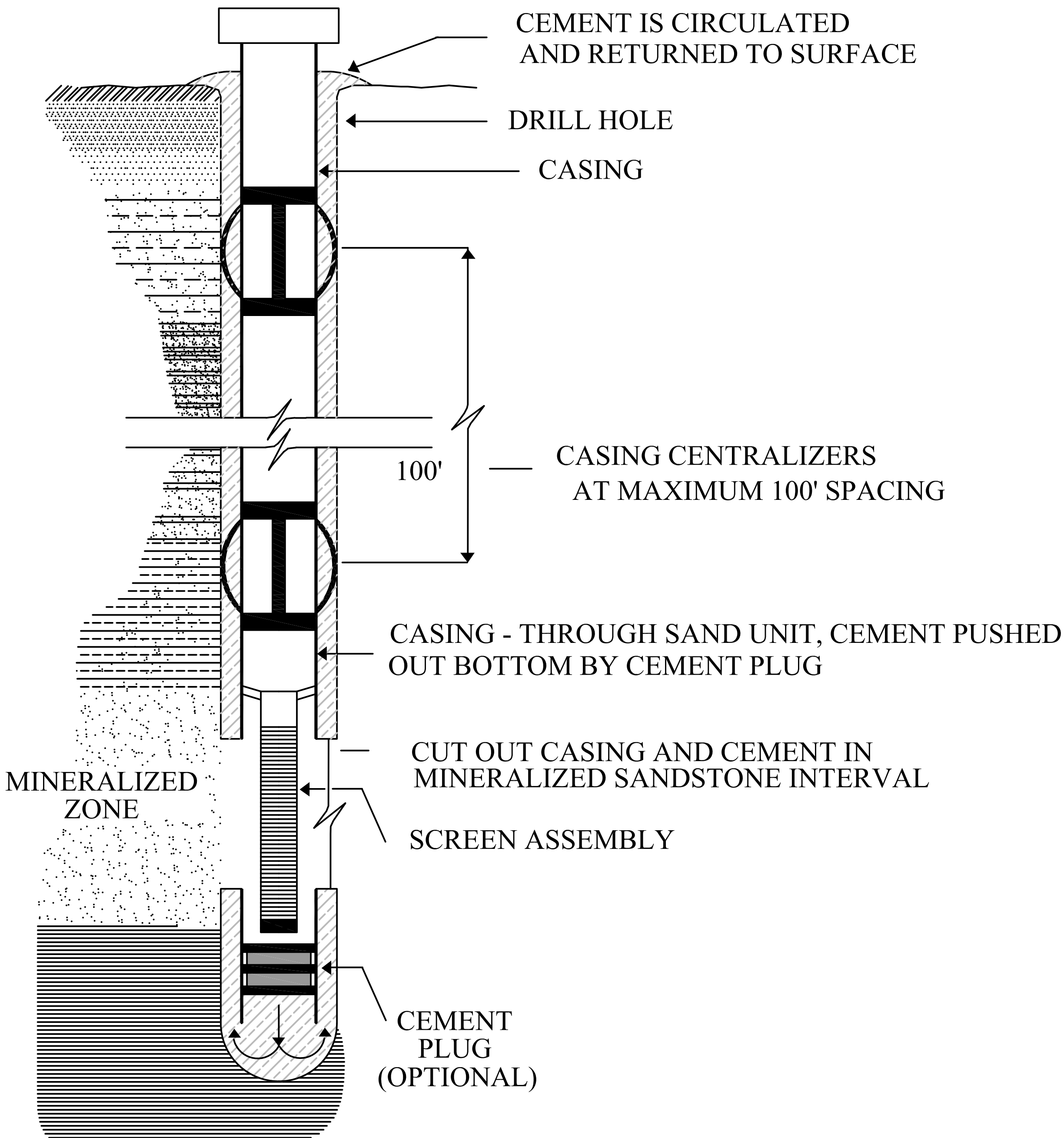
Figure 1.3-2 Typical Mineralized Zone Completion for Injection/Production Wells – Method No. 1



CROW BUTTE RESOURCES, INC.

FIGURE 1.3-2

TYPICAL MINERALIZED ZONE COMPLETION FOR INJECTION/PRODUCTION WELLS

METHOD NO.1

PROJECT: CO001396.02 MAPPED BY: JC CHECKED BY: JEC

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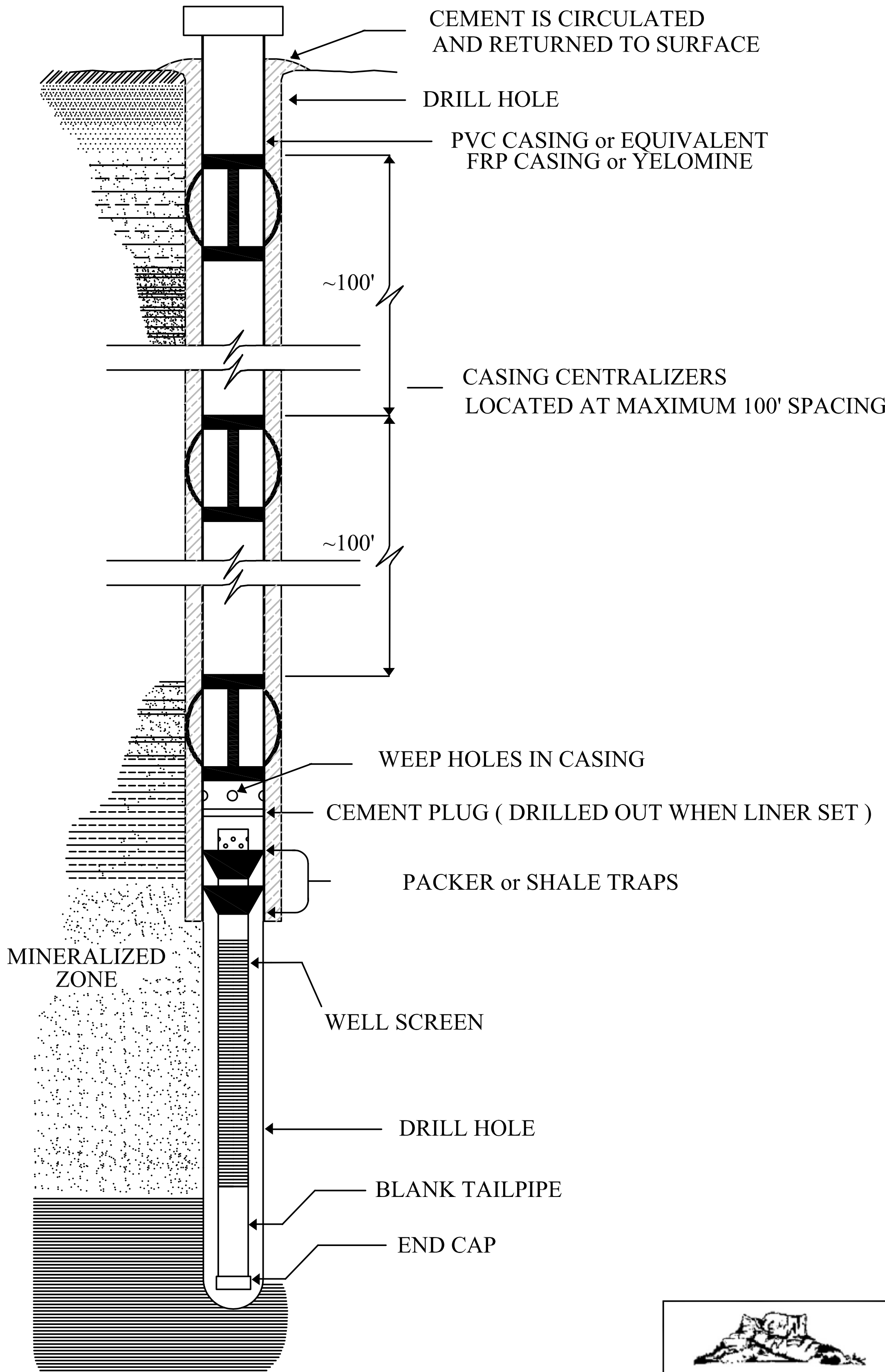
PATH: K:\CBR_Projects\CO001396_ThreeCrow\1_ACAD\ARCADIS_NewDrawings\WellCompletionMethods.dwg LAYOUT: ER_1 DATE/TIME: 7/9/2010 11:43 AM

Figure 1.3-3 Typical Mineralized Zone Completion for Injection/Production Wells – Method No. 2



CROW BUTTE RESOURCES, INC.

