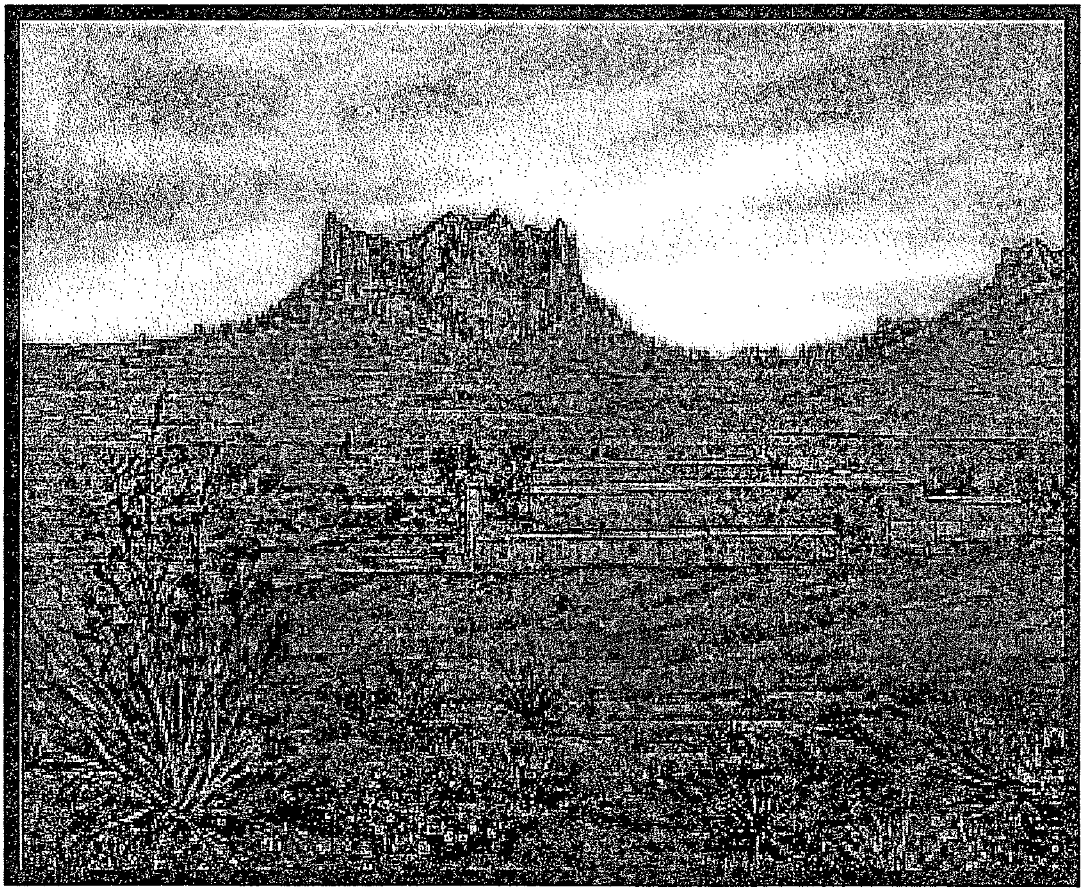
Application for Amendment of USNRC Source Materials License SUA-1534 Three Crow Expansion Area Crawford, Nebraska

Environmental Report Volume I



Prepared by

Crow Butte Resources, Inc.
86 Crow Butte Road
Crawford, Nebraska 69339

August 2010

CROW BUTTE RESOURCES, INC.

Nuclear Regulatory Commission

Environmental Report

Volume I

Three Crow Expansion Area

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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 leach (ISL) 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 Three Crow Expansion Area (TCEA). By letter dated November 27, 2007, CNR applied for the continued operation of the CPF. In response to a May 27, 2008 Notice of Opportunity for Hearing, NRC action on the license renewal application is pending. In the meantime, the current license stays in effect.

This ER provides the supplemental information necessary to determine the environmental impacts of amending License No. SUA-1534 to allow uranium recovery activities in the TCEA. 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 TCEA is located within Sioux and Dawes Counties, which are located 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 ISL facilities, as well as for applications to amend or renew existing ISL 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 a SEIS. When such conditions are met, the NRC will prepare an SEIS for the CBR amendment, fulfilling agency responsibilities under the National Environmental Protection Act (NEPA).

This ER has been prepared using suggested guidelines and standard format from NRC. The ER is presented primarily in the format found in NUREG-1748, *Environmental Review Guidance for Licensing Actions Associated with NMSS Programs* (August 2003). The pertinent guidance in NUREG-1748 was used to ensure that complete information is provided to NRC for review. In addition, NRC document NUREG-1569, *Standard Review Plan for In Situ Leach Uranium Extraction License Applications* (June 2003) was consulted to ensure that all necessary information is provided.

1.1.1 Crow Butte Uranium Project Background

The original CBR development was performed by Wyoming Fuel Corporation, which constructed a Research and Development (R&D) Facility in 1986. The project was subsequently acquired 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 owned 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 my Cameco Corporation, which is a Canadian corporation that is publicly traded on both the Toronto and New York Stock Exchanges.

The Research and Development Facility was located in N1/2 SE1/4 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 1 of Commercial Operations.

The CPF is located in Section 19, T31N, R51W, Dawes County, Nebraska. The original license area is approximately 2,875 acres and the surface area affected over the estimated life of the project is approximately 1,265 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 was successfully completed in Mine Unit 1 in 1999. Mine Unit 1 is currently undergoing surface reclamation activities. The operating history and schedules for the current production area are discussed in more detail in Section 1.1.4.1.

1.1.2 Site Location and Description

The location of the CPF license area is in portions of Sections 11, 12, 13, and 24 of T31N, R52W and Sections 18, 19, 20, 29, and 30 of T31N, R51W, Dawes County, Nebraska. The CPF is situated approximately 4.0 miles southeast of the City of Crawford (**Figure 1.1-1**).

The proposed TCEA is located in Sections, 28, 29, 30, and 33 of T31N, R52W, and Section 25 of T31N, R53W (**Figure 1.1-2).**

All of the mineral resources leased within the TCEA are privately owned. There is no state or federal minerals. **Figure 1.1-3** shows land ownership in the proposed TCEA.

1.1.3 Operating Plans, Design Throughput, and Processing

The CPF is licensed for a flow rate of 9,000 gallons per minute, excluding restoration flow, under License No. SUA-1534. Total annual production is limited to 2 million pounds of yellowcake.

Uranium extracted from the Three Crow wellfield will be processed at a satellite facility located within the TCEA. The satellite facility will operate at an overall flow rate of 6,000 gallons per minute (gpm), plus an additional 1,500 gpm restoration flow rate. The anticipated bleed rate is assumed to be 0.5 to 1.5 percent of the total mining flow.

The expected annual production rate will be approximately 600,000 pounds U_3O_8. Indicated ore resources as U_3O_8 for the TCEA are 3,750,481 pounds (lbs) with an additional inferred estimate of 1,135,452 lbs. Total reserves are estimated at 4,900.000 lbs. The proposed TCEA encompasses approximately 1,643 acres. The planned mine units and other surface disturbances will impact approximately 671 acres based on the current CBR operating plans and knowledge of available reserves.

The uranium extracted from the TCEA will be loaded onto ion exchange (IX) resin at the satellite facility. The IX resin will then be transported by tanker truck to the CPF for elution, drying and packaging. Barren resin will be returned to the satellite facility by tanker truck.

1.1.4 Proposed Operating Schedules

1.1.4.1 Current Production Area

Sufficient reserves in the current license area have been estimated to allow mining operations to continue until the end of 2014. Completion of groundwater restoration in the current license area is scheduled for 2023. Projected production and restoration schedules for the CPF are shown in **Figure 1.1 -4**. The current status of the 11 mine units are shown in **Table 1.1-1**. In 2008 the total annual production rate for the CPF was 592,541 pounds U_3O_8 and in 2009 it was 751,632 pounds U_3O_8.

Additional mine unit plans are developed approximately one year prior to the planned commencement of new mining operations. For the current production area, planning and construction are underway for Mine Unit 11. The layout of the current and planned mine units in the CPF license area is shown in **Figure 1.1-1**.

1.1.4.2 Three Crow Expansion Area Schedule

Assuming favorable regulatory action by the NRC and State of Nebraska regulatory agencies, CBR projects initial construction of the satellite facility and associated assets will begin in 2014. Production is scheduled to begin in late 2014 and last for approximately 7 years. Groundwater restoration activities at TCEA are expected to begin in late 2017 with Mine Unit 1. Groundwater restoration will extend for approximately 6 years with final site decommissioning completed by mid-2025.

Projected production and restoration schedules for the TCEA are shown in **Figure 1.1-5**. The layout of the proposed TCEA and mine units is shown in **Figure 1.1-6**.

1.1.4.3 North Trend Expansion Area Schedule

On May 30, 2007, Cameco Resources submitted to NRC an application for amendment of Radioactive Source Materials License SUA-1534 for the development of additional in-situ leach mining resources at the North Trend Expansion Area (NTEA). The NTEA is located in Sections 21, 22, 27, 28, 33, and 34 of Township 31 North, Range 51 West, Dawes County, Nebraska. The southernmost boundary of the NTEA is located approximately one-half mile north of the City of Crawford and approximately 1.7 miles northwest of the northern boundary of the CPF. Similar to the TCEA, uranium extracted from the NTEA will be loaded onto IX resin, which will be transported by tanker truck to the CPF for elution, drying and packaging.

The locations of the CPF, TCEA and NTEA in relation to each other are shown in **Figure 1.1-7**.

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 schedules, and reserve estimates, CBR could continue production at the present annual levels of approximately 800,000 pounds U_3O_8 until the end of 2014 when reserves would begin to 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 TCEA 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 based largely on local residents. If the TCEA is not developed, CBR estimates that some of these personnel (e.g., well drilling, well and wellfield construction) will no longer be required as early as 2010.

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 TCEA, the current estimated recoverable resource is approximately 3,750,481 pounds U_3O_8 with an additional inferred estimate of 1,135,452 lbs U_3O_8. Total reserves are estimated at 4,900,000 lbs.

In 2008, total domestic U.S. uranium production was approximately 3.9 million pounds U_3O_8, of which over 590,000 pounds (or approximately 15 percent) was produced at the CPF (EIA 2010a). During the same year, purchases of domestic U.S. uranium by U.S. civilian nuclear power reactors were approximately 53 million pounds U_3O_8e (equivalent) with approximately 14% supplied by domestic producers (EIA 2010b). Foreign-origin uranium accounted for the remaining 86 percent of deliveries. The CPF (including the TCEA and NTEA) represents an important source of new domestic uranium supplies that are essential to provide 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 affect on the individuals that have surface leases with CBR and own the mineral rights in the TCEA.

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 and 24 of T31N, R52W and Sections 18, 19, 20, 29, and 30 of T31 N, R51W, Dawes County, Nebraska. The proposed TCEA is located in Sections 28, 29, 30, and 33, of T31N, R52W and Section 25 of T31N, R53W.

The maps used in this section and other sections of this amendment application are Vector 7.5 minute quad maps. These are CAD/GIS drawings where each road, stream, and contour line are individual entities. The layers in these maps were derived from the U.S. Census Bureau's TIGER/Line data, 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 longitude and latitude 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 NAD 1927, and the geographic coordinate reference system (map projection) is:

NAD_1927_StatePlane_Nebraska_North_FIPS_2601 US_Foot.

Figure 1.1-2 shows the general area surrounding the project area, including the proposed TCEA, 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 mine unit boundaries, the deep disposal well, and the R&D and commercial evaporation ponds.

Figure 1.1-6 shows the proposed location of the satellite facility, evaporation ponds, mine units, access roads, fencing, and Restricted Areas within the TCEA. The latitude and longitude for the center of the satellite facility is provided in **Table 1.3-1**.

Figure 1.1-7 shows the project location in relation to the CPF and the proposed NTEA. 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 ISL 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 purposes. 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 TCEA is being developed by CBR in conjunction with the CPF licensed under NRC Source Material License SUA-1534. The TCEA will be developed by constructing independent wellfields and mining support facilities while utilizing existing processing equipment for uranium recovery. Transfer of recovered leach solutions from the area is prohibitive because of the distance that a relatively large stream would have to be pumped. Therefore, a satellite facility will be constructed in the TCEA to provide chemical makeup of leach solutions, recovery of uranium by IX, and restoration capabilities. The IX processes at the satellite facility serve to 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

Orebody

In the CPF license area, uranium is recovered by in-situ leaching from the Chadron Sandstone at a depth that varies from 400 feet to 900 feet. The overall width of the mineralized area varies from 1000 feet to 5000 feet. The orebody ranges in grade from less than 0.05 to greater than 0.5 percent U_3O, with an average grade estimated at 0.27 percent U_3O_8. The layout of the orebody as determined to date is shown in **Figure 1.3-1**.

In the TCEA, uranium will also be recovered from the Chadron Sandstone. The depth in the TCEA ranges from 580 to 940 feet. The width varies from 2,100 feet to 4,000 feet. The ore body ranges in grade from less than 0.05 percent to 0.5 percent U_3O_8, with an average grade estimated at 0.22 percent U_3O_8. Indicated ore resources as U_3O_8 for the TCEA are 3,750,481 pounds (lbs), with an additional inferred estimate of 1,135,452 lbs. Total reserves are estimated at 4,900,000 lbs. The expected annual production rate will be approximately 600,000 pounds U_3O_8.

Typical stratigraphic intervals to be mined by the in situ mining method are shown in the geologic cross sections contained in Section 3.3. For ISL wellfields, the production zone is the geological sandstone unit where the leaching solutions are injected and recovered.

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 polyvinyl chloride (PVC). PVC well casing is 4.5 inch SDR-17 (or equivalent). The PVC casing joints normally have a length of approximately 20 feet each. With SDR-17 PVC casing, each joint is connected by a water tight o-ring seal which is located with a high strength nylon spline.

There are two types of well screen that will be used for development of the TCEA – polyvinyl chloride (PVC) and stainless steel (SS). Both types of screens have been used historically for the existing CBR production, injection and monitor wells. SS screens are more durable than PVC screens, are rated for greater depths than PVC screens, 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 be continued as an option for Three Crow. The primary reason for use of the PVC screens for these types of wells is because these types of monitor wells typically have much longer screen intervals than other types of wells. This results in employee safety issues due to the handling of the heavy stainless steel screens. In addition, flow rate 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 inches have been used successfully at CBR. In most cases, a slot size of 0.020 inches is sufficient to prevent sand entering the screens.

The SS well screen consists of longitudinal ribs of SS with a 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 inches 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 the methods is appropriate for monitor wells and have been approved by the NDEQ under the current CBR Class III UIC Permit. Final, detailed engineering drawings depicting the construction details of the Class III wells will be submitted to the NRC and NDEQ for approval prior to commencement of construction.

Three well construction methods are described in this section. Of the three methods, CBR primarily uses Method 1 shown in **Figure 1.3-2** on a routine basis. Method 2 shown in **Figure 1.3-3** may be used by the CBR Geology 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 in **Figure 1.3-4** is not routinely used, but this method 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 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 pick a casing depth, and will then begin to review the local area wells for the best location (depth) to pick 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 use of a rubber cement plug that is pushed to the bottom and stays in the bottom of the well, or cement 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 and 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. Allowing for time for 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 serve to 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 the setting of 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 cured sufficiently, 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 100-foot spacing, are run on the casing to ensure 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 cement returns to the surface. In almost all cement jobs, returns to the surface are observed. In rare instances, 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 placement of 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 that is 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 Geologic staff based on the location of sands and ore grade material. Correlating and selecting the zones to be mined and making certain that the screened intervals between wells are hydrologically connected are completed by reviewing geophysical logs. 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 amount of screens to be placed in the well must cover the production zone and the screen-to-blank ratio must exceed 50%. Care should be taken to ensure that those zones impacted by nearby wells are covered by screens, not blank. A well completion report is completed on 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 American Society for Testing Materials (ASTM) Type I, II or American Petroleum Institute (API) Class B or G and meet the following criteria:

- 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 Logging Procedures and Other Tests

Appropriate geophysical logs and other tests are conducted during the drilling and construction of new Class III wells. The logs and other tests 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. 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 the probes used by CBR, measure Single Point Resistance (RES), spontaneous Potential (SP), Natural Gamma (GAM[NAT]), and Deviation. Some of the probes used by CBR also are capable of measuring temperature, 16-inch normal resistance, and 64-inch normal resistance. Probes used at CBR include the 9060, 9055, 9144, and 9057 types (**Table 1.3-2**). 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.

Additional discussions as to borehole geophysical logging equipment, procedures and other tests are presented in Section 3.3.

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 TCEA. 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 generally performed by air lifting 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 is continued until clear, sediment-free formation water is produced.

When the water begins to become clear, the development flow will be temporarily stopped and/or the flow rate 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. Monitoring for pH and conductivity is performed 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 to the lined evaporation ponds. Additional wellfield and process waste are presented below.

Well Integrity Testing

Field-testing of all (i.e., injection, production, and monitor) wells is performed to demonstrate the mechanical integrity of the well casing. This mechanical integrity test is performed using pressure-packer tests. Every well will be tested after well construction is completed before it can be placed in service; after any workover with a drill rig or servicing with equipment or procedures that could damage the well casing; at least once every five years; and whenever there is any question of casing integrity. To assure 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 are currently contained in the Safety, Health, Environment and Quality Management System (SHEQMS) Volume III, *Operating Manual*. These same procedures will be used at the TCEA.

The following general mechanical integrity test procedure is used:

- 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 psi).
- The well is then "closed in" and the pressure is monitored for a minimum of twenty minutes.
- If more than ten percent of the pressure is lost during this time 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 6.0.

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

Wellfield Design and Operation

The proposed TCEA Mine Unit map and mine schedule are shown in **Figure 1.1-6** and **Figure 1.1-5**, respectively. The preliminary map and mine schedule are based on current knowledge of the area. As the TCEA is developed, the mine schedule and a mine unit map will be developed further. The TCEA will be subdivided into an appropriate number of mine units. Each mine unit will contain a number of 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 wellfield houses will be either polyvinyl chloride (PVC) or high-density polyethylene (HDPE) with butt welded joints or an equivalent. In the wellfield house, injection pressure will be monitored on the injection trunk lines. 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 TCEA wellfields will be designed in a manner consistent with the existing CBR wellfields.

CBR is proposing a restoration schedule of approximately 28 months for the TCEA individual mine units (**Figure 1.1-5**). Based on decommissioning timeline regulations specified in 10 CFR 40.42 (g) (2), the CBR schedule of 28 months, as opposed to the NRC's requirement of 24 months for completion of decommissioning, will be considered an alternate restoration schedule. The NRC must approve such an alternate schedule, as per 10 CFR 40.42 (g) (2). CBR will request a formal alternate restoration schedule in the TCEA license application, with timeline deviations requiring a license amendment. Based on recent restoration experience, it is expected that full restoration of a mine unit will take 28 months.

The wellfield injection/production pattern employed is based on a hexagonal seven spot pattern, which is 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 in a normal pattern are expected to be between 65 feet and 150 feet apart. A typical wellfield layout is shown in **Figure 1.3-5**. 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 each mine unit, 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% of the total wellfield production rate and the maximum bleed rate typically approaches 1.5%. Over-production is adjusted as necessary to ensure that the perimeter ore zone monitor wells are influenced by the cone of depression resulting from the wellfield production bleed.

Monitor wells will be placed in the Chadron Formation and in the first significant water-bearing Brule sand above the Chadron Formation. 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. The typical locations of monitor wells for the proposed Three Crow mine map are shown in **Figure 1.3-6**. As previously noted, the map is preliminary, based on current knowledge of the area. As the TCEA is developed, the mine unit map will be developed further.

Injection of solutions for mining will be at a rate of 6,000 gpm with a 0.5% to 1.5% 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**. The liquid waste generated at the satellite facility will be primarily the production bleed which, at a maximum scenario, is estimated at 1.5% of the production flow. At 6,000 gpm process flow, the maximum volume of liquid waste at 90 gpm would be approximately 47,300,000 gallons per year. CBR proposes to adequately handle the liquid waste through the combination of deep disposal well injection and evaporation ponds.

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 TCEA result in a value of 0.62 psi. As such, the injection pressure is limited to less than 0.63 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 3.4.3.3, a regional pumping test has been conducted to assess the hydraulic characteristics of the Basal Chadron Sandstone, and overlying confining units. Pumping tests also will be performed for each mine unit to demonstrate hydraulic containment above the production zone, demonstrate communication between the production zone mining and exterior monitor wells, and to further evaluate the hydrologic properties of the Basal Chadron Sandstone.

A full and detailed analysis of the potential impacts of the mining operations at Three Crow 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 Crow Butte Resources) in 1991, and that application provides a reasonable analogy between the current licensed area and satellite facility. The application states that water levels in the City of Crawford (approximately three miles northwest of the mining area) could potentially be impacted by approximately 20 feet by consumptive withdrawal of water from the Basal Chadron Sandstone during mining and restoration operations (based on a 20-year operational period).

A similar order of magnitude impact (drawdown) exists for the TCEA operations. No impact to other users of groundwater is expected because there is no documented existing use of the Basal Chadron in the proposed TCEA.

Because the Basal Chadron Sandstone (production zone) is a deep confined aquifer, no surface water impacts are expected. Based on the observed groundwater flow directions in the Basal Chadron Sandstone in the TCEA and review of the regional bedrock geology, the recharge zone for the TCEA appears to be located as far as 20 to 30 miles north and northwest of the TCEA license boundary. Based on available information, all water supply wells within the TCEA and AOR are completed in the relatively shallow Brule Formation, with no domestic or agricultural use of groundwater from the Basal Chadron Sandstone.

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

Based on a bleed of 0.5% to 1.5% which has been successfully applied in the current licensed area, the potential impact from consumptive use of groundwater is expected to be minimal. In this regard, the vast majority (e.g., on the order of 99%) 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.

Table 1.3-3 presents the assumptions used to generally quantify the potential impact of drawdown due to mining and restoration operations.

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;
- No recharge to the aquifer occurs;
- The pumping well is fully penetrating; and,
- Well diameter is small, so well storage is negligible.

Based on these assumptions and results from the Three Crow Trend Pumping Test, drawdown after 20 years of operation at 2- and 3-mile radial distances from the centroid of pumping was estimated to be 65 and 55 feet, respectively. This amount of drawdown is approximately 10 percent of the available drawdown in the Basal Chadron Sandstone.

As discussed in Section 6.0 of this application, 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 of 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 be continued throughout the operational phase of mining for detection of excursions. Water quality sampling will also be conducted 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 1.5% 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.

Wellhead pressure will be monitored at all injection wells. Pressure gauges will be installed at each injection wellhead or on the injection manifold and monitored at least daily. Wellhead pressure will be restricted to less than 0.63 pounds per square inch (psi) per foot of well depth. Injection rates will be adjusted to maintain wellhead pressure below that level.

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 level measurements will be routinely performed 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 be an indication of fluid migration from the production zone. Adjustments to well flow rates or complete shutdown of individual wells may be required to correct this situation. Increases in water levels in the overlying aquifer may also be an indication of casing failure in a production, injection or monitor well. Isolation and shut down of individual wells can be used to determine the well causing the water level increases.

To ensure 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 two weeks as discussed in Section 6.2.2.

Flooding Potential

There is a minimum potential for flooding throughout the TCEA. As shown in **Tables 1.3-4** and **1.3-5**, the average monthly stream flow of the White River at the Crawford gauge station is approximately 20 ft^3/sec. The highest discharge and gauge height on record between 1920 and 2004 occurred on May 10, 1991. On that date, severe thunderstorms resulted in significant rainfall, the gauge height was 16.32 feet and the stream flow exceeded 13,300 ft^3/sec. Several city facilities were damaged by floodwaters and hail, including the local golf course and fishery, and the event was considered a "100 year" flood. However, it is noted that, while there are certainly historical extremes, the average gauge height on the While River at Crawford is less than 5 feet, with an average annual stream flow of 20.2 ft^3/sec.

An assessment of the potential for flooding or erosion that could impact the in-situ mining processing facilities and surface impoundments has been performed based on data from the Federal Emergency Management Agency (FEMA 1995). FEMA has not mapped unincorporated Dawes County south of Crawford, Nebraska; however, FEMA maps are available for the City of Crawford, and an analogy can be drawn between the flooding potential in Crawford and that southeast of Crawford adjacent to the proposed TCEA. As shown in **Figure 1.3-8**, FEMA has classified the portion of Crawford between the D M & E Railroad (immediately west of First Street) as Zone A (i.e., an area that could be impacted by a 100-year flood) (FEMA 1995). The elevations of the White River in the Zone A classification ranges from 3,669 to 3,659 feet amsl. The surface elevation of the railroad tracks ranges from 3,678 to 3,671 feet amsl. These data suggest that significant flooding potential exists with a rise in the White River elevation of 9 to 12 feet above base flow conditions. This is consistent with the data from the 1991 100-year flood event, where the river elevation was approximately 11.3 feet above base gauge height (approximately 5 feet).

The proposed TCEA surface facilities are to be located in the north-west portion of Section 30. T31N R52W, approximately 0.72 miles south of the White River, and approximately 139 feet topographically above the common river elevation. Proposed wellfields are planned for portions of Sections 28, 29, 30 and 33 of T31N R52W, and Section 25 of T31N R53W (**Figure 1.1-6**). All of the wellfields are projected to be at least 116.6 feet above the White River elevation (**Table 1.3-6**).

There is no portion of the proposed TCEA with the reasonable potential of flooding due to flooding of the White River. Elevations of different points of the proposed TCEA license boundary and centerpoint of the assets (i.e., wellfields, satellite facility main building and evaporation ponds) indicate that elevations at these locations in relation to the nearest point on the White River range from 116.6 to 219.1 feet higher than the river (**Table 1.3-6**).

Based on these data, the Three Crow surface facilities occur outside of the 100 year-flood plain, and are not considered to be in a "flood prone" area. Therefore, consistent with NUREG-1623, erosion modeling was not considered necessary or performed.

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:	$UO_{2\ (solid)} + H_2O_{2\ (in\ solution)}$	$\longrightarrow$	$UO_{3\ (at\ solid\ surface)} + H_2O$
	$UO_{2\ (solid)} + \frac{1}{2}\ O_{2\ (in\ solution)}$	$\longrightarrow$	$UO_{3\ (at\ solid\ surface)}$
Dissolution:	$UO_3 + 2\ HCO_3^{-1}$	$\longrightarrow$	$UO_2(CO_3)_2^{-2} + H_2O$
	$UO_3 + CO_3^{-2} + 2HCO_3^{-1}$	$\longrightarrow$	$UO_2(CO_3)_3^{-4} + H_2O$

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 utilizes the following steps:

1. Loading of uranium complexes onto an IX resin;
2. Reconstitution of the leach solution by addition of carbon dioxide and/or sodium bicarbonate and an oxidizer;
3. Elution of uranium complexes from the resin; and,
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 in **Figure 1.3-9**. The left side of **Figure 1.3-9** depicts the uranium extraction process that is 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 the completion of 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:

$2\ R\ HCO_3 + UO_2(CO_3)_2^{-2}$	$\longrightarrow$	$R_2UO_2(CO_3)_2 + 2HCO_3^{-1}$
$2\ RCl + UO_2(CO_3)_2^{-2}$	$\longrightarrow$	$R_2UO_2(CO_3)_2 + 2Cl^-$
$R_2SO_4 + UO_2(CO_3)_2^{-2}$	$\longrightarrow$	$R_2UO_2(CO_3)_2 + SO_4^{-2}$

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 is shown in **Table 1.3-7.**

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 transferred to a tanker truck for transport to the CPF for elution and final processing. Once the resin has been stripped of the uranium by the process of elution, the resin will be returned to the satellite facility for reuse in the IX circuit.