FIGURE 1.3-3

TYPICAL LINER COMPLETION FOR MONITOR OR INJECTION/PRODUCTION WELLS

METHOD NO.2

PROJECT: CO001396.02 MAPPED BY: JC CHECKED BY: JEC

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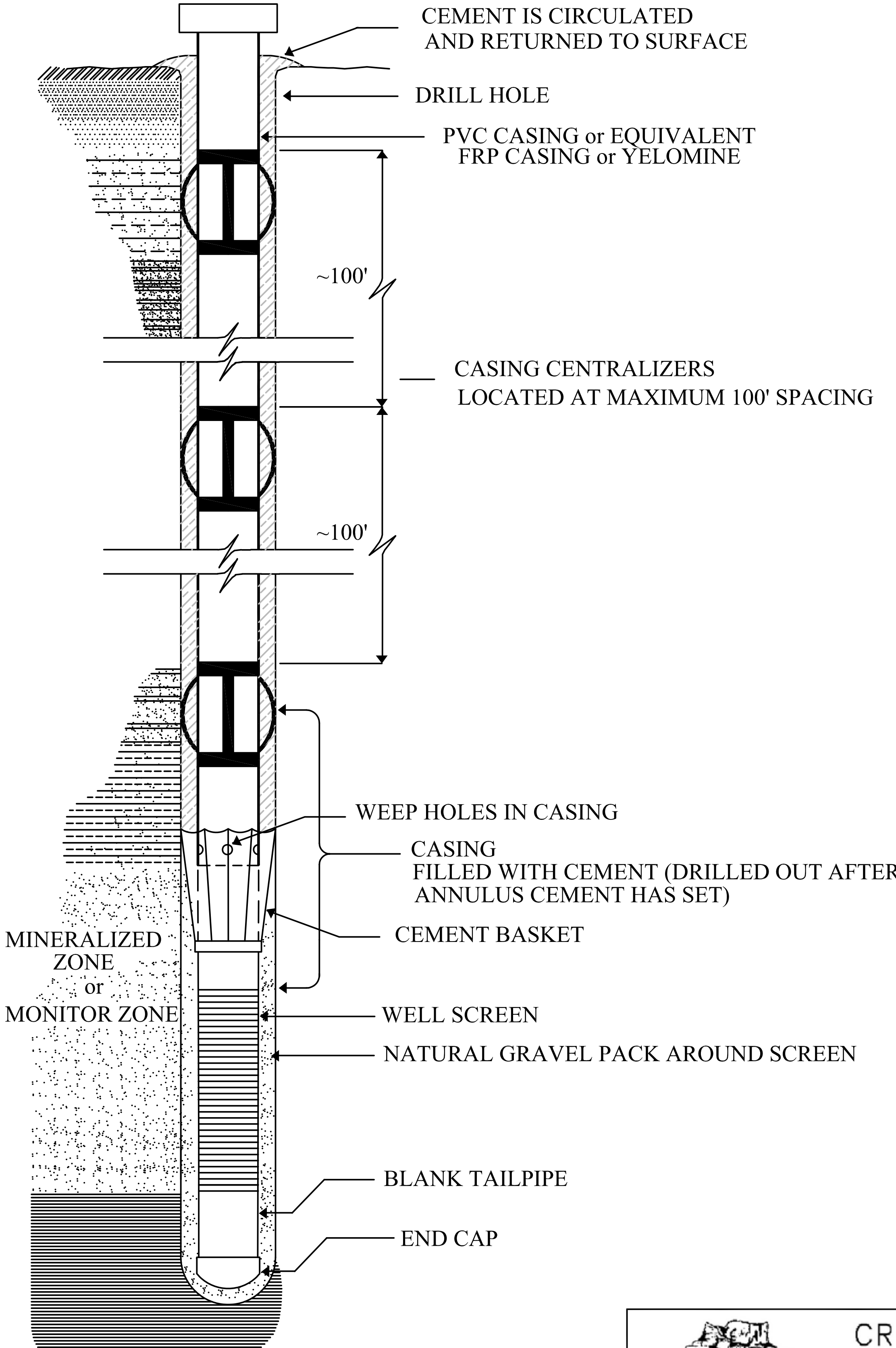
PATH: K:\CBR_Projects\CO001396_ThreeCrow\1_ACAD\ARCADIS_NewDrawings\WellCompletionMethods.dwg LAYOUT: ER_2 DATE/TIME: 7/9/2010 11:43 AM

Figure 1.3-4 Typical Mineralized Zone Completion for Injection/Production Wells – Method No. 3



CROW BUTTE RESOURCES, INC.

FIGURE 1.3-4

TYPICAL CEMENT BASKET COMPLETION FOR MONITOR OR INJECTION/PRODUCTION WELLS

METHOD NO.3

PROJECT: CO001396.02 MAPPED BY: JC CHECKED BY: JEC

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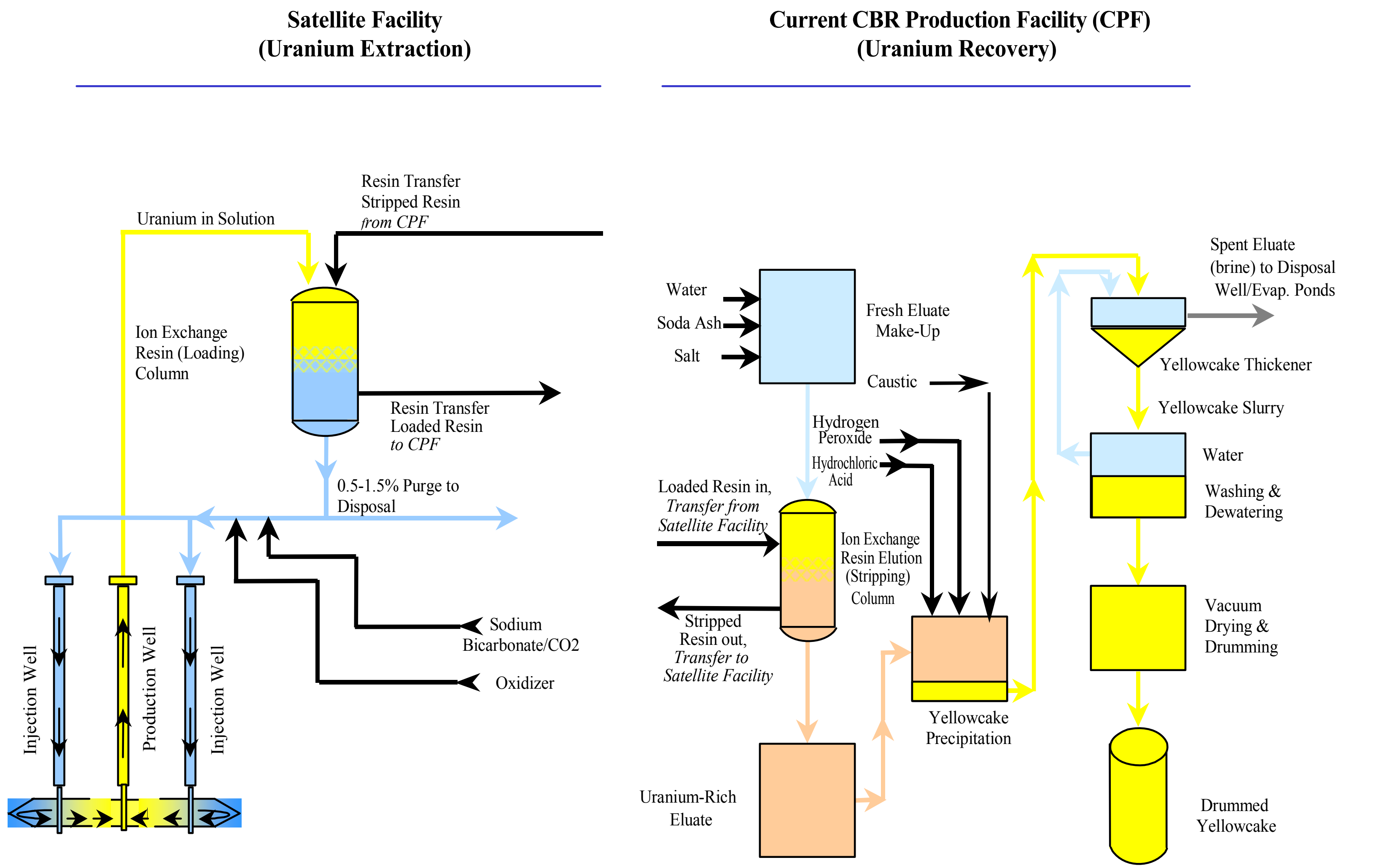
PATH: C:\Users\jchen\Documents_PROJECTS\KICBR_Projects\CO001636_Marsland\1_ACAD\WellCompletionMethods.dwg LAYOUT: UIC_3 DATE/TIME: 10/21/2011 11:46 AM

Figure 1.3-5 Marsland Expansion Area Satellite Facility and Current CBR Production Facility Process Flow Diagram



CROW BUTTE RESOURCES, INC.

FIGURE 1.3-5
MARSLAND EXPANSION AREA
SATELLITE FACILITY AND
CURRENT CBR PRODUCTION FACILITY
PROCESS FLOW DIAGRAM

PROJECT: CO001636.00001 MAPPED BY: JC CHECKED BY: JEC

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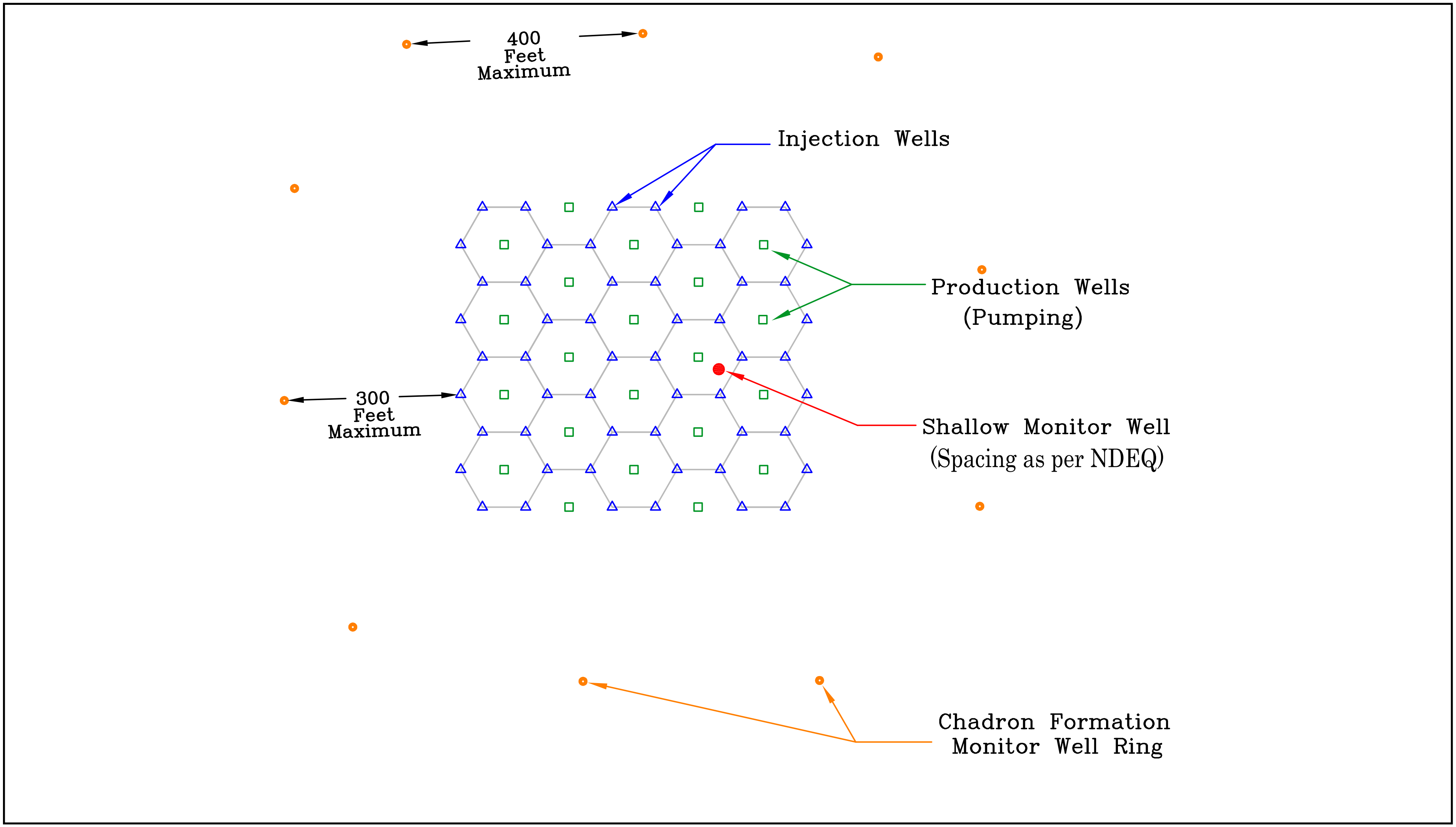
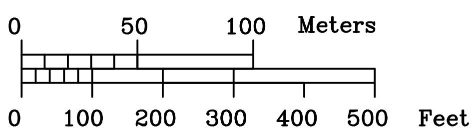
K:\CBR_Projects\CO001636_Marsland\3_IMAGES\Illustrator\TR Figure 3_6-1 Process Flow Diagram.ai @ 10/21/2011 BY: J.CHEN @ Boulder, CO

Figure 1.3-6 Typical Wellfield Layout





CROW BUTTE RESOURCES, INC.

FIGURE 1.3-6

TYPICAL WELLFIELD LAYOUT

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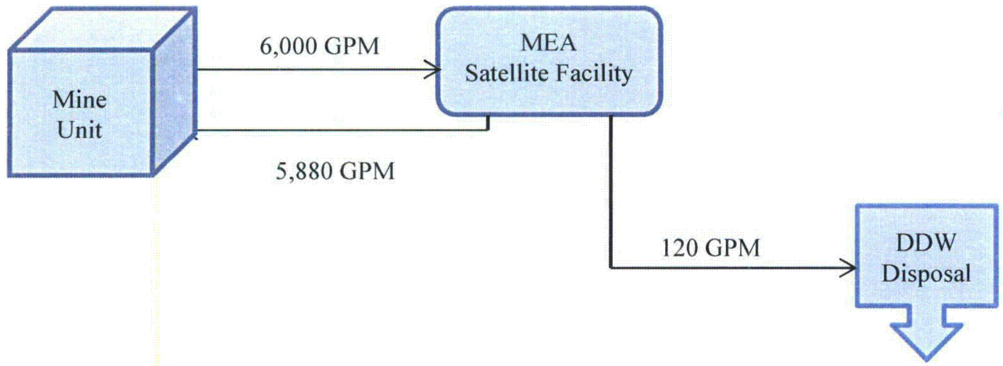
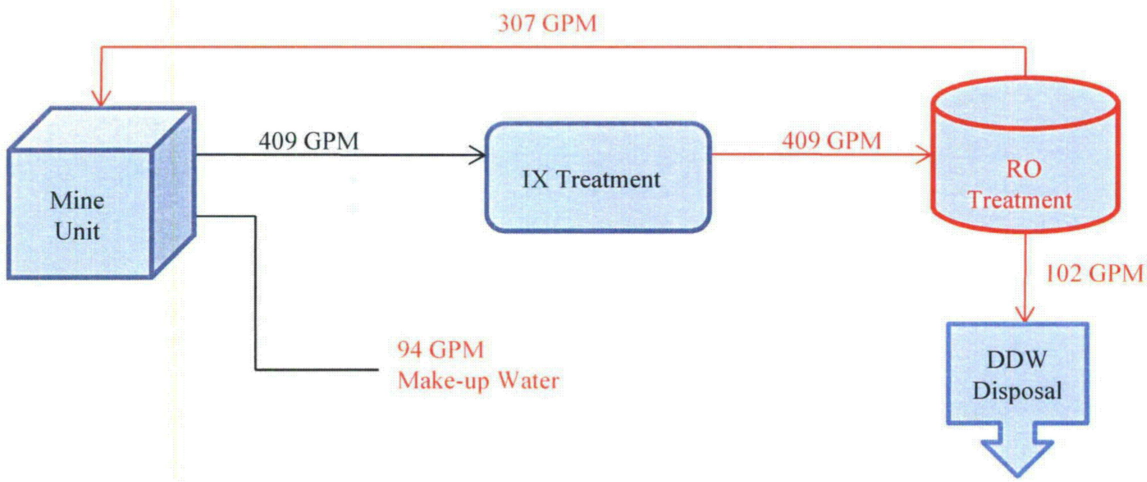
Figure 1.3-7 Water Balance for Marsland Satellite Facility