At the CPF, the loaded resin that has been transported from the satellite facility 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 from the resin, the resin is rinsed with a solution containing sodium bicarbonate. 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 CO2. The decarbonization can be represented as follows:

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

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

Hydrogen peroxide 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 lined evaporation ponds.

The operation of the satellite facility will result in one source of liquid waste being generated at the satellite facility and an increase in the liquid waste at the CPF. A production bleed stream is continuously withdrawn from the recovered lixiviant stream at a rate that is expected to be 0.5 to 1.5 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 combination of evaporation pond and deep disposal well injection, both of which will be constructed at the satellite facility.

The other source of wastewater resulting from uranium mining activities in the TCEA is the eluent bleed stream at the CPF. This is an existing source of wastewater at the CPF that is 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 in existing ponds and/or by deep disposal well 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 on-site disposal of these materials.

1.3.2.5 Central Processing Facility, Satellite Facility, Wellfields, 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 recovery from the leach solution by IX will be performed 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.

Three Crow 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 for the satellite facility is shown on **Figure 1.3-10**. 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; and,

- Chemical addition.

The satellite facility will be located within a 1.8 acre fenced area in Section 30, T31N, R52W. The evaporation pond will located a short distance away from the satellite facilities within an 11.6 acre fenced area. **Figure 1.3-11** 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, a small laboratory and an employee break room. Bulk soda ash and carbon dioxide and oxygen in compressed form and/or hydrogen peroxide will be stored adjacent to the satellite facility or in the wellfield. Sodium bicarbonate and/or gaseous carbon dioxide are added to the lixiviant as the fluid leaves the satellite facility for the wellfields. Gaseous oxygen 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 with each column sized at 11.5 foot diameter by 21 foot overall height with 500 cubic feet of resin operated downflow. Once a set of columns is loaded with uranium, the resin is transferred to a truck for transport to the CPF. The downflow columns are pressurized, sealed systems so there is no overflow of water, oxygen stays in solution and radon emissions are contained. Radon releases from the pressurized downflow columns occur 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 TCEA 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., sodium bicarbonate and/or carbon dioxide). The injection filtration system consists of optional backwashable filters, with an option of installing polishing filters downstream. The lixiviant injection pumps are centrifugal type.

A discussion of the areas in the proposed satellite facility where fumes or gases could be generated can be found in Section 4.12.2. The potential sources are minimal in the satellite facility since 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 (**Figure 1.3-10**). Other non-hazardous bulk process chemicals (e.g., sodium carbonate) 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, oxygen, and or hydrogen peroxide. Sodium sulfide may also be stored for use as a reductant during groundwater restoration.

- Carbon Dioxide

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

- Oxygen

Oxygen 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. Since oxygen readily supports combustion, fire and explosion are the principal hazards that must be controlled. The oxygen 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 NFPA-50 (NFPA 1996).

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

The design location of the carbon dioxide and oxygen storage tanks are shown on **Figure 1.3-10.**

- Sodium Sulfide

Hazardous materials typically used during ground water restoration activities include the addition of a chemical reductant (i.e., sodium sulfide or hydrogen sulfide gas). To minimize potential impacts to radiological safety, these materials are stored outside of process areas. Sodium sulfide 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 super sacks of 1,000 pounds. The bulk inventory is stored outside of process areas in a cool, dry, clean environment to prevent contact with any acid, oxidizer, or other material that may react with the product. Hydrogen sulfide gas has never been used at the CPF. In the event that CBR determines that use of hydrogen sulfide 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 recognize 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 covered under the 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.

1.3.2.6 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 above ground and within secondary containment structures to meet EPA and Occupational Safety and Health Administration (OSHA) requirements.

1.3.2.7 Instrumentation and Control

The wellfield houses 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 that is being applied to the injection trunklines. Wellfield houses will be equipped with wet alarms to monitor the presence of liquids in the wellfield house sumps.

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 will be sized or equipped so that they are incapable of producing pressures high enough to exceed design pressure of the injection lines or the maximum pressure to be applied to the injection wells. Pressure gauges, pressure shutdown switches and pressure transducers will be used to monitor and control the trunkline pressures.

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 wellfield house 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 Header House to alert the facility and wellfield operators of increasing manifold pressures. All critical equipment will be equipped with uninterruptible power supply systems 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 on a real-time basis, 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.*

1.3.2.8 Gaseous and Airborne Particulate Control

This section describes the gaseous effluent control systems that will be installed in the North Trend Satellite Facility.

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. Redundant exhaust fans will direct collected gases to discharge piping that will exhaust fumes to the outside atmosphere. The design of the fans will be 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 Reg. Guide 8.31. Airflow through any openings in the vessels will be from the process area into the vessel and into 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 utilized in the CPF process area. Operational radiological in-plant monitoring for radon concentrations has proven this system to be an effective method for minimizing employee exposure.

Work Area Ventilation System

The work area ventilation system will be designed to force air to circulate within the satellite facility process areas. The ventilation system will exhaust outside the building, drawing fresh air in. During favorable weather conditions, open doorways and convection vents in the roof will assist in providing satisfactory work area ventilation. The design of the ventilation system will be adequate to ensure that radon daughter concentrations in the facility are maintained below 25 percent of the derived air concentration (DAC) from 10 CFR Part 20.

1.3.2.9 Liquid Waste

Sources of Liquid Waste

As a result of in-situ leach mining, there are several sources of liquid waste. The potential wastewater sources that exist at the satellite facility will be similar to those currently generated and managed at the CPF. These sources of wastewater 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. The water will be discharged directly to the solar evaporation pond and silt, fines and other natural suspended matter collected during well development will settle out in the pond. Well development water may also be treated with filtration and/or RO and used as facility make-up water or disposed of in the deep well.

Liquid Process Waste

The operation of the satellite facility results in one primary source of liquid waste, a production bleed as previously discussed. This bleed will be routed to either the deep disposal well or an evaporation pond.

Aquifer Restoration Waste

Following mining operations at North Trend, 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; and,
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. A RO unit will be used to reduce the total dissolved solids (TDS) of 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 such that runoff will not pose a potential source of pollution.

Domestic Sewage

Domestic sewage from the restrooms and lunchrooms 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 North Trend Satellite Facility.

Liquid Waste Disposal

Two methods of disposal are proposed for the North Trend Satellite Facility:

Deep Disposal Well

CBR has operated the deep disposal well at the CPF for over ten years with excellent results and no serious compliance issues. CBR expects that the liquid waste stream at the North Trend Satellite Facility will be chemically and radiologically similar to the waste disposed of in the current deep disposal well.

CBR plans to install a deep disposal well at the North Trend Satellite Facility 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 North Trend Satellite Facility will be disposed of in the planned deep well. At the time of preparation of this amendment request and ER, a permit application is under preparation for submittal to the NDEQ for a Class I UIC Permit for the North Trend Satellite Facility.

Evaporation Pond

Evaporation pond design, installation and operation criteria are those found in Reg. Guide 3.11. The evaporation pond configuration at the satellite facility will be similar to the existing ponds at the CPF. The exact number and capacity of the ponds will depend upon the performance of the deep disposal well as far as waste water disposal rate.

Each pond will have the capability of being pumped to a water treatment plant before disposal. A variety of treatment options exist depending upon the specific chemical contaminants identified in the wastewater. In general, a combination of chemical precipitation and RO is adequate to treat the water to a quality that falls well within NPDES criteria.

As noted in Section 3.11.2.1, CBR currently maintains three commercial and two R & D evaporation ponds in the CPF license area. The current pond inspection program is based on NRC recommendations in Reg. Guide 3.11.1 and will be implemented for the Three Crow evaporation ponds.

1.3.2.10 Solid Waste

Solid waste generated at the North Trend Satellite 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 which are not contaminated or which 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 ISL facilities consists of filters, personal protective equipment (PPE), spent resin, piping, etc. These materials will be stored on site until such time that 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, records of the 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 restrooms and lunchrooms will be disposed of in an approved septic system that meets the requirements of the State of Nebraska. Disposal of solid materials collected in septic systems must be performed 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.

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; and
- 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 TCEA, 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 CPF License Area and Satellite Facility Security

1.4.1.1 Central Processing Facility Area

The active mining areas are controlled with fences and appropriate signs. All CPF areas where source or byproduct material is handled are fenced. The main access road is equipped with a locking gate. Strategically placed surveillance cameras monitor the access road and areas around the CPF. A 24-hour per day 7-day per week staff is on duty in the CPF.

CPF operators perform an inspection to ensure the proper storage and security of licensed material at the beginning of each shift. The inspection determines whether all licensed material is properly stored in a restricted area or, if in controlled or unrestricted areas, is properly secured. In particular, operators ensure that loaded IX resin, slurry, drummed yellowcake, and byproduct material is properly secured. If licensed material is found outside a restricted area, the operator will ensure that it is secured, locked, moved to a restricted area, or kept under constant surveillance by direct observation by site personnel or surveillance cameras. The results of this inspection will be properly documented.

Office Building

There is a reception area located at the main entrance into the office building. All other entrances are locked during off-shift hours. There are a limited number of traceable keys to the office and they are given out to select employees. The main door and the door to the CPF entrance are also equipped with an access keypad.

Visitors entering the office are greeted by the receptionist and announced to the receiving person. All visitors are required to sign the access log and indicate the purpose of their visit and the employee to be visited. The person being visited is responsible to supervise the visitors at all times when they are on site. Visitors are only allowed at the facility during regular working hours unless prior approval is obtained from the General Manager or the Manager of Safety, Health, Environment, and Quality.

Three Crow Satellite Facility

Entrance to the TCEA site will be via the gravel Four Mile Road to the south 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 capable of being locked. The satellite facility site within the license area will be properly posted in accordance with 10 CFR § 20.1902 (e). Evaporation ponds will be fenced and posted.

The security fence surrounding the satellite facility serves as a control for industrial/property protection purposes (**Figure 1.3-10**). The entire area within the security fencing surrounding the evaporation ponds will be a designated restricted area (**Figure 1.3.11**). Access to wellfields will have area fencing that will serve as a control for industrial/property protection purposes. Appropriate signage will be placed on all fencing advising of access restrictions.

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 in **Figures 1.3-10 and 1.3-11**. 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 that a radiological condition will exist. When evaluating the likelihood of specific conditions, normal situations as well as unique situations that can reasonably be expected to occur will be considered.

All visitors, contractors, or inspectors, entering the TCEA 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 hardhat 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 RSO or designee. Training requirements associated with visitors and contractors are discussed in Section 5.5 of the Technical Report.

The satellite facility will routinely operate 24 hours per day and 7 days per week, so 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, and has no business on the property, 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 lixivant from the wellhouses to the satellite building would be located within an area within perimeter fencing that only authorized personnel would be allowed to enter. Gates associated with perimeter fencing enclosing any well field that is in operation would be kept locked when operators and workers are not present (e.g., remote from the satellite facility). Security may further be increased by installing continuous video surveillance of outside areas.

CBR maintains and enforces requirements of the SHEQMS, Volume IV *Health Physics Manual, Environmental, Health, and Safety Management Plan*, that specifies 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 Section 4.12.2.3, for a downwind receptor near the TCEA is 32.3 mrem/year This is based on an occupancy factor of 100% or 8760 hours per year. If the frequent visitor were onsite for 2000 hours per year (a full work year) and exposed to the same sources of radiation as the highest downwind receptor, the visitor would receive an annual dose of 7.4 mrem per year. It is unlikely that even frequent visitors to the TCEA 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; and

§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 take measures to provide personnel security by screening applicable job applicants, prevent unauthorized access to the hazardous materials or vehicles being prepared for shipment, and provide for in 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 by 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's cargo while on the road; and
- 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; and
- The unit is to be kept visible by an employee at all times when left unattended outside a restricted area.

The security guidelines and procedures apply to all transport assignments. All drivers and non-driving personnel are expected to be knowledgeable of, 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 Reg. Guide 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 cm^2 (25% 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 the 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 the performance of 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 is located, it would be more efficient to have properly trained full-time personnel at the Three Crow 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 received radiation safety training that all employees are required to take. In addition, they would also be subject to additional hands-on training as to the survey instruments and procedures. The release limits are set by *"Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses For Byproduct or Source Materials"*, NRC, May 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 GM survey meter with a beta/gamma probe with an end window thickness of not more than 7 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 Reg. Guide 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 instructions currently contained in the SHEQMS Program Volume IV, *Health Physics Manual.*

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. A summary of the relevant permits and authorizations for the CPF license area is given in **Table 1.4-1.** Permits and authorizations anticipated for the satellite facility are shown in **Table 1.4-2.**

1.6 Environmental Approvals and Consultations for the Proposed Three Crow Expansion Area

1.6.1 Environmental Approvals and Permits

The TCEA will be subject to similar permitting requirements as the CPF. **Table 1.4-2** contains a summary list of the type of permit or authorization, the granting authority, and the status.

1.6.2 Licensing and Permitting Consultations

During the course of the preparation of this License Amendment application and the NDEQ Class III UIC Application for TCEA, consultations were conducted with the following agency contacts:

<u>U.S. Nuclear Regulatory Commission</u>

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

1.6.3 Environmental Consultations

During the course of the preparation of this license amendment application, consultations were conducted with several agencies in regard to information required for various sections of the application:

1.6.3.1 Climate and Meteorology (Section 3.6)

Requested meteorology data available for Whitney, NE (WHN5) meteorology station near Crawford, NE.

Seth I. Gutman
Physical Scientist
NOAA Earth System Research Laboratory (ESR)
325 Broadway R/GSD7
Boulder, CO 80305-3328
Phone: 303.497.7031
Fax: 303.497.6014
Seth.I.Gutman@noaa.gov

1.6.3.2 Seismology (Section 3.3.4)

Requested assistance as to available list of historical earthquakes for Nebraska.