Water Balance Flow Example for Production



Water Balance Flow Example: Restoration – IX Treatment & RO Treatment Phase

CROW BUTTE RESOURCES, INC.

FIGURE 1.3-7
WATER BALANCE FOR MARSLAND FACILITY

PROJECT: CO001636.00001 MAPPED BY: JC CHECKED BY: JEC

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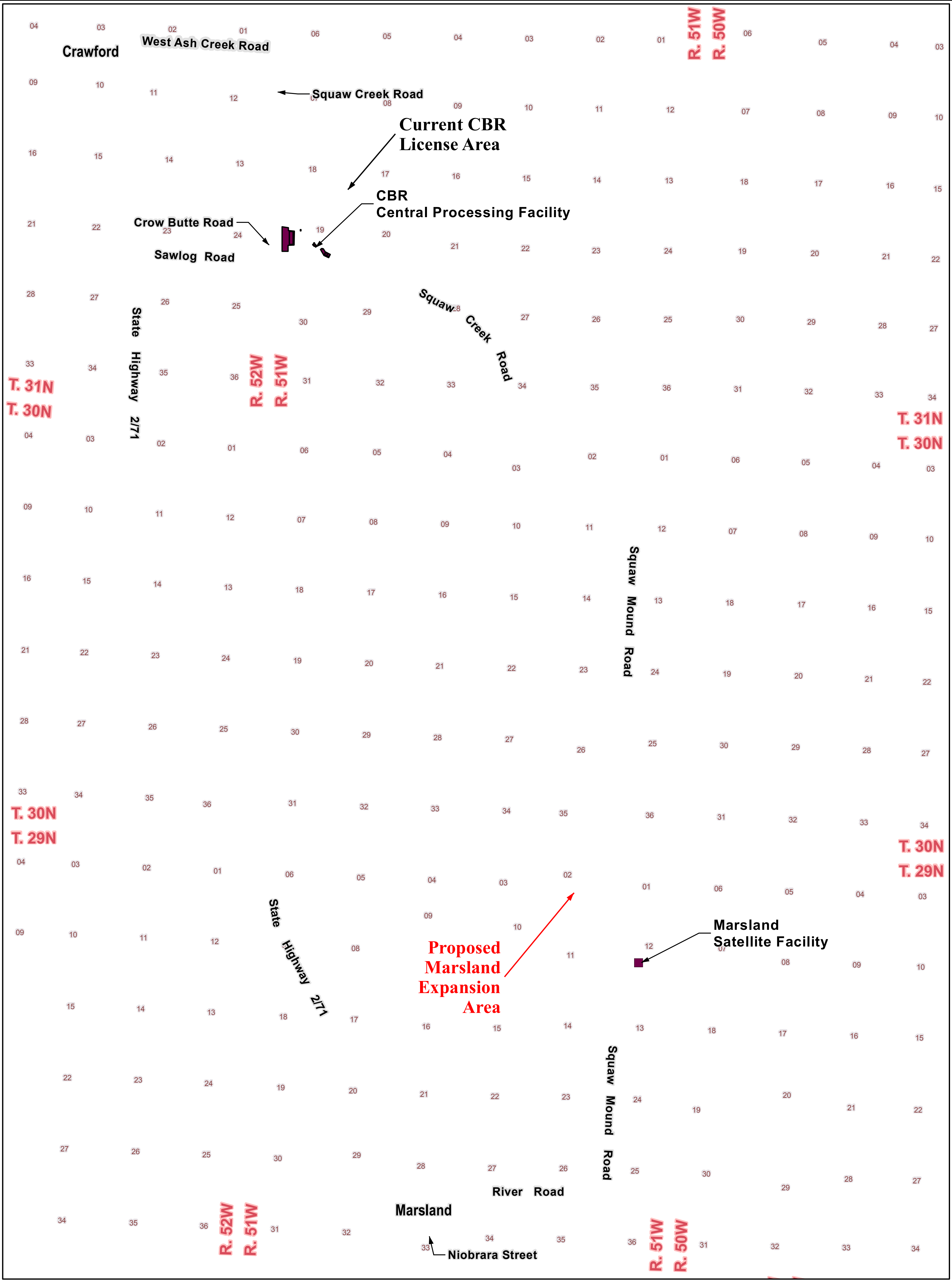
Figure 1.4-1 Proposed Access Route Between Marsland Expansion Area Satellite Facility and Crow Butte Central Processing Facility

K:\CBR_Projects\CO001636_Marsland\2_GIS\ArcMaps\0005_NRC_ER\ER Figure 1-4-1 Proposed Access Route_11X17.mxd - 3/21/2012 @ 10:03:00 PM



LEGEND

- Primary Access Route
- Alternative Route A
- Alternative Route B

N

0 3,500 7,000

Feet

PROJECTION: NAD1927,
STATE PLANE NEBRASKA NORTH, FIPS 2601
SOURCES: USA TOPO MAPS, SERVICED
BY ESRI ARCGIS ONLINE

FIGURE 1.4-1
PROPOSED ACCESS ROUTE BETWEEN MARSLAND EXPANSION AREA SATELLITE FACILITY AND CROW BUTTE CENTRAL PROCESSING FACILITY

PROJECT: CO001636 MAPPED BY: JC CHECKED BY: JEC

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2 ALTERNATIVES TO PROPOSED ACTION

2.1 No-Action Alternative

2.1.1 Summary of Current Activity

CBR currently operates the CPF, a commercial ISR uranium mining operation located approximately 4 miles (6.4 km) southeast of the City of Crawford in Dawes County, Nebraska. Operation is allowed under NRC Source Materials License SUA-1534. The CPF is located approximately 11.1 miles (17.9 km) to the north-northwest of the proposed MEA (centerpoint of CPF processing building to centerpoint of MEA satellite building).

An R&D facility was operated in 1986 and 1987. Construction of the commercial process facility began in 1988, with production beginning in April of 1991. The total license area is 2,861 acres, and the surface area affected by the current commercial project is approximately 2,000 acres. Facilities include the R&D facility (which now houses the Restoration Circuit), the CPF and office building, solar evaporation ponds, parking, access roads, and wellfields.

In the CPF license area, uranium is recovered by in-situ leaching from the basal sandstone of the Chadron Formation at depths that vary from 400 to 900 feet. The overall width of the mineralized area varies from 1,000 to 5,000 feet. The ore body ranges in grade from less than 0.05 percent to more than 0.5 percent U_3O_8, with an average grade estimated at 0.27 percent U_3O_8. Production is currently in progress in MUs 6 through 11. Groundwater restoration has been completed and regulatory approval has been received in MU 1. Groundwater restoration is currently underway in MUs 2 through 6.