Lisa Wald, Geophysicist
Web Team Manager
USGS Earthquake Hazards Program
Golden, CO

1.6.3.3 Surface Water (Section 3.4.2)

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

Dwain Curtis
NWIS DBA
Nebraska Water Science Center
U.S. Geological Survey
5231 South 19th
Lincoln, Ne 68512-1271
402.328.4142 Work
402.416.6144 Mobile

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

Kimberley Martz
IT Specialist
U.S. Geological Survey, Water Resources Discipline
Email: kimmartz@usgs.gov

Assistance requested for information on City of Crawford's Wellhead Protection Area.

Nadine
Nebraska Department of Environmental Quality (NDEQ)
NDEQ Records Management Unit
Lincoln, NE
Email: ndeq.records@nebraska.gov

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

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

1.6.3.5 Ecological Resources (Section 3.5)

Preparation of the ecology discussion (Section 3.5) required consultations with the following individuals and agencies:

- S. Anschutz, Nebraska Field Supervisor, U.S. Dept. of Interior, Fish and Wildlife Service, Grand Island, NE;
- M. Fritz, Raptor Biologist, Nebraska Game and Parks Commission. Lincoln, NE;
- K. Hams, Big Game Biologist, Nebraska Game and Parks Commission, Lincoln, NE;
- D. Ferraro, Herpetologist, University of Nebraska, Lincoln, NE;
- J. Godberson, Environmental Analyst Supervisor, Nebraska Game and Parks Commission, Lincoln, NE; and
- T. Nordeen, Biologist, Nebraska Game and Parks Commission, Alliance, NE.

1.6.3.6 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:

- Steinacher, Terry, H.P. Archaeologist and L. Robert Puschendorf, Deputy, Nebraska State Historic Preservation Officer, Nebraska State Historical Society.
- Tribal Authorities.

1.6.3.7 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.

Table 1.1-1 Current Production Area Mine Unit Status

Mine Unit	Production Initiated	Current Status
Mine Unit 1	April 1991	Groundwater Restored; Reclamation Underway
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	Production
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	Pending	Production to start mid-2010

Table 1.3-1 Geographic Location of TCEA License Boundary and Satellite Facility

Layer	Geographic Projection: NAD 83 (Degrees)		Geographic Projection: NAD 27 (Degrees)		NAD_1927_StatePlane_Nebraska_North_FIPS_2601 (US_Foot)	
	Latitude	Longitude	Latitude	Longitude	Northing	Easting
License Boundary	42.62554	-103.44117	42.62558	-103.44069	489627	1074216
License Boundary	42.62595	-103.45758	42.62598	-103.45709	489954	1069811
License Boundary	42.62595	-103.45821	42.62598	-103.45773	489961	1069641
License Boundary	42.62599	-103.46268	42.62602	-103.46220	490024	1068440
License Boundary	42.62603	-103.46417	42.62606	-103.46368	490053	1068040
License Boundary	42.62612	-103.47063	42.62615	-103.47014	490158	1066305
License Boundary	42.62622	-103.47514	42.62625	-103.47466	490243	1065091
License Boundary	42.62622	-103.48537	42.62625	-103.48488	490357	1062342
License Boundary	42.63848	-103.48526	42.63852	-103.48478	494822	1062553
License Boundary	42.63841	-103.48039	42.63844	-103.47991	494740	1063861
License Boundary	42.63793	-103.43989	42.63796	-103.43941	494123	1074743
License Boundary	42.63782	-103.43143	42.63785	-103.43095	493992	1077015
License Boundary	42.62480	-103.43134	42.62483	-103.43086	489247	1076849
License Boundary	42.61854	-103.43142	42.61858	-103.43094	486972	1076736
License Boundary	42.61846	-103.44127	42.61849	-103.44079	487048	1074086
License Boundary	42.62151	-103.44127	42.62154	-103.44079	488157	1074130
License Boundary	42.62554	-103.44117	42.62558	-103.44069	489627	1074216
Center of Satellite Facility	**42.63389**	**-103.46448**	**42.63392**	**-103.46400**	**492920**	**1068072**

Table 1.3-2 Background Information for Logging Probes Used at the Three Crow 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, Radioactive Source (1 Curie Am241Be)
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 Resisitivity 48 in., Spontaneous Potential, Single Point Resistance, Temperature and Delta Temperature, Slant Angle and Azimuth

Table 1.3-3 Assumptions Used for Quantification of Drawdown Impact due to Mining and Restoration

Activity	Assumption*
Mining/restoration	8 Years
Average net consumption use	50 gpm
Location of pumping centroid	Center of Section T31N R52W 30 (Mine Unit TC-3)
Radius of Influence	Greater than 4,600 feet**
Formation transmissivity	477 square feet /day
Formation thickness	64 feet
Formation hydraulic conductivity	7.5 feet/day
Formation storativity	8.8E-04

*Average values for pumping test.
**Based on drawdown response of 1.2 feet at distant monitor well COW 2006-1; suggests Radius of Influence (ROI) of greater than 4,600 feet.

Table 1.3-4 Comparison of Mean Monthly Precipitation With Normal Mean Monthly Discharge of the White River at Crawford, Nebraska

Month	Mean Precipitation [1]		Mean Discharge [2]	
	inches	centimeters	ft^3/sec	$meters^3$/sec
January	0.61	1.55	21	0.59
February	0.76	1.93	23	0.65
March	1.74	4.42	27	0.76
April	2.65	6.73	25	0.71
May	3.11	7.9	27	0.76
June	2.42	6.15	22	0.62
July	2.77	7.04	16	0.45
August	1.21	3.07	13	0.37
September	1.38	3.51	14	0.4
October	1.66	4.22	17	0.48
November	0.82	2.08	19	0.54
December	0.79	2.01	20	0.57

1 – NOAA 1981.

2 – USGS 2004. (Period of Record 1931-2004)

Table 1.3-5 Normal Mean Monthly Discharge of the White River at Crawford, Nebraska 1999 through September 2007

Month	1999 (ft^3/sec)	2000 (ft^3/sec)	2001 (ft^3/sec)	2002 (ft^3/sec)	2003 (ft^3/sec)	2004 (ft^3/sec)	2005 (ft^3/sec)	2006 (ft^3/sec)	2007 (ft^3/sec)
January	22.6	21.7	21.0	22.9	22.6	23.0	23.9	24.1	18.9
February	22.4	24.1	24.3	23.6	24.0	24.8	23.3	24.5	20.2
March	23.1	25.5	27.0	26.8	26.4	25.9	24.5	26.4	22.6
April	26.1	29.1	26.4	25.3	26.5	22.7	25.3	25.9	23.4
May	23.7	10.0	24.7	23.9	25.9	21.1	26.5	23.2	20.3
June	27.1	20.5	18.6	16.6	23.2	17.1	26.5	17.8	15.9
July	21.4	15.4	14.4	10.3	13.2	17.4	17.6	11.0	10.0
August	15.0	11.5	12.5	10.1	11.7	11.3	18.1	10.0	4.1
September	17.0	12.1	12.9	13.7	23.3	17.8	14.8	14.8	8.7
October	19.4	17.4	17.2	18.1	17.5	20.8	18.5	18.6	*
November	20.8	20.1	22.0	22.3	22.6	21.3	21.0	21.1	*
December	21.4	20.7	22.2	22.2	23.1	22.1	23.1	21.3	*
Average	**21.7**	**16.7**	**20.3**	**19.7**	**21.6**	**20.4**	**21.9**	**19.9**	**16.0***

Source: Nebraska Department of Natural Resources (NDNR) 2010. Available period of record ended 2007.
*Data not available for fourth quarter of 2007.

Table 1.3-6 Differences in Elevation of Three Crow Assets and White River

Project Boundary and Facility Assets		Elevation of Nearest Point of White River	Difference in Elevation (ft)[2]	Distance of Asset from Nearest Point of White River (ft)
Individual Measurement Points[1]	**Elevation (ft)**			
Satellite Facility	3918.0	3779	139.0	7583
Evaporation Ponds	3912.5	3779	133.5	7249
MU1	3920.1	3779	141.1	8301
MU2	3895.6	3779	116.6	6159
MU3	3927.8	3779	148.8	7070
MU4	3987.6	3779	208.6	10131
MU5	3948.4	3760	188.4	10009
MU6	3955.5	3760	195.5	11335
MU7	3961.9	3760	201.9	11833
MU8	3951.7	3760	191.7	13619
MU9	3979.1	3760	219.1	15443
NW Corner of Permit Boundary	3924	3798.6	125.4	4365
SW Corner of Western Most Permit Boundary	4035.8	3858	177.8	7218
Center Point of North Permit Boundary	3941.6	3772.5	169.1	7133
Northeast Corner of Permit Boundary	3904.4	3761.6	142.8	10672

[a] Measurements made at center-point of satellite building, evaporation ponds, and mine units.

[b] Positive values indicate elevations of satellite facility and associated assets greater than nearest sampling point of White River.

Table 1.3-7 Typical Lixiviant Concentrations

Species	Range	
	Low	High
Na	≤ 400	6000
Ca	≤ 20	500
Mg	≤ 3	100
K	≤ 15	300
CO_3	≤ 0.5	2500
HCO_3	≤ 400	5000
Cl	≤ 200	5000
SO_4	≤ 400	5000
U_3O_8	≤ 0.01	500
V_2O_5	≤ 0.01	100
TDS	≤ 1650	12000
pH	≤ 6.5	10.5

All values in mg/l except for pH (standard units).
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 1.4-1 Environmental Approvals for Crow Butte Project

Issuing Agency	Permit Description
U.S. Nuclear Regulatory Commission Washington, DC 20555	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 Source Materials License SUA-1534 Issued: December 29, 1989 Renewed: February 28, 1998
U.S. Environmental Protection Agency 1200 Pennsylvania Ave, NW, Washington, DC 20460	Aquifer Exemption Approval Effective: June 22, 1990
Nebraska Department of Environmental Quality PO Box 98922 Lincoln, Nebraska 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 for North Trend Expansion Area Submitted: August 15, 2007 Approval: Petition denied due to deficiencies Resubmittal: August 20,2008 Approval: Pending
	Underground Injection Control Class III Permit Application for the North Trend Expansion Area Submitted: August 15, 2008 Approval: Pending
	Underground Injection Control Class I Authorization NE0206369 Approved: September 9, 1994 Replaced: July 2, 2004

Table 1.4-1 Environmental Approvals for Crow Butte Project

Issuing Agency	Permit Description
Nebraska Department of Environmental Quality PO Box 98922 Lincoln, Nebraska 68509-8922	Underground Injection Control Class I Authorization NE0210457 Approved: July 2, 2004
	National Pollutant Discharge Elimination System Permit NE0130613 Approved: September 30, 1994
	Mineral Exploration Permit NE0209317 Approved: June 3, 2003 Replaced July 16, 2007
	Mineral Exploration Permit NE0210679 Approved: July 16, 2007
	Mineral Exploration Permit NE0210678 Approved: July 16, 2007
	Mineral Exploration Permit NE0210680 Approved: July 18, 2007
	Mineral Exploration Permit NE0210824 Approved August 19, 2009
	Underground Injection Control Class V Authorization NE0207388 Approved: November 6, 2000
	Evaporation Pond Design Approved: July 21, 1988
	Construction Stormwater NPDES General Permit NER 100000 Authorization #NER105203 Approved December 19, 2006
Nebraska Department of Natural Resources 301 Centennial Mall South Lincoln, Nebraska 68509-4676	Industrial Ground Water Permit Approved: August 7, 1991
Nebraska Department of Health and Human Services Regulation and Licensure PO Box 95007 Lincoln, Nebraska 68509-5007	Class IV Public Water Supply Permit NE3121024 Approved: April 12, 2002

Table 1.4-2 Environmental Approvals for Proposed Three Crow Expansion Area

Issuing Agency	Description	Status
U.S. Nuclear Regulatory Commission Washington, DC 20555	Amendment to Source Materials License SUA-1534 (10 CFR 40)	This document has been submitted as the License Amendment for the TCEA
U.S. Environmental Protection Agency 1200 Pennsylvania Ave, NW Washington, DC 20460	Aquifer exemption application forwarded to EPA following NDEQ action	Aquifer exemption application will be forwarded to EPA following NDEQ action
Nebraska Department of Environmental Quality PO Box 98922 Lincoln, Nebraska 68509-8922	Underground Injection Control Class III Permit (NDEQ Title 122)	Class III UIC Permit application under preparation; expected submittal to NDEQ in second quarter 2010.
	Aquifer Exemption (NDEQ Title 122)	Aquifer exemption application under preparation; expected submittal to NDEQ in second quarter 2010
	Underground Injection Control Class I (NDEQ Title 122)	Class I UIC Permit application under preparation; expected submittal to NDEQ in fourth quarter 2010
	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

Table 1.4-2 Environmental Approvals for Proposed Three Crow Expansion Area

Issuing Agency	Description	Status
	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 Environmental Quality PO Box 98922 Lincoln, Nebraska 68509-8922	Evaporation Pond Design	The evaporation pond design will be submitted following final facility design
Nebraska Department of Natural Resources 301 Centennial Mall South Lincoln, Nebraska 68509-4676	Industrial Ground Water Permit (NDNR Title 456)	The Industrial Groundwater Permit application will be prepared for submittal to the NDNR; expected in the fourth quarter 2010