The CPF is operating with a licensed flowrate of 9,000 gpm. Maximum allowable throughput from the facility under SUA-1534 is currently 2,000,000 pounds of U_3O_8 per year.

2.1.2 Impacts of the No-Action Alternative

The no-action alternative would allow CBR to continue mining operations in the CPF license area, with mining limited to remaining reserves at the CPF site. Based on current plans and mining timelines discussed in Section 1 (**Table 1.1-1** and **Figure 1.1-5**), CBR could continue production at the CPF license area until 2014, when reserves are expected to be depleted to the point where commercial production would no longer be economical and would be discontinued shortly thereafter. Groundwater restoration and reclamation would become the primary activities, with final groundwater restoration in 2023 and reclamation completed in 2025.

Assuming favorable regulatory action by the NRC and State of Nebraska and, that the MEA is licensed, and commercial production remains economical, mining operations are estimated to begin at the proposed NTEA satellite facilities in 2024 and last for approximately 8 years (until 2032). As discussed in the NTEA Technical Report (Application for Amendment of NRC Source Materials License SUA-1534; CBR 2007), NTEA reserves would be depleted in 2032.

When commercially recoverable resources are depleted in the CPF license area, all activities at the site not associated with groundwater restoration and decommissioning will be completed, resulting in the loss of a significant portion of the total employment at the site. In actuality, some of these jobs would be lost before 2014. For example, the well drilling, installation, and wellfield construction activities would be completed several years before the completion of mining activities, and these positions would no longer be necessary. At the completion of decommissioning, all employment opportunities at the mine would be terminated. If approved, mining operations at the MEA would extend current employment levels through 2023, at which time the NTEA would be ready to start producing. The impacts to the local economy from the approval of mining operations at MEA, including employment opportunities, are evaluated in the MEA Technical Report (CBR 2007).

In addition to the loss of significant employment opportunities in the City of Crawford and Dawes County, the premature closing of the CPF before commercially viable resources are recovered would adversely affect the economic base of Dawes County. As discussed in further detail in Sections 4.10.3 and 7, the CPF currently provides a significant economic impact to the local Dawes County economy as shown in **Table 4.10-2**.

If this amendment request is denied, the negative impact on the Dawes County economy would be felt as early as 2013, when employment levels for drilling and construction activities would be cut, and purchases of services and materials would diminish. In the event that NTEA, TCEA, and MEA are approved, employment would continue at current levels. The potential positive economic impact to the local economy from construction and operation of the MEA is demonstrated in **Table 4.10-2**.

A decision to not amend SUA-1534 to allow mining in the MEA would leave a large resource unavailable for energy production supplies. Although CBR is continuing to develop estimates of the reserves at MEA, the current indicated ore reserves as U_3O_8 for the MEA are 6,161,679 lbs, with an additional inferred estimate of 3,389,518 lbs. Total reserves for the MEA are currently estimated at 9,551,197 lbs. The MEA will operate with an expected annual production rate of approximately 600,000 lbs U_3O_8.

In 2012, total domestic U.S. uranium concentrate production was approximately 4,100,000 pounds U_3O_8, of which approximately 800,000 pounds (or approximately 20 percent) was produced at the CPF (EIA 2013a). During the same year, purchases of domestic U.S. uranium by U.S. civilian nuclear power reactors from U.S. and foreign suppliers were approximately 58,000,000 pounds U_3O_8e (equivalent) with approximately 17 percent supplied by domestic producers (EIA 2013b). Foreign-origin uranium accounted for the remaining 83 percent of deliveries. The CPF (including the MEA, TCEA, and NTEA) represents an important source of new domestic uranium supplies essential to providing a continuing source of fuel to power generation facilities.

In addition to leaving a large deposit of valuable mineral resources untapped, a denial of this amendment request would result in the loss of a large investment in time and money made by CBR for the rights to and development of these valuable deposits.

Denial of the amendment request would have an adverse economic effect on the individuals that have surface leases with CBR and own the mineral rights in the MEA.

2.2 Proposed Action

The proposed MEA timeline and MU map are shown on **Figures 1.1-6** and **1.1-7,** respectively. There will be a total of 11 MUs, with construction for MU 1 to commence in 2014. Production for the project will start in 2015 and terminate in the year 2039. Restoration in designated MUs will commence in the year 2020 and will be completed in 2044. Site reclamation will be completed in 2046. The ore grade as U_3O_8 ranges from 0.11 to 0.33 percent with an average ore grade of 0.22 percent.

The proposed MEA contains a licensed area of approximately 4,622.3 acres. Of this potential licensed area, the total surface area to be affected by mining operations will be approximately ~~591~~592 acres for the proposed MUs, processing facility, disposal well, well sites, and access roads. Currently, these areas are cropland (~~71.7~~71.9 acres) and livestock range (~~491.2~~491 acres).

The proposed satellite facility will be located within a 1.8-acre area in sections 26, 35 of T30N; R51W; sections 1, 2, 12, 13 of T29N R51W; and sections 7, 18, 19, 20 29, 30 of T29N, R50W. This area will also contain the chemical storage area. There could be as many as six onsite DDWs, with the nearest DDW (DDW-M1) being ~~will be~~ located approximately 0.3 mile (0.48 km) north-northwest of the satellite facilities (**Figure 1.1-7**). **Figure 1.1-8** shows the plan view of the satellite building.

Figure 1.1-3 shows the locations of the current license area and the proposed MEA.

The MEA will be developed and operated by CBR. All land within the proposed license boundary of the MEA is privately owned. CBR has obtained surface and mineral leases from the appropriate landowners necessary to construct and operate the required ISR facilities.

Commercial production at the CPF is expected to extend for the next several years, with the uranium reserves largely depleted by 2014. Commercial production at the proposed MEA would occur over 24 years between 2015 and 2039. The aquifer will be restored and reclaimed concurrent with operations, plus an additional period at the end of the project for final decommissioning and surface reclamation. The combined CPF and MEA projects would be completely restored and reclaimed by 2046. More detailed timelines are provided in Section 1.

The CPF recovers uranium from the basal sandstone of the Chadron Formation. In the MEA, uranium will also be recovered from the basal sandstone of the Chadron Formation. The depth in the MEA ranges from 800 to 1,250 feet. The width varies from 1,000 to 4,000 feet.

The satellite facility process structure will be a building approximately 130 feet long by 100 feet wide. The proposed satellite facility equipment will include the following systems:

- IX
- Filtration
- Resin transfer
- Chemical addition

The in-situ process consists of an oxidation step and a dissolution step. The oxidants used in the facility are H_2O_2 and/or O_2. A $NaHCO_3$ lixiviant is used for the dissolution step.

The uranium-bearing solution resulting from the leaching of uranium underground is recovered from the wellfield and piped to the satellite facility for extraction. The satellite facility process employs the following steps:

- Loading of uranium complexes onto an IX resin
- Reconstitution of the solution by the addition of $NaHCO_3$ and O_2
- Shipment of loaded IX resin to the CPF
- Restoration of groundwater following mining activities

The satellite facility will be designed for a maximum flowrate, excluding restoration flow, of 6,000 gpm (restoration would account for another 1,500 gpm). Uranium-bearing resin will be transported to the CPF for elution and packaging of yellowcake.

The operation of the satellite facility results in a number of effluent streams. Airborne effluents are limited to the release of radon-222 gas during the uranium recovery process. Liquid wastes are handled through evaporation and/or deep well injection.

Groundwater restoration activities consist of four steps:

- Groundwater transfer
- Groundwater sweep
- Groundwater treatment
- Aquifer recirculation

Groundwater restoration will take place concurrently with development and production. The primary goal of the groundwater restoration is to return the water quality of the affected zone to a chemical quality consistent with baseline conditions required by 10 CFR 40, Appendix A, Criterion 5(B)(5) (or an approved alternate concentration limit [ACL] under 5[B][5][c]); or, as a secondary goal, to the quality level specified by the NDEQ.