Table 1.4-3 Tribal Contacts for Proposed Three Crow Expansion Area

Nebraska Commission on Indian Affairs Judi M. Gaiashkibos, Executive Director P.O. Box 94981 Lincoln, NE 68509-4981	Mr. Dale Oldhorn Tribal Historic Preservation Officer Crow Nation Cultural Committee P.O. Box 1094 Crow Agency, MT 59022	President Ronald Rice Pawnee Nation of Oklahoma 881 Little Dee Drive Pawnee, OK 74058
Chairman Alonzo Chalepa Apache Tribe of Oklahoma P.O. Box 1220 Anadarko, OK 73005	Chairman Billy Evans Horse Kiowa Business Committee Kiowa Tribe of Oklahoma P.O. Box 369 Carnegie, OK 73015	Mr. Francis Morris Repatriation Coordinator Pawnee Nation of Oklahoma P.O. Box 470 Pawnee, OK 74058
Chairman Joseph J. Brings Plenty, Sr. Cheyenne River Sioux Tribe P.O. Box 590 Eagle Butte, SD 57625	Chairman Michael G. Jandreau Lower Brule Sioux Tribal Council 187 Oyate Circle Lower Brule, SD 57548	Ms. Alice Alexander THPO and Assistant Repatriation Coordinator 881 Little Dee Drive Pawnee, OK 74058
Mr. Albert LeBeau Tribal Historic Preservation Officer Cheyenne River Sioux Tribe P.O. Box 590 Eagle Butte, SD 57625	Chairman Richard Brannan Northern Arapaho Business Council P.O. Box 396 Fort Washakie, WY 82514	President Rodney Bordeaux Rosebud Sioux Tribe P.O. Box 430 Rosebud, SD 57570
Governor Darrell Flyingman Cheyenne & Arapaho Business Committee Cheyenne & Arapaho Tribes of Oklahoma P.O. Box 38 Concho, OK 73022	Mr. Robert Goggles NAGPRA Representative Northern Arapaho Tribe 328 17 Mile Road Arapaho, WY 82514	Mr. Terry Gray NAGPRA Coordinator Rosebud Sioux Tribe SGU Heritage Center P.O. 675 Mission, SD 57555
Mr. Joe Big Medicine NAGPRA Representative Cheyenne & Arapaho Tribes of Oklahoma P.O. Box 38 Concho, OK 73022	Ms. Jo Ann White THPO Director Northern Arapaho Tribe P.O. Box 396 Fort Washakie, WY 82514	Chairman Roger Trudell Santee Sioux Nation 108 Spirit Lake Avenue, West Niobrara, NE 68760
Mr. Gordon Yellowman NAGPRA Representative Cheyenne & Arapaho Tribes of Oklahoma P.O. Box 38 Concho, OK 73022	Chairman Eugene Little Coyote Northern Cheyenne Tribal Council P.O. Box 128 Lame Deer, MT 59043	Chairman Ron His-Horse-is-Thunder Standing Rock Sioux Tribal Council P.O. Box D Fort Yates, ND 58538

Table 1.4-3 Tribal Contacts for Proposed Three Crow Expansion Area

Chairman Lester Thompson, Jr. Crow Creek Sioux Tribe P.O. Box 50 Fort Thompson, SD 57325	Mr. Conrad Fisher Tribal Historic Preservation Officer Northern Cheyenne THPO Office Northern Cheyenne Tribe P.O. Box 128 Lame Deer, MT 59043	Mr. Tim Mentz Cultural Resource Planner Standing Rock Sioux Tribe P.O. Box D Fort Yates, ND 58538
Chairman Carl E. Venne Crow Nation P.O. Box 159 Crow Agency, MT 59022	President John Yellowbird Steele Oglala Sioux Tribal Council P.O. Box 2070 Pine Ridge, SD 57770	Mr. George Reed Secretary of Cultural Education Crow Nation Cultural Committee P.O. Box 1094 Crow Agency, MT 59022
Mr. Edgar Bear Runner Tribal Historic Preservation Officer Oglala Sioux Tribe P.O. Box 2070 Pine Ridge, SD 57770	Harvey Whitewoman Oglala Sioux Tribe email: harveyww@rapidnet.com	

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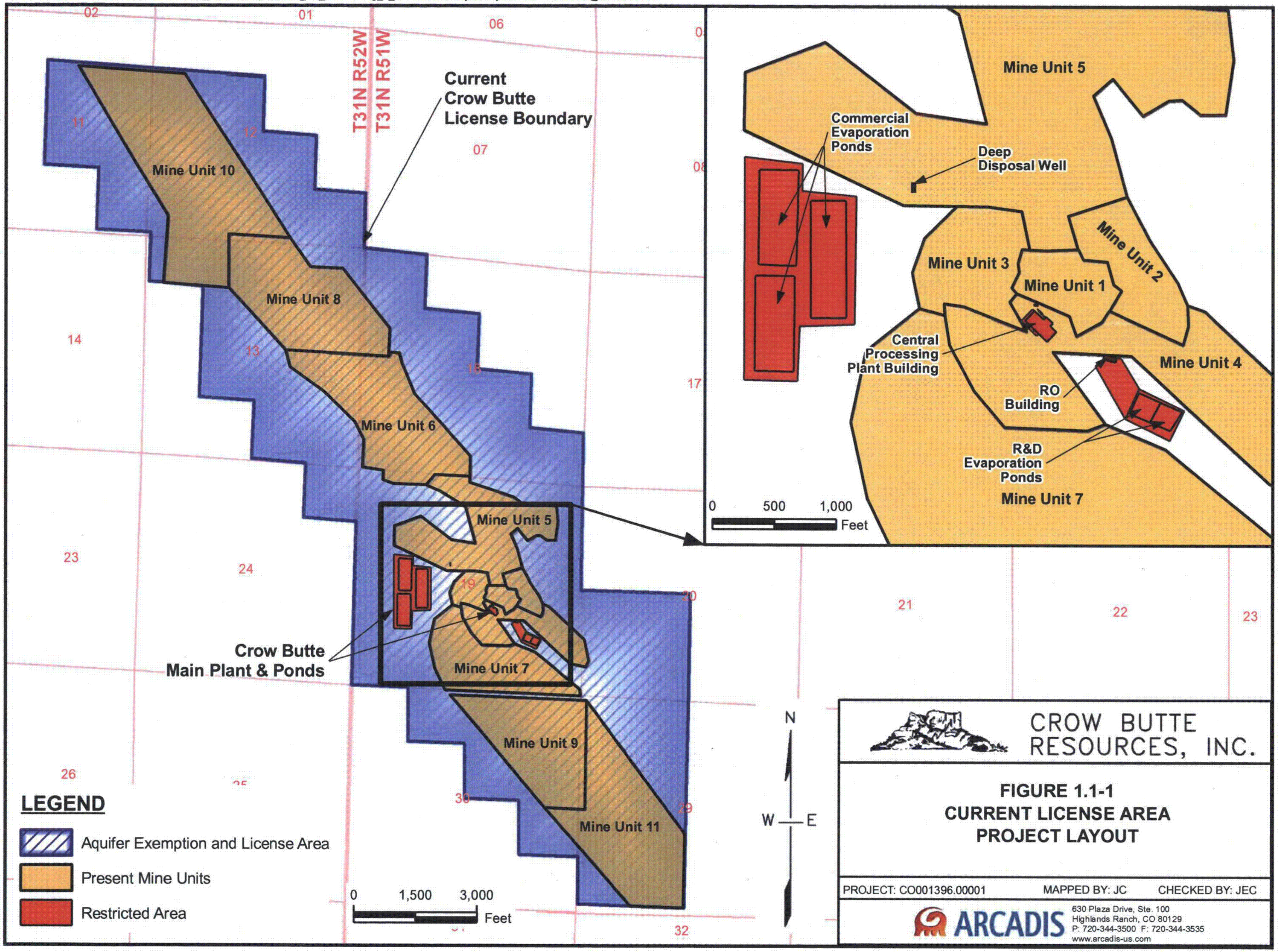

CROW BUTTE RESOURCES, INC.

FIGURE 1.1-1
CURRENT LICENSE AREA
PROJECT LAYOUT

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

ARCADIS
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Highlands Ranch, CO 80129
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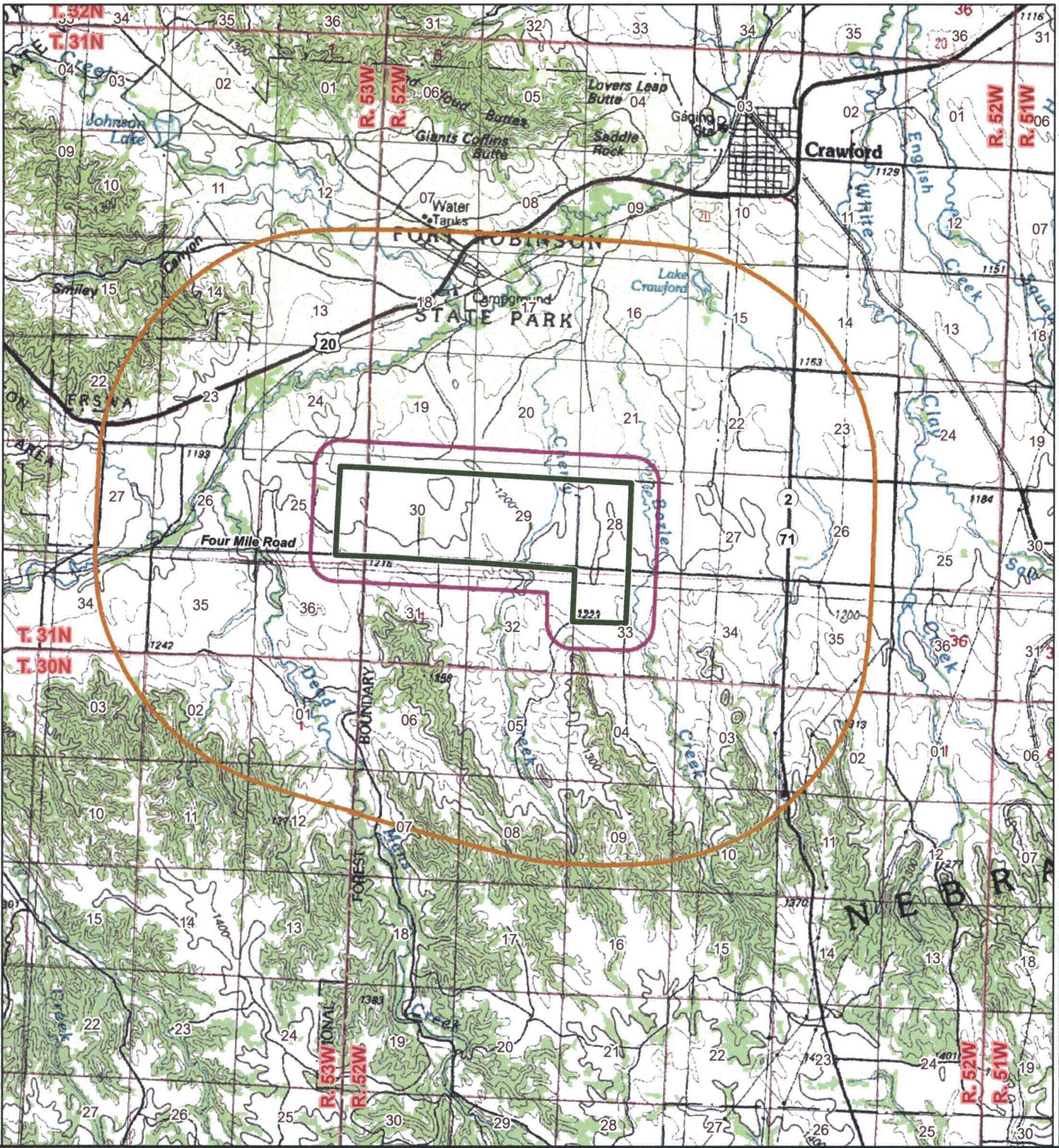
www.arcadis-us.com



LEGEND

- Proposed Three Crow Expansion Area
- ZOEI Boundary (1/4-Mile Buffer)
- AOR Boundary (2 1/4-Mile Buffer)

NOTE: Both buffer distances are relative to the boundary of the proposed Three Crow Expansion Area.

0 3,000 6,000
Scale in Feet

PROJECTION: NAD_1927_STATE_PLANE_NEBRASKA_NORTH_FIPS_2601
SOURCES: USGS 100K TOPO, CONTOUR ELEVATIONS IN METER

CROW BUTTE RESOURCES, INC.