Following groundwater restoration, all injection and recovery wells will be reclaimed using appropriate plugging and abandonment procedures. In addition, a sequential land reclamation and revegetation program will be implemented on the site. This reclamation will be performed on all disturbed areas, including the satellite facility, wellfields, and roads. The current estimate of the total acreage that may be affected over the life of the project is ~~1,760~~1,754 acres.

CBR will maintain financial responsibility for groundwater restoration, facility decommissioning, and surface reclamation. Currently, an irrevocable letter of credit is maintained based on the estimated costs of the aforementioned activities.

The environmental impacts of the requested action will be minimal as discussed in Section 4. The primary radiological air impacts will be from the release of radon gas during production and will be minimized by the use of pressurized downflow IX columns. In addition, radon gas quickly dissipates in the atmosphere and results in a minimal additional exposure to the public as discussed in Section 4.12. All drying and packaging will be performed at the CPF using a vacuum drying system, thereby minimizing the potential for radioactive air particulate releases at MEA.

ISR alters the geochemistry and the water quality in the mining zone. CBR has proven in the current licensed area that impacts to groundwater can be controlled through stringent well construction techniques, wellfield operating methodologies that minimize excursions, and the use of best practicable technologies (BPTs) to restore the groundwater to premining baseline or class of use after mining activities are complete.

The impacts discussed in Section 4 include short-term and long-term impacts. However, it should be noted that the uranium ISR mining technique allows the entire mine site to be decommissioned and returned to unrestricted use within a relatively short time.

Commercial production at the CPF including the proposed MEA and NTEA is expected to extend over the next 27 years with the uranium reserves at both areas depleted by 2039. The MEA site alone will produce U_3O_8 from 2014 through 2039. Commercial production at the proposed MEA would occur over 24 years from late 2015 through 2039. Aquifer restoration and reclamation will be done concurrent with operations, plus an additional period at the end of the project for final decommissioning activities and surface reclamation. All three projects would be completely restored and reclaimed by 2046. More detailed timelines are provided in Section 1.

2.3 Reasonable Alternatives

2.3.1 Process Alternatives

2.3.1.1 Lixiviant Chemistry

CBR is employing a $NaHCO_3$ lixiviant that is an alkaline solution. Where the groundwater contains carbonate, as it does at CBR, an alkaline lixiviant will mobilize fewer hazardous elements from the ore body and will require less chemical addition than an acidic lixiviant. Also, test results at other projects indicate only limited success with acidic lixiviants, while the $NaHCO_3$ has proven highly successful to date at the CBR operations. Alternate leach solutions include ammonium carbonate solutions and acidic leach solutions. These solutions have been used in solution mining programs in other locations; however, operators have experienced difficulty in restoring and stabilizing the aquifer. Consequently, these solutions were excluded from consideration.

2.3.1.2 Groundwater Restoration

The restoration of the R&D project, the successful completion of restoration in MU 1, and the current restoration activities in MUs 2 through 6 at the current licensed CPF demonstrate the effectiveness of the restoration methods. These methods (groundwater sweep, permeate/reductant injection, and aquifer recirculation) have been shown to restore groundwater to premining quality. No feasible alternative groundwater restoration method is currently available for the CPF and proposed MEA. The NRC and NDEQ consider the method currently employed at the CPF as the BPT.

2.3.1.3 Waste Management

Liquid Waste

Liquid wastes generated from in situ production and restoration activities are typically handled by one of three methods: solar evaporation in ponds, DDW injection, or land application. All three methods are permitted at the CPF. The use of DDWs in conjunction with storage/evaporation ponds to dispose of the high TDS liquid wastes that primarily result from the yellowcake processing and drying facilities is considered the best alternative to dispose of these types of wastes. Alternative wastewater disposal options that were considered for MEA were DDW injection, surge/evaporation ponds, point source discharge and/or land application. In addition, surge tanks were evaluated as waste management facilities to support the selected DDW alternative.

The proposed method of liquid waste disposal at MEA will be DDW injection without the need for supporting surge/evaporation ponds or surge tanks. The justification for this proposed action is discussed in Section 3.12.2.1. There are currently no plans for any point source discharges or land application of wastewaters. However, the land application option could be applied in the future if such disposal is deemed feasible and more beneficial for a specific wastewater stream. Any such action would require an NRC license amendment and a discharge permit from the NDEQ.

Based on the proposed project development schedule and the water balance of the MEA project, additional liquid waste disposal methods will be phased for the MEA operations. For approximately the first 6 years of operation (2015 through 2020), the MEA operations will send wastewaters to storage tanks located in the satellite building, which will then be discharged to two onsite DDWs. As discussed in Section 3.12.2.2, it is estimated that an additional four DDWs (for a total of six DDWs) may be needed to address wastewater disposal over the life of the project. There will be no evaporation ponds or large surge tanks located outside the satellite building. The proposed waste management system will be sufficient to handle the total quantities of wastewaters that will be generated during startup. Production and restoration flows will increase in 2021 to the extent that additional wastewater management and controls will be needed because the increased flows may exceed the capacity of two DDWs.

During the first 6 years of operations, CBR will assess the maximum injection rates of the DDWs and the overall efficiency of the waste management system. Efforts will be made to maximize the DDW injection rates, minimize the amounts of wastewaters generated during production and restoration that require disposal, better quantify actual site wastewater flows, and assess viable waste management alternatives and environmental implications. This time period will allow CBR time to develop an updated waste management system that will be the most optimum for handling the increasing wastewater flows. Additional wastewater management systems to be evaluated will include additional DDWs, surge tanks, surge/evaporation ponds, and process modifications to minimize liquid waste generation.

As stated above, CBR considered and rejected using either surge/evaporation ponds, point source discharge, or land application as a disposal method for currently planned operations at Marsland due to required treatment and monitoring costs and potential environmental impacts. However, as the project develops, a determination will be made as to the extent of additional wastewater management alternatives that may be needed in addition to the DDWs to handle all of the generated wastewater streams amenable to disposal by DDW. Additional alternative evaluations will consider options such as additional DDWs, surge tanks, surge/evaporation ponds, land application, or treated wastewater discharge. CBR will be able to assess the maximum injection rates for the two initial DDWs, and the resulting information will be of value in planning future DDWs and/or other disposal options. CBR will submit the necessary license amendment(s) and waste alternative analyses to the NRC and request approval as per applicable license condition(s), as well as permits required by the NDEQ and other appropriate state agencies.

Surge Tanks

Surge tanks may be a viable option in the future in addressing increased production and restoration flows. If a reasonable number of surge tanks can handle the proposed wastewater volumes, then that may be the only option required. This would assume that additional DDWs would be added and the overall disposal capacity was sufficient.

Surge tanks offer the following advantages over evaporation ponds:

- Less waste solids would be generated with tanks because the tanks would be enclosed, and windblown dust and dirt would not enter the tanks as it would with open evaporation ponds.
- Tank sediments could be managed and removed in a more environmentally acceptable manner compared to evaporation ponds.
- Tanks would eliminate the potential for exposure of wildlife (birds, small mammals, amphibians, and reptiles) to the open evaporation ponds.
- Tanks would have less potential of contamination to the surrounding area compared to the potential of spray via enhanced evaporation (sprayers) from the evaporation ponds.
- Tanks (mounted on concrete foundations with spill contaminant) would have less potential of contamination of the soils underneath and around the tanks (e.g., liner leaks of ponds).
- Potential radon emissions would be less of a risk with enclosed tanks (vented in a manner to minimize employee/public exposures) compared to large, open ponds (e.g., evaporation spray systems).
- Tanks would require a smaller footprint than evaporation pond(s).
- Waste volumes of tanks would be less than for evaporation ponds (ponds will generate liners and additional expected contaminated soils to be disposed of as byproduct material).

Surge/Evaporation Ponds

Surge/evaporation ponds could be a viable alternative in the future if additional surge capacity requirements exceed what could be reasonably handled with additional storage tanks (e.g., size constraints) and DDWs. The surge/evaporation ponds would allow for additional wastewater disposal through passive or enhanced (spray systems) evaporation, especially during the warmer times of the year. Additional surge tanks could be used to the extent possible to minimize the size of any required surge/evaporation ponds. A stated above, prior to the increase in wastewater flows that would result in two DDWs not being able to adequately dispose of the generated wastewaters, viable waste management alternatives will be evaluated in detail. The objective of the alternatives evaluation will be to select options that will adequately handle the maximum amounts of produced wastewaters, while providing for protection of the environment and safe operations by the employees.