FIGURE 1.1-2
THREE CROW EXPANSION AREA
2.25-MILE AREA OF REVIEW

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

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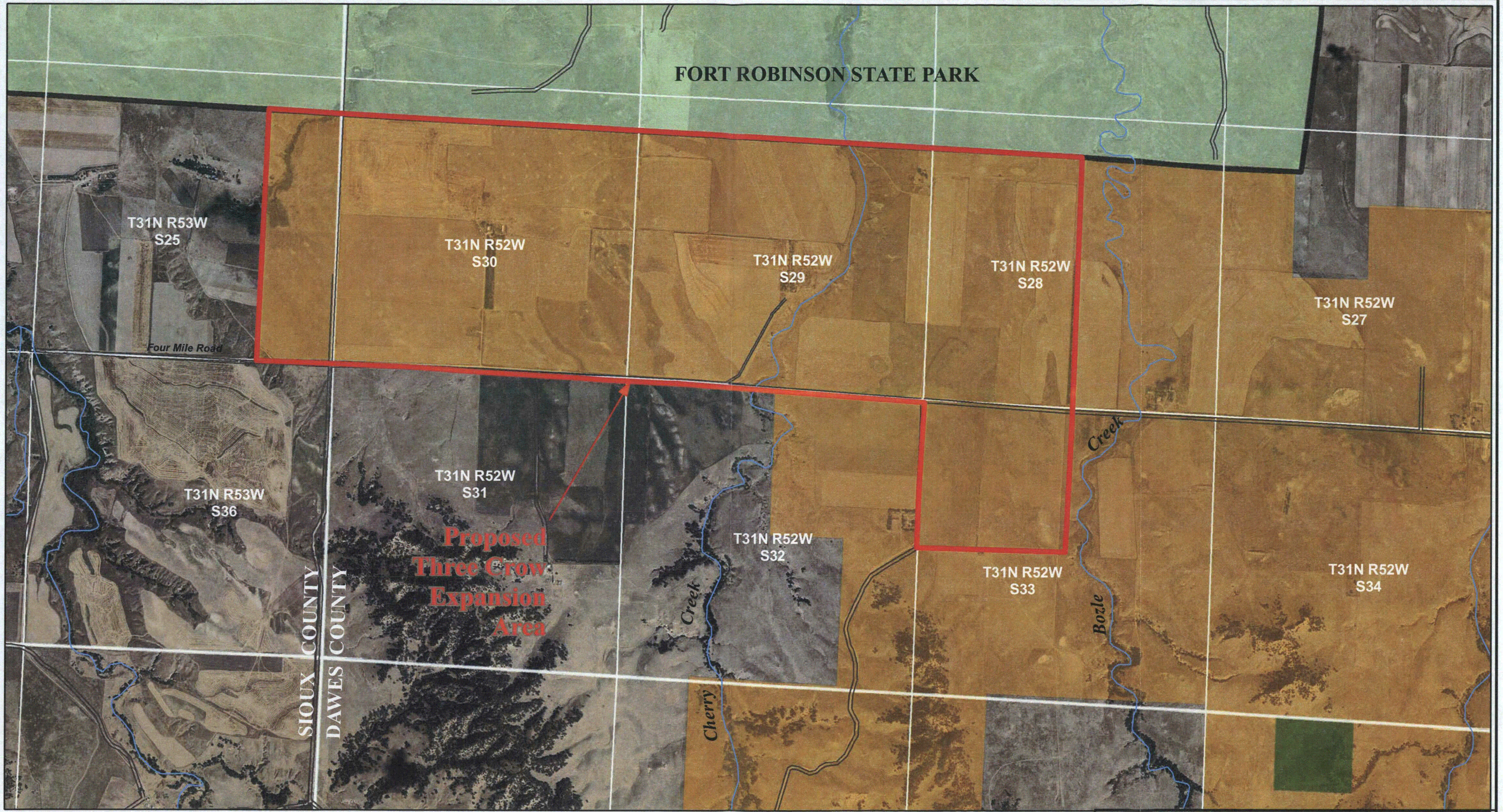

LEGEND

- Drainage
- Road
- Proposed Three Crow Expansion Area
- Private Leased Land
- State of Nebraska Land
- U.S. Forest Service Land

0 500 1,000 1,500
Scale in Feet

PROJECTION:
NAD_1927_STATE_PLANE_
NEBRASKA_NORTH_FIPS_2601
SOURCE:
AERIAL - NAIP 2006, SIOUX COUNTY & DAWES COUNTY, NEBRASKA;
LAND OWNERSHIP: NE-GAP ANALYSIS LAND STEWARDSHIP AND MANAGEMENT, ACOE, 1998

N
W E

CROW BUTTE RESOURCES, INC.

FIGURE 1.1-3
THREE CROW EXPANSION AREA
PROPERTY LAND OWNERSHIP MAP

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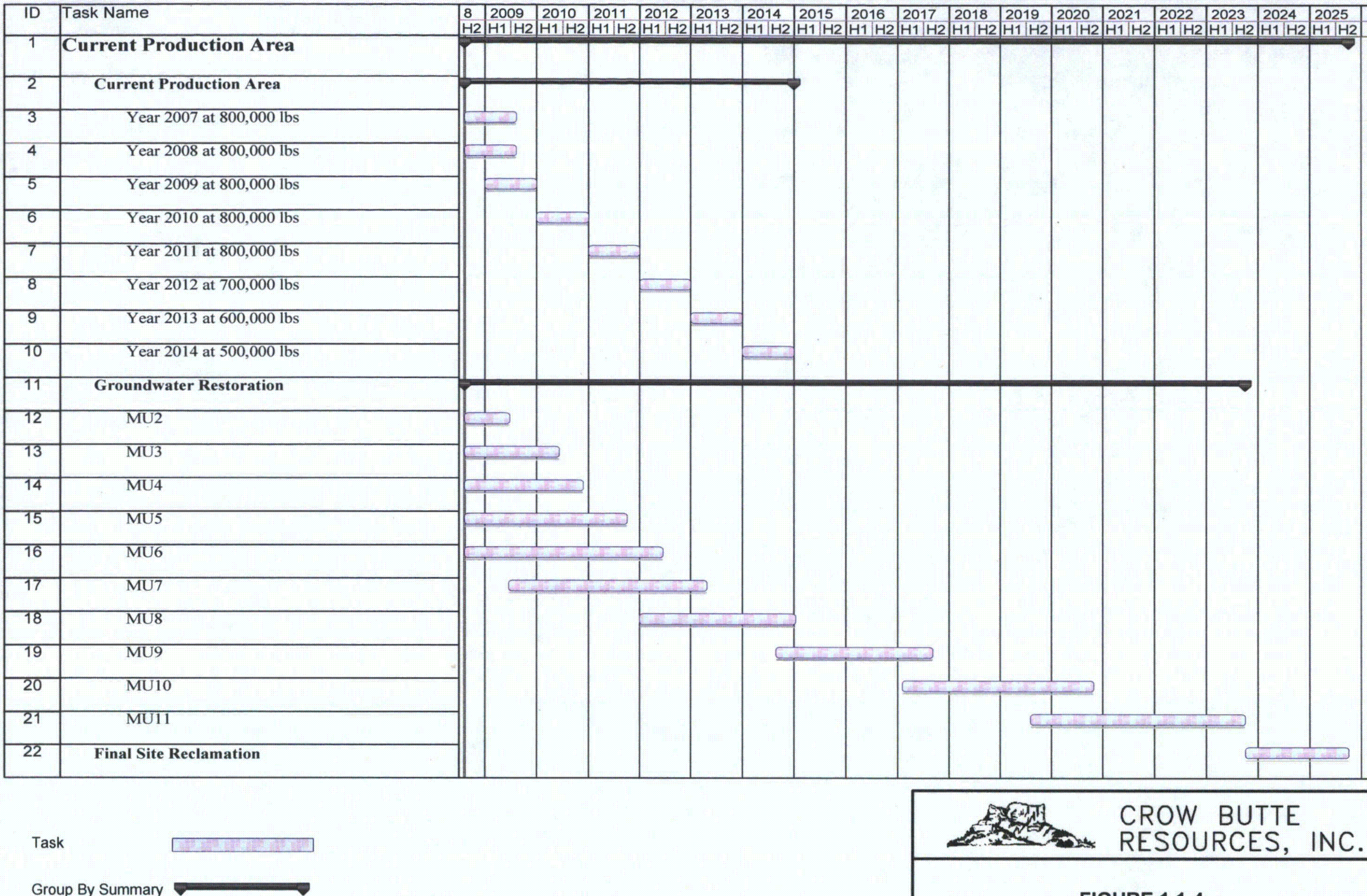

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FIGURE 1.1-4
CURRENT PRODUCTION AREA
MINE UNIT SCHEDULE

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

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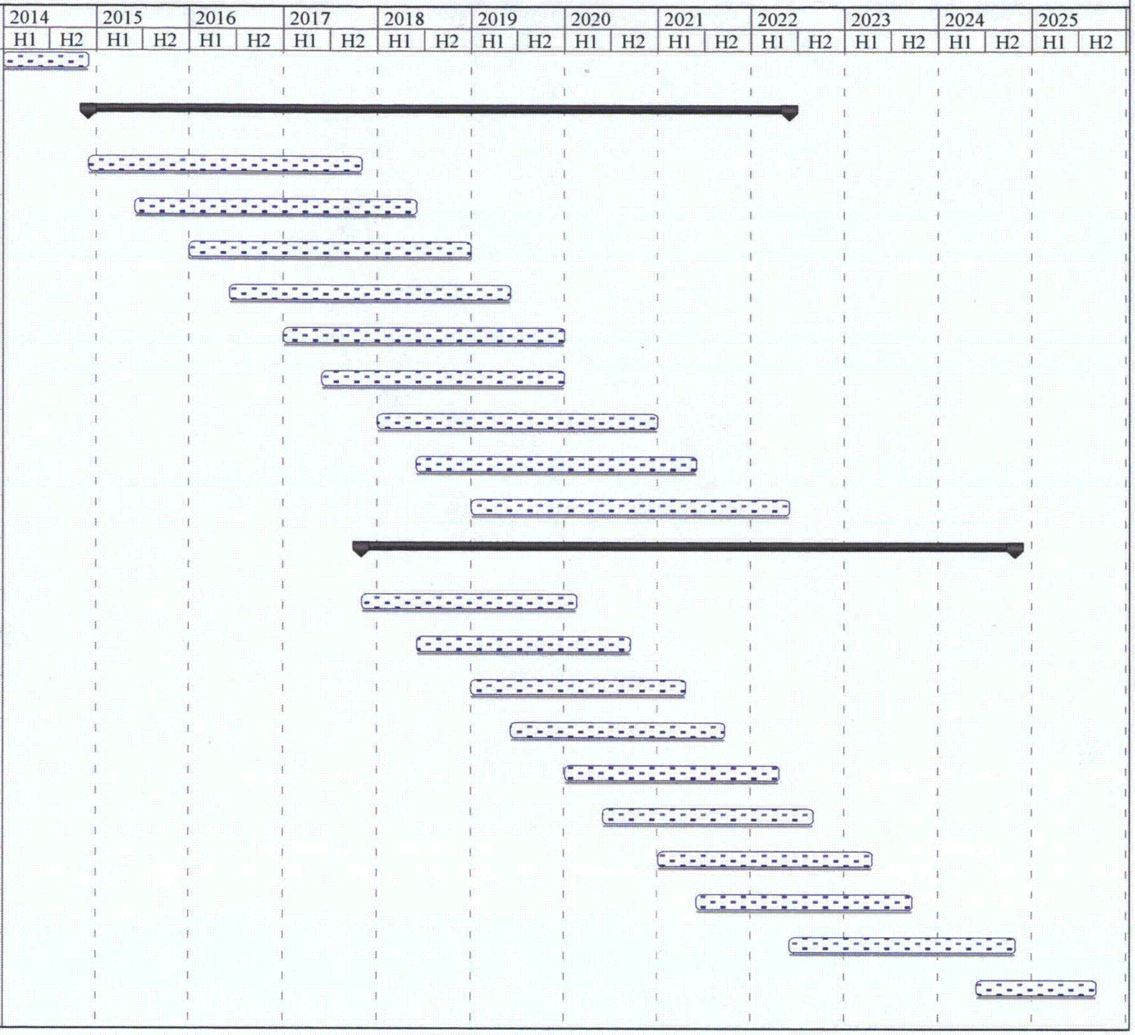
K:\CBR_Projects\CO001396_ThreeCrow\3_IMAGES\Illustrator\ER Fig_1_1-4 Current Production Area Schedule.ai @ 01/19/2010

THREE CROW MINING AND RESTORATION SCHEDULE

ID	Task Name	Start	Finish	Predecessors
1	**Facility Construction**	Wed 1/1/14	Tue 12/2/14	
2	**Production**	**Tue 12/2/14**	**Wed 6/1/22**	
3	Mine Unit 1	Tue 12/2/14	Wed 11/1/17	1
4	Mine Unit 2	Tue 6/2/15	Fri 6/1/18	1
5	Mine Unit 3	Thu 12/31/15	Mon 12/31/18	1
6	Mine Unit 4	Mon 6/6/16	Thu 6/6/19	1
7	Mine Unit 5	Mon 1/2/17	Fri 1/3/20	1
8	Mine Unit 6	Thu 6/1/17	Wed 1/1/20	1
9	Mine Unit 7	Tue 1/2/18	Fri 1/1/21	1
10	Mine Unit 8	Fri 6/1/18	Tue 6/1/21	1
11	Mine Unit 9	Wed 1/2/19	Wed 6/1/22	1
12	**Groundwater Restoration**	**Thu 11/2/17**	**Tue 10/29/24**	
13	Mine Unit 1	Thu 11/2/17	Wed 2/19/20	3
14	Mine Unit 2	Mon 6/4/18	Fri 9/18/20	4
15	Mine Unit 3	Tue 1/1/19	Mon 4/19/21	5
16	Mine Unit 4	Fri 6/7/19	Thu 9/23/21	6
17	Mine Unit 5	Mon 1/6/20	Fri 4/22/22	7
18	Mine Unit 6	Tue 6/2/20	Thu 9/1/22	8
19	Mine Unit 7	Mon 1/4/21	Wed 4/19/23	9
20	Mine Unit 8	Wed 6/2/21	Fri 9/22/23	10
21	Mine Unit 9	Thu 6/2/22	Tue 10/29/24	11
22	**Site Reclamation**	Fri 5/31/24	Mon 9/8/25	17



Task

Group By Summary

CROW BUTTE RESOURCES, INC.