Evaporation ponds are commonly used at ISR facilities for the disposal of liquid wastes, which involves pumping liquids into one or more ponds and allowing natural solar radiation to reduce the volume through evaporation. Wastewaters discharged to evaporation ponds are not always treated prior to discharge to the ponds, which can result in concentration of radionuclides and other metals as the liquids evaporate. The basic design criteria for an evaporation pond system are contained in 10 CFR Part 40, Appendix A, Criteria 5A and 5E. The NRC has established standards for the location of pond(s), design and construction of the required clay or geosynthetic liner systems, pond embankments, and leak detection systems (NRC 2003, NRC 2008). Pond inspection and maintenance criteria are also established by NRC regulations.

Evaporation pond effectiveness depends on how much waste is being generated over a given time period, evaporation rates for the area being used, and how quickly liquid wastes are generated. Evaporation rates will vary seasonally, being dependent largely upon temperature and relative humidity, with the rate of evaporation being highest during warm, dry conditions and lower during cool, humid conditions. The pond size and surface area can be increased in order to enhance evaporation when the evaporation rates are low or seasonal conditions reduce evaporation.

NRC recommends that evaporation ponds include sufficient freeboard and reserve capacity. The NRC recommends a freeboard of approximately 3 to 6 feet (distance from water level to top of embankment) and a reserve capacity that will allow the entire contents of one or more ponds to be transferred to other ponds in the event of a leak requiring repair or to handle additional wastewater volumes.

With ponds being open to the atmosphere, dust and dirt can be blown into the ponds, with the concentrations of dissolved solids increasing due to evaporation. This could result in the precipitation of salts form the solution. Periodic cleaning of the ponds may be required in order to maintain good repair and the necessary freeboard. The accumulated pond sediments may need to be disposed of as byproduct material at a licensed disposal facility. When the site is permanently closed, pond liners, accumulated materials, and any contaminated solid underlying or adjacent to the pond liner may need to be disposed of as byproduct material.

During the winter months in northwest Nebraska, ponds can ice over, resulting in reduced evaporation rates. In order to adequately manage wastewaters year-round in this region, additional storage capacity or additional disposal options would be needed for a typical ISR facility (e.g., land application and/or point source discharge).

Land Application

In general, liquid waste disposal using the land application alternative would involve pre-treatment of liquid waste in lined settling ponds followed by application of treated waste through center pivot or other types of irrigation sprinklers to agricultural production areas. Application would be seasonally restricted to the approximately mid-March through early-July winter wheat growing season. Treatment may require IX columns, RO, and barium/radium sulfate precipitation to decrease uranium and radium levels in the wastewater below the permitted discharge limits. Until the site and facilities are decommissioned, any byproduct material in storage facilities and within tanks, ponds, and radium-settling basins would need to be managed to prevent any releases (NRC 2003).

Land application would require the construction of additional facilities, including radium settling pond(s), outlet pond(s) to intercept treated water from the radium settling pond(s), storage pond(s) to store treated water during the non-irrigation season, and emergency containment pond(s). Storage tanks could alternatively be used in place of the settling, storage, and emergency containment ponds.

Although not a preferred option at this time, land application may be a feasible option in the future when used in conjunction with other disposal options such as disposal via DDW with support facilities such as surge tanks or ponds. If land application disposal is determined to be needed in the future, a facility specific land application plan under a license amendment application will be submitted to the NRC for review and approval. In addition, required permits/approvals from the NDEQ and other applicable state agencies will be obtained.

Discharge to Surface Drainage

Discharge of wastewater would be expected to require treatment similar to what is described above for land application. Radionuclides and specific radionuclide parameters would have to meet applicable NDEQ and NRC discharge standards. An NPDES permit would have to be obtained from the NDEQ, and a license condition allowing the activity issued by the NRC. Although not a preferred option at this time, it may viable for future disposal if warranted due to capacity issues.

See additional discussions of liquid waste disposal in Section 3.12.2.1 and the project water balance in Section 3.12.2.2.

Solid Waste

All solid wastes are transported from the site for disposal. Non-contaminated waste is shipped to an approved sanitary landfill. Contaminated wastes are shipped to an NRC-approved facility for disposal. Should an NRC (or Agreement State)-licensed disposal facility not be available to CBR at the time of decommissioning, on-site burial may be necessary. This alternative could incur long-term monitoring requirements and higher reclamation costs. At this time, CBR believes that off-site disposal of 11(e)2 byproduct material from the MEA at a licensed disposal facility is the best alternative, and there are no plans for on-site disposal.

2.4 Alternatives Considered but Eliminated

As a part of the alternatives analysis conducted by CBR, several mining alternatives were considered. Due to the significant environmental impacts and cost associated with these alternative mining methods in relation to the MEA ore body, they were eliminated from further consideration.

2.4.1 Mining Alternatives

Underground and open pit mining represent the two currently available alternatives to IRM mining for the uranium deposits in the project area. Neither of these methods is economically viable for producing the MEA reserves at this time for several reasons, including the spatial characteristics of the mineral deposit and environmental factors. The depth of the deposit and subsequent overburden ratio make surface mining impractical. Surface mining is commonly undertaken on large, shallow (less than 300 feet) ore deposits. At the MEA, uranium is recovered from depths ranging from about 800 to 1,250 feet bgs.

In addition, the physical characteristics of the deposit and the overlying materials make underground mining infeasible for the MEA. The costs of mine development, including surface facilities, shaft, subsurface stations, ventilation systems, and drifting, would decrease the economic efficiency of the project.

From an environmental perspective, open-pit mining or underground mining and the associated milling process involve higher risks to employees, the public, and the environment. Radiological exposure to the personnel in these processes is increased not only from the mining process but also from milling and the resultant mill tailings. Moreover, the personnel injury rate is historically much higher in open-pit and underground mines than at ISR solution mining operations.

Both open-pit and underground mining methods would require substantial dewatering to depress the potentiometric surface of the local aquifers and provide access to the ore. The groundwater would contain naturally high levels of radium-226 that would have to be removed prior to discharge, resulting in additional radioactive solids that would have to be disposed. For conventional mining, a mill tailings pond containing 5,000,000 to 10,000,000 tons of solid tailings waste from the uranium mill would also be required.

In a comparison of the overall impacts of uranium ISR with conventional mining, an NRC evaluation (NRC 1982) concluded that environmental and socioeconomic advantages of ISR include the following:

1. Significantly less surface area is disturbed than in surface mining, and the degree of disruption is much lower.
2. No mill tailings are produced, and the volume of solid wastes is reduced significantly. The gross quantity of solid wastes produced by ISR is generally less than 1 percent of that produced by conventional milling methods (more than 948 kg [2,090 lb] of tailings usually result from processing each metric ton [2,200 lb] of ore).
3. Because no ore and overburden stockpiles or tailings pile(s) are created and the crushing and grinding ore-processing operations are not needed, the air pollution problems caused by windblown dusts from these sources are eliminated.
4. The tailings produced by conventional mills contain essentially all of the radium-226 originally present in the ore. By comparison, less than 5 percent of the radium in an ore body is brought to the surface when ISR methods are used. Consequently, operating personnel are not exposed to the radionuclides present in and emanating from the ore and tailings, and the potential for radiation exposure is significantly lower than that associated with conventional mining and milling.
5. By removing the solid wastes from the site to a licensed waste disposal site and otherwise restricting them from contaminating the surface and subsurface environment, the entire mine site can be returned to unrestricted use within a relatively short time.
6. Solution mining results in significantly less water consumption than conventional mining and milling.
7. The socioeconomic advantages of uranium ISR include:

- The ability to mine a lower grade ore
- A lower capital investment
- Less risk to the miner
- Shorter lead time before production begins
- Lower manpower requirements

Finally, and perhaps most important, because CBR is an established commercial solution mining site, there are no viable alternative mining methods at this time. The current market price of uranium makes an established solution mining operation the most economically viable method of mining uranium at the MEA at this time.