FIGURE 1.1-5
THREE CROW EXPANSION AREA
MINING AND RESTORATION SCHEDULE

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

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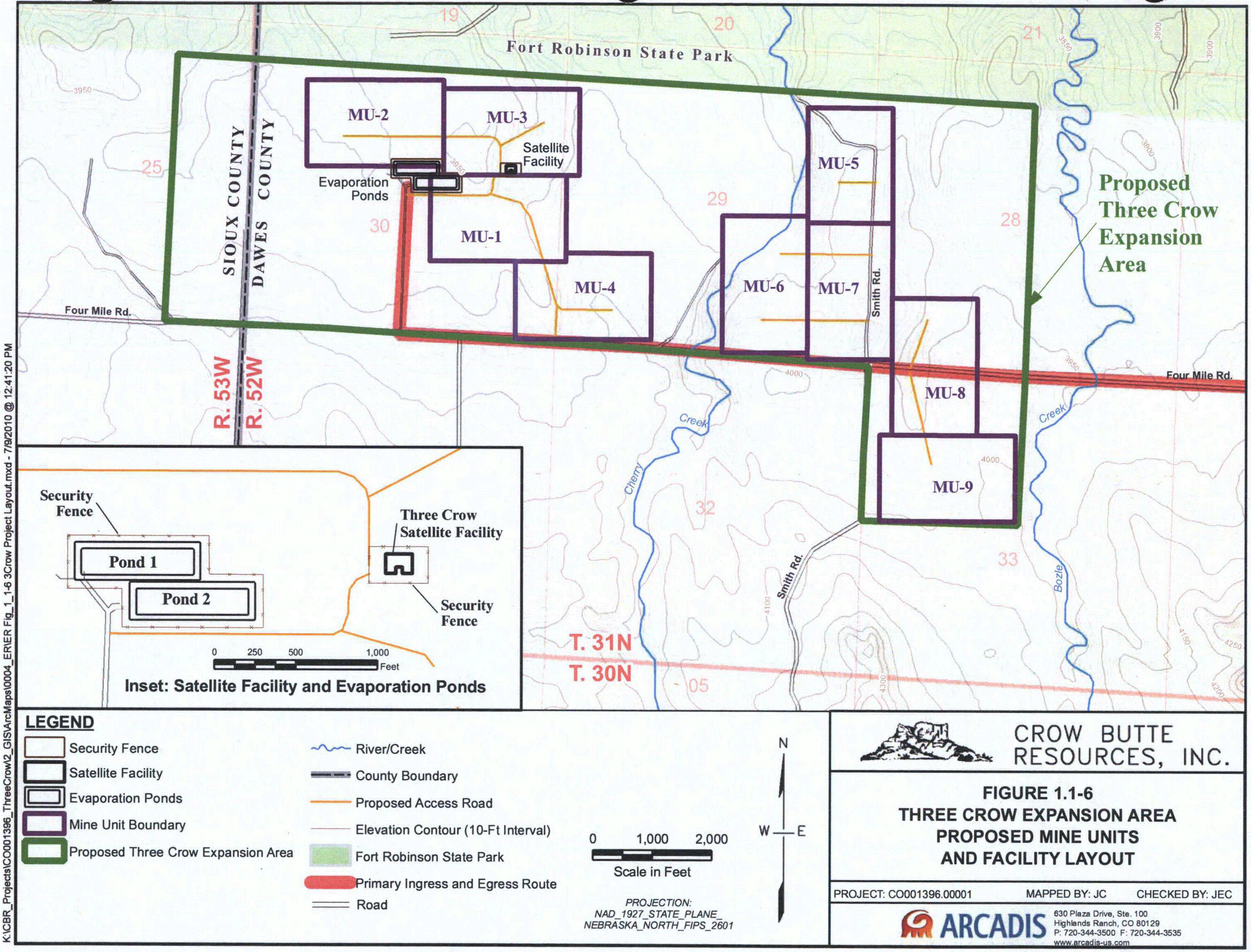

CROW BUTTE RESOURCES, INC.

FIGURE 1.1-6
THREE CROW EXPANSION AREA PROPOSED MINE UNITS AND FACILITY LAYOUT

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

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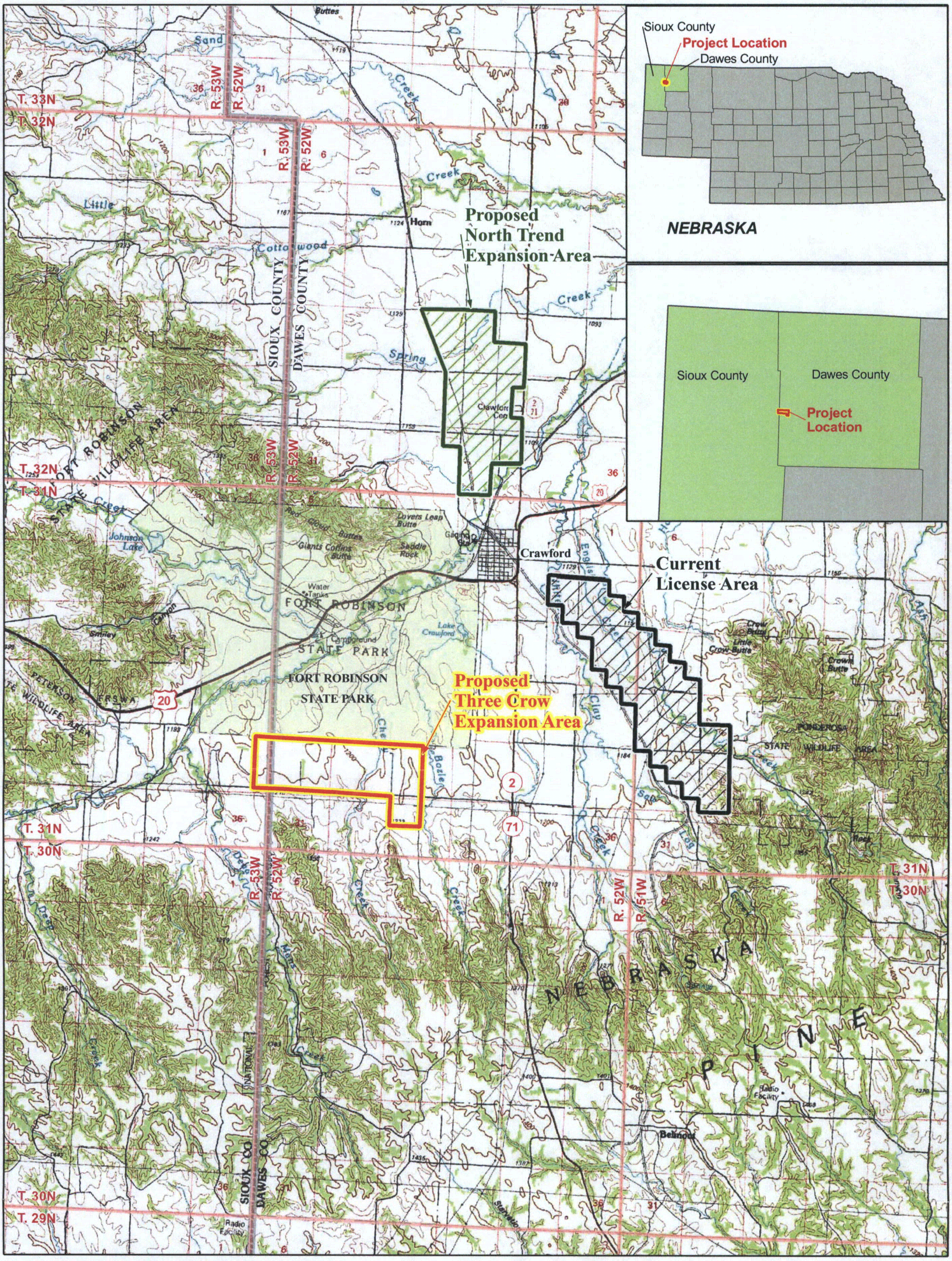

Source: USGS 1:100,000 scale topographic map - Crawford (1984), NE

LEGEND

- Proposed Three Crow Expansion Area
- Proposed North Trend Expansion Area
- Current License Area

0 5,000 10,000
Scale in Feet

CROW BUTTE RESOURCES, INC.

FIGURE 1.1-7
WESTERN NEBRASKA/DAWES COUNTY
PROJECT LOCATION MAP

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

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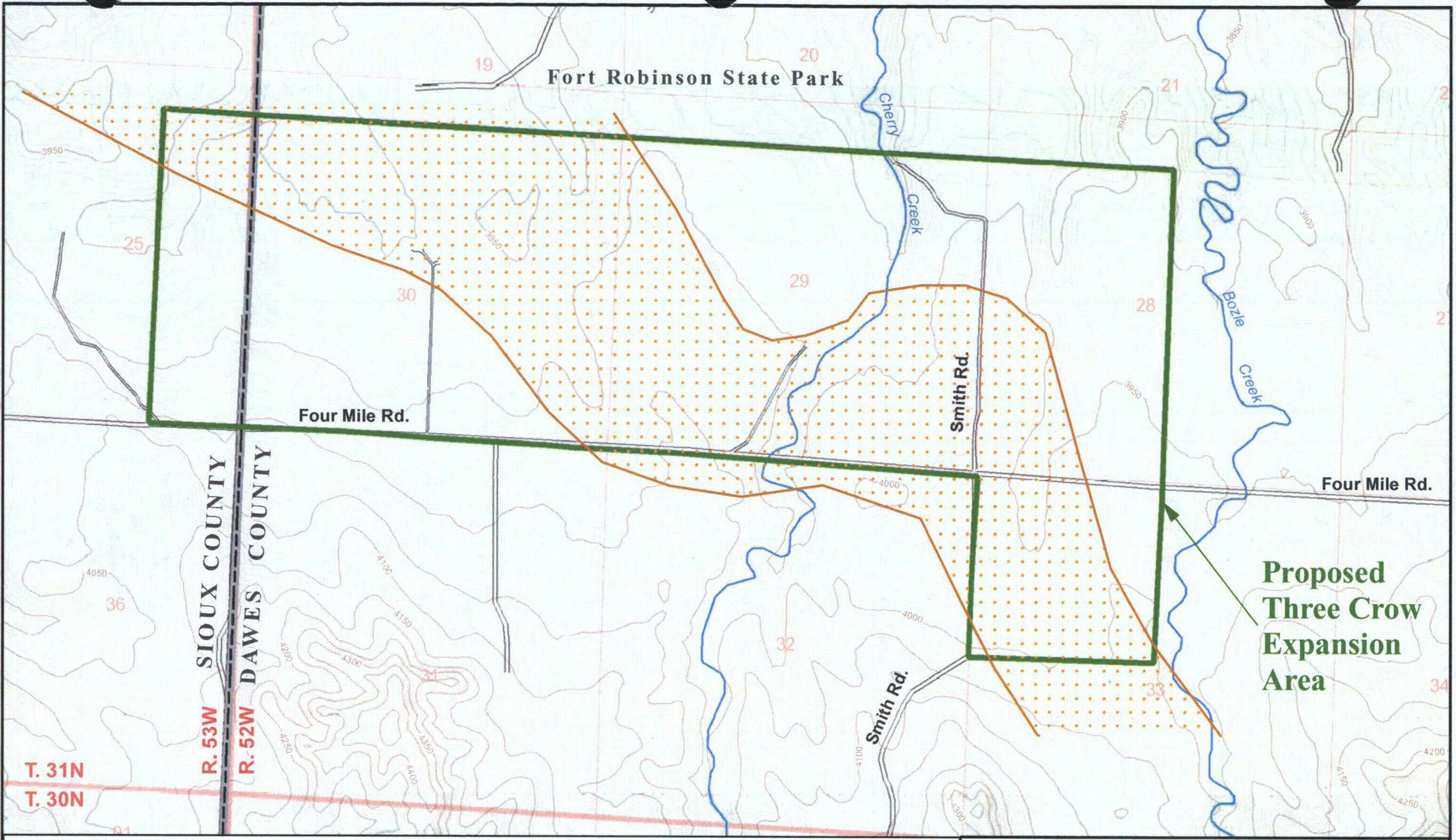

LEGEND

- General Ore Trend
- Proposed Three Crow Expansion Area
- River/Creek
- County Boundary
- Elevation Contour (10-Ft Interval)
- Road

0 1,000 2,000

Scale in Feet

N
W E

PROJECTION:
NAD 1927, STATE PLANE
NEBRASKA NORTH FIPS 2601

ALL ELEVATIONS ARE IN FT-AMSL

CROW BUTTE RESOURCES, INC.

FIGURE 1.3-1
THREE CROW EXPANSION AREA ORE BODY

PROJECT: CO001396.00003 MAPPED BY: JC CHECKED BY: MS

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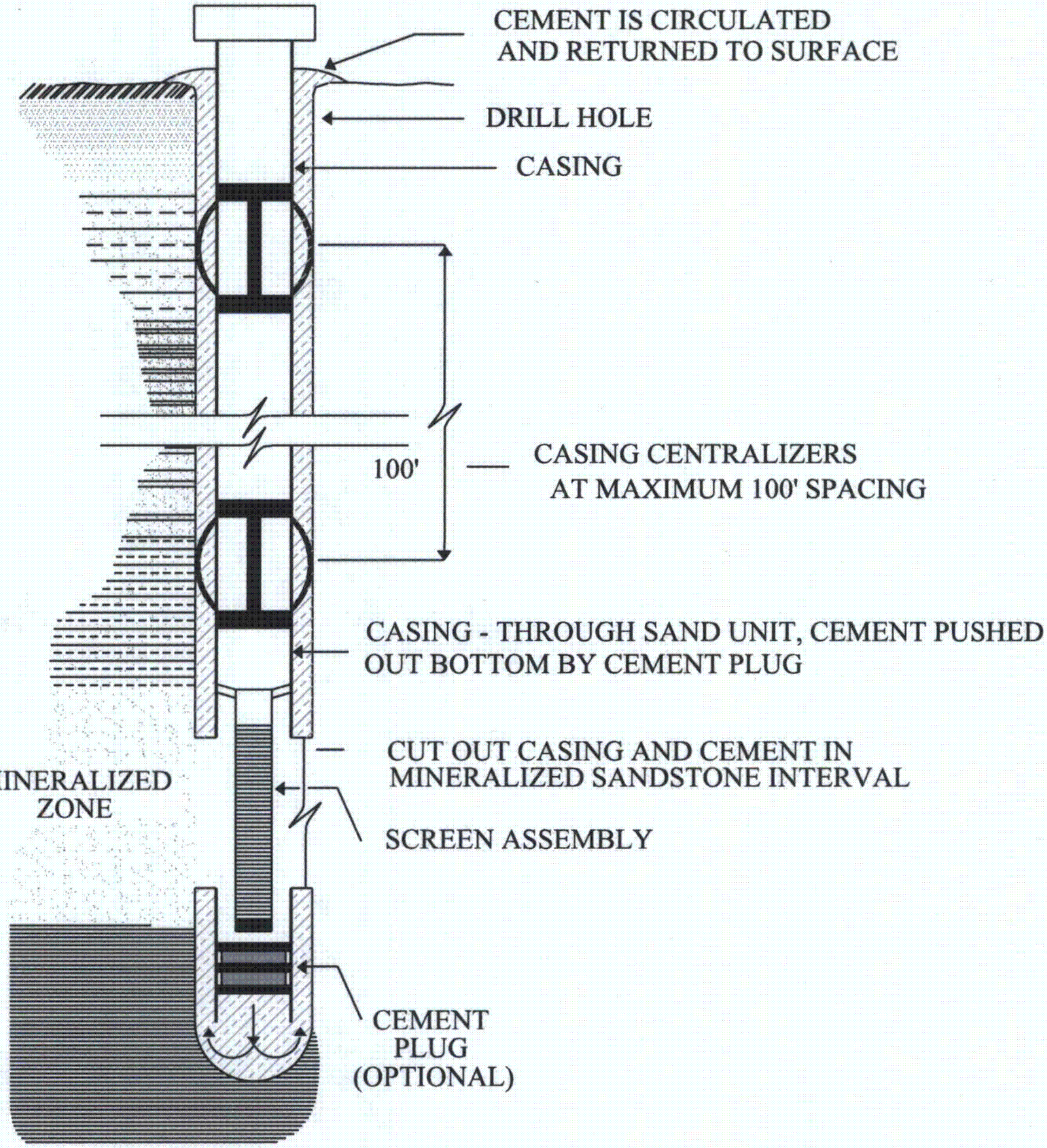

CROW BUTTE RESOURCES, INC.