The uranium ISR process is used when specific conditions exist, including the following (EPA 2008):

- *The ore is too deep to be mined economically by conventional means.*
- *The uranium is present in multiple-layered roll fronts.*
- *The ore body is below the water table.*
- *The ore grade is low, and the ore body is too thin to mine by conventional means.*
- *A highly permeable rock formation exists in which uranium can be economically produced.*

These conditions exist at the MEA site.

2.4.2 Production Facility Alternatives

The option existed for CBR to construct a new yellowcake production facility for the MEA project rather than the proposed satellite facility. The selected option was the construction of a new satellite facility instead because the existing CBR production facility is only approximately11.1 miles (17.9 km) to the north-northwest of the proposed MEA site (centerpoint of CPF processing building to centerpoint of MEA satellite building).

The use of the existing facility as a centralized processing facility will allow processing of uranium-loaded resin from the CBR's proposed MEA satellite facility and two other nearby proposed satellite facilities (NTEA and TCEA). Such a centralized design enhances the economics of uranium production in the region by maximizing production capacity while minimizing further capital expenditures on processing facilities. The construction and operational cost of a satellite facility would be significantly lower than that of a new production facility. The potential for release of radiological particulates would be lower for a satellite facility due to it being a "wet" process because no yellowcake would be produced. Other advantages include: less land disturbance for the operating assets; non-radiological air emissions (e.g., fugitive dust, diesel, and gasoline emissions) during operations would be lower; fewer employees working at the site would be potentially exposed to radiation; there would be less byproduct and other types of waste generated that would need to be handled and disposed of; smaller deposits located within the MEA can be mined with the resin trucked to the CPF; and the front end of the "milling" process can begin independent of the larger CPF.

In summary, the construction and operation of a new processing facility was not deemed to be a viable economical alternative and would result in more environmental impacts than a new satellite facility. Transportation of the uranium-loaded resin from the satellite facility to the CPF would serve as an additional risk. However, such risk is deemed minimal with the use of trucks designed for hauling resin, trained drivers, required speed of the vehicles, conditions of the roadways, minimal amount of road traffic in the area, and relative short distance between the two facilities.

2.5 Cumulative Effects

2.5.1 Cumulative Radiological Impacts

On October 17, 2006, CBR submitted a license amendment request to the NRC requesting an increase in the licensed flow at the CPF. License Condition 10.5 of SUA-1534 limited current operation to an annual facility throughput of 5,000 gpm exclusive of restoration flow. CBR requested an amendment to this license condition to increase production and assist restoration efforts. The production increase was to be accomplished by expanding the existing facility and mining existing wellfields to lower levels of soluble uranium. CBR requested approval to increase the annual facility throughput to 9,000 gpm exclusive of restoration flow. The amendment request did not change the annual licensed production rate of 2,000,000 pounds of U_3O_8 per year. NRC issued the license amendment on November 30, 2007.

The only environmental impact of the increased flowrate at the current operation is a corresponding increase in the emission of radon-222 from the current operation. The amendment estimated a 22 percent increase in the maximum public dose, and that the maximum public dose would remain well below the limit found in 10 CFR § 20.1301.

2.5.2 Future Development

CBR has identified several additional areas in the region near the CPF that are being considered for development. Licensing and permitting efforts are ongoing for two additional satellite facilities (NTEA and TCEA). Development of additional facilities is not currently planned, although such development depends on further site investigations by CBR and the future of the uranium market. If conditions warrant, CBR could submit additional license amendment requests to permit development of these additional resources. However, CBR currently projects that development of these areas would be primarily intended to maintain production allowed under the current license as reserves in the current licensed area and at the MEA are depleted.

2.6 Comparison of the Predicted Environmental Impacts

Table 2.6-1 summarizes the environmental impacts for the no-action alternative (Section 2.1), the preferred alternative (Section 2.2), and the process alternatives (Section 2.3.1). The predicted impacts for the mining alternatives discussed in Section 2.4 are not included for comparison because these alternatives were rejected due to significant environmental and economic impacts. Environmental impacts are discussed in greater detail in Section 4.

Table 2.6-1 Comparison of Predicted Environmental Impacts

Table 2.6-1 Comparison of Predicted Environmental Impacts

Impacts of Operation	No-Action Alternative	Preferred Alternative	Process Alternatives: Alternate Lixiviant Chemistry	Process Alternatives: Alternate Waste Management
Land Surface Impacts	None	Minimal temporary impacts in wellfield areas, significant surface and subsurface disturbance confined to a portion of the ~12 acre satellite facility site.	Same as Preferred Alternative.	Same as Preferred Alternative. Potential additional impacts from land application of treated waste water.
Land Use Impacts	None	Loss of crop and cattle production in 562 acre area for duration of project.	Same as Preferred Alternative.	Same as Preferred Alternative plus a potential long term land use impact from on-site disposal of 11(e)2 byproduct material.
Transportation Impacts	None	Minimal impact on current traffic levels. Estimated additional heavy truck traffic of delivery trucks (`7 day) & resin truck (`2/day)	Same as Preferred Alternative.	Same as Preferred Alternative.
Geology and Soil Impacts	None	None	None	None
Surface Water Impacts	None	None	None	None
Groundwater Impacts	None	Consumption of Chadron groundwater for control of mining solutions and restoration (estimated at 315 gpm average)	Same as Preferred Alternative. Increased difficulty with groundwater restoration and stabilization.	Same as Preferred Alternative.
Ecological Impacts	None	No substantive impairment of ecological stability or diminishing of biological diversity.	Same as Preferred Alternative.	Same as Preferred Alternative.
Air Quality Impacts	None	Additional 28.9 tons per year for offsite unpaved roads (uncontrolled) and 14.5 tons per year for onsite unpaved roads (uncontrolled).	Same as Preferred Alternative.	Same as Preferred Alternative.
Noise Impacts	None	Barely perceptible increase over background noise levels in the area.	Same as Preferred Alternative.	Same as Preferred Alternative.

Table 2.6-1 Comparison of Predicted Environmental Impacts

Impacts of Operation	No-Action Alternative	Preferred Alternative	Process Alternatives	
			Alternate Lixiviant Chemistry	**Alternate Waste Management**
Historic and Cultural Impacts	None	None	None	None
Visual/Scenic Impacts	None	Moderate impact; noticeable minor industrial component in sensitive viewing areas.	Same as Preferred Alternative.	Same as Preferred Alternative plus possible long term visual and scenic impacts from on-site disposal cell for 11(e)2 byproduct material
Socioeconomic Impacts	Eventual loss over the next 5 to 10 years of positive economic impact of $10.4M to the local area as reserves deplete in the current licensed operation	Extension of the current annual direct economic impact of $10.4M plus the addition of between $5.3M and $6.1M annual direct economic impact to local area	Same as Preferred Alternative.	Same as Preferred Alternative.
Nonradiological Health Impacts	None	None	None	None
Radiological Health Impacts	None	The estimated additional maximum dose rate within 80 km of MEA was 1.6 person-rem/yr and 0 person-rem/yr beyond 80 km	Same as Preferred Alternative.	Same as Preferred Alternative.
Waste Management Impacts	None	Generation of additional liquid and solid waste for proper disposal.	Same as Preferred Alternative. Mobilization of additional hazardous elements in lixiviant requiring disposal.	Same as Preferred Alternative. Potential additional long term impact from on-site disposal of 11(e)2 byproduct material.

Table 2.6-1 Comparison of Predicted Environmental Impacts

Impacts of Operation	No-Action Alternative	Preferred Alternative	Process Alternatives	
			Alternate Lixiviant Chemistry	Alternate Waste Management
Mineral Resource Recovery Impacts	Loss of a valuable domestic energy resource. CBR estimated reserves are under development but the current estimated recoverable resource is 9.5 million pounds with a current spot market value (8/2011) of $475 million.	Recovery and use of a domestic energy resource.	Same as Preferred Alternative.	Same as Preferred Alternative.