FIGURE 1.3-2

TYPICAL MINERALIZED ZONE COMPLETION FOR INJECTION/PRODUCTION WELLS

METHOD NO.1

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

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

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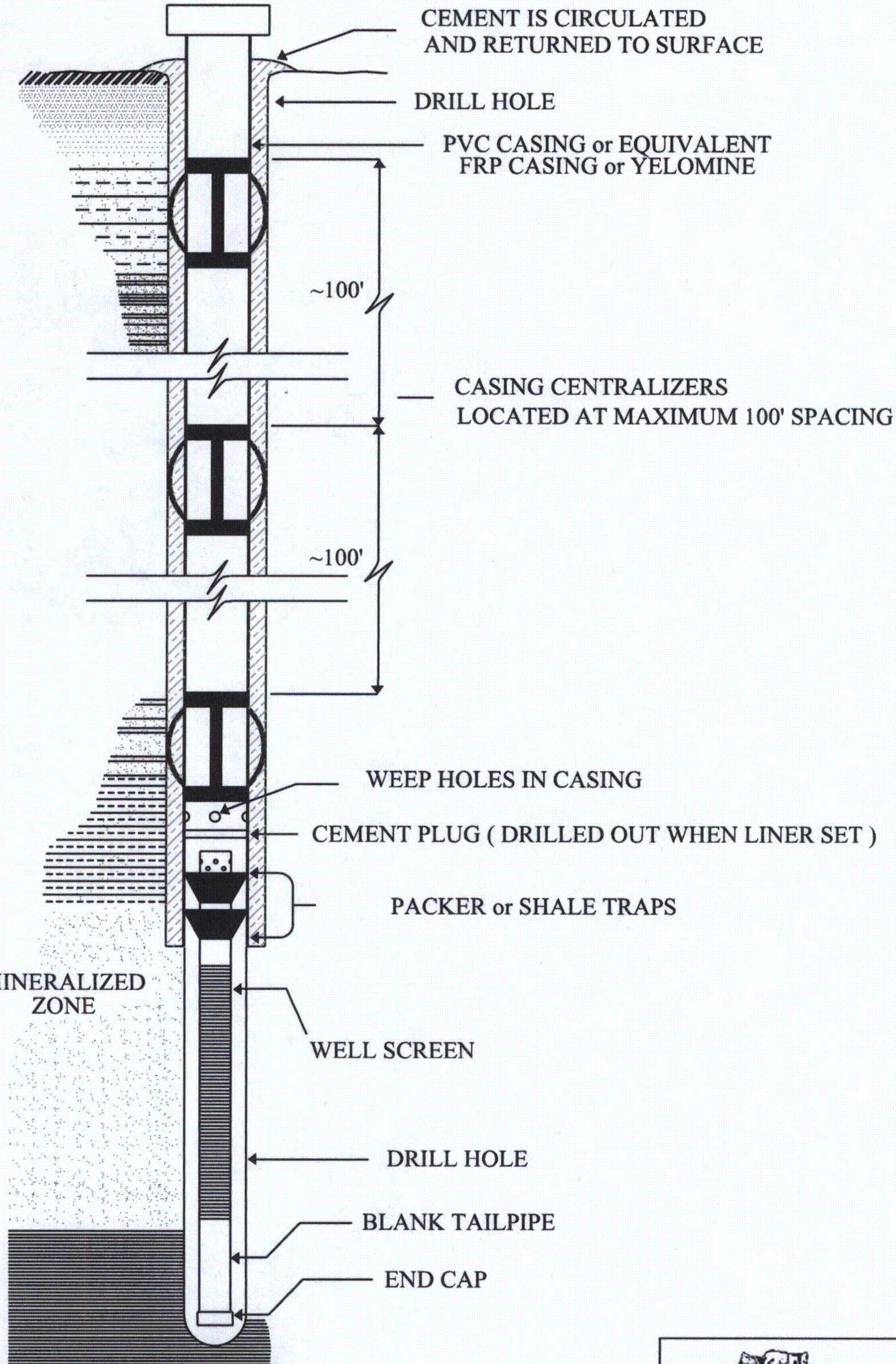

CROW BUTTE
RESOURCES, INC.

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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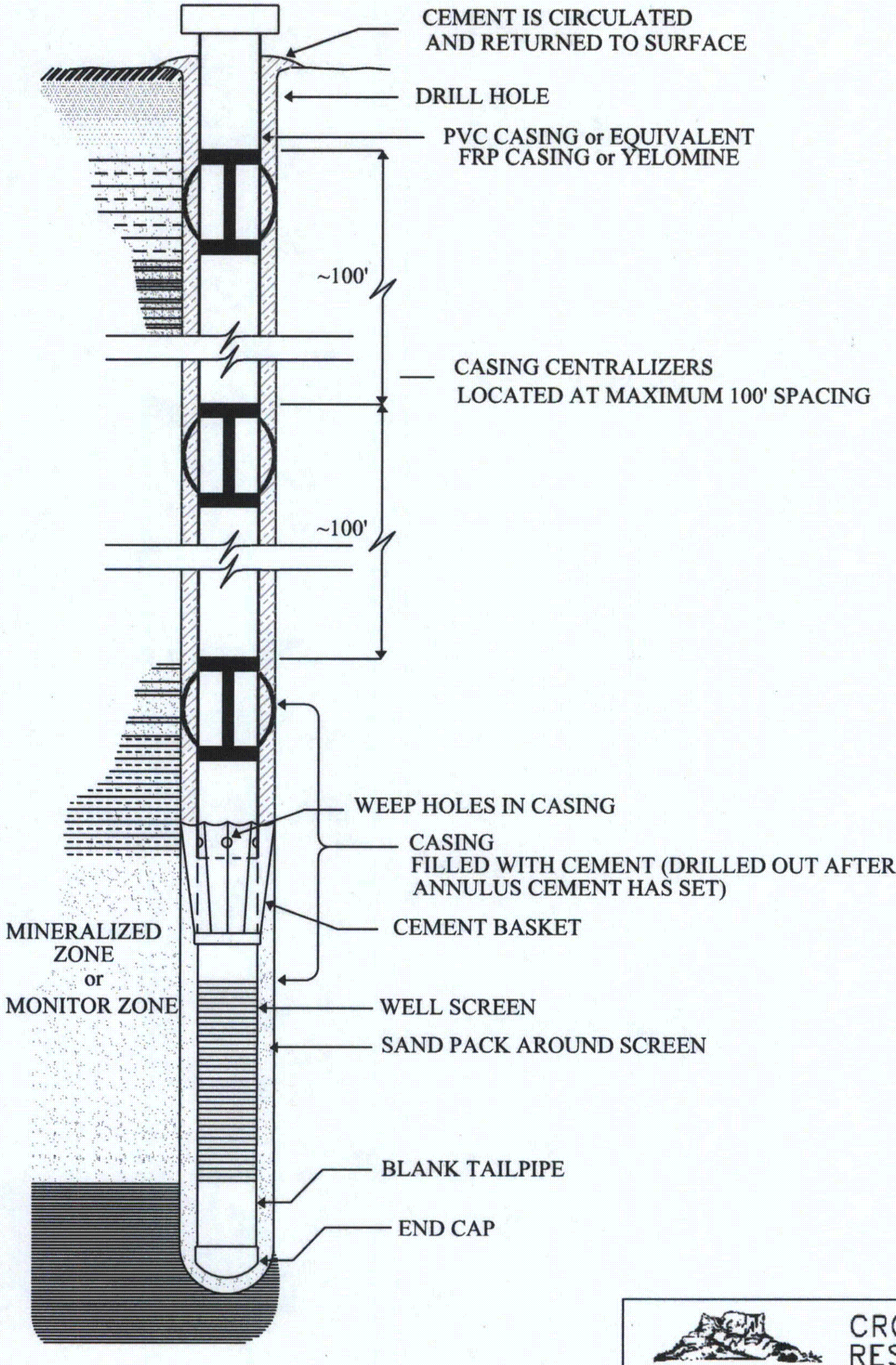

CROW BUTTE RESOURCES, INC.

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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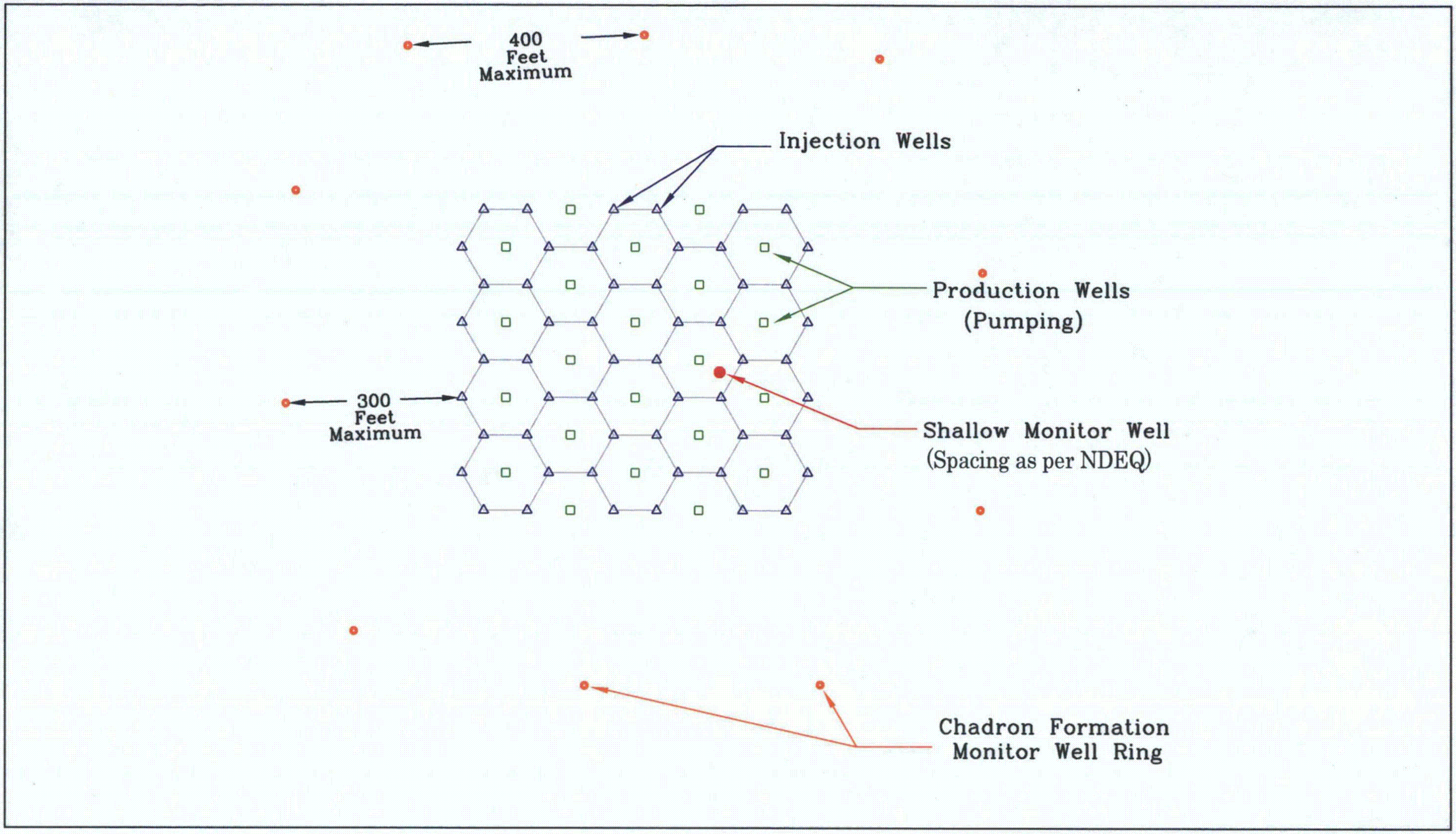

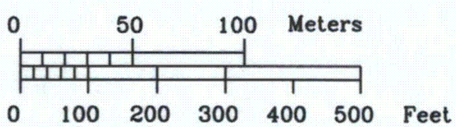

CROW BUTTE
RESOURCES, INC.

FIGURE 1.3-5

TYPICAL WELLFIELD LAYOUT

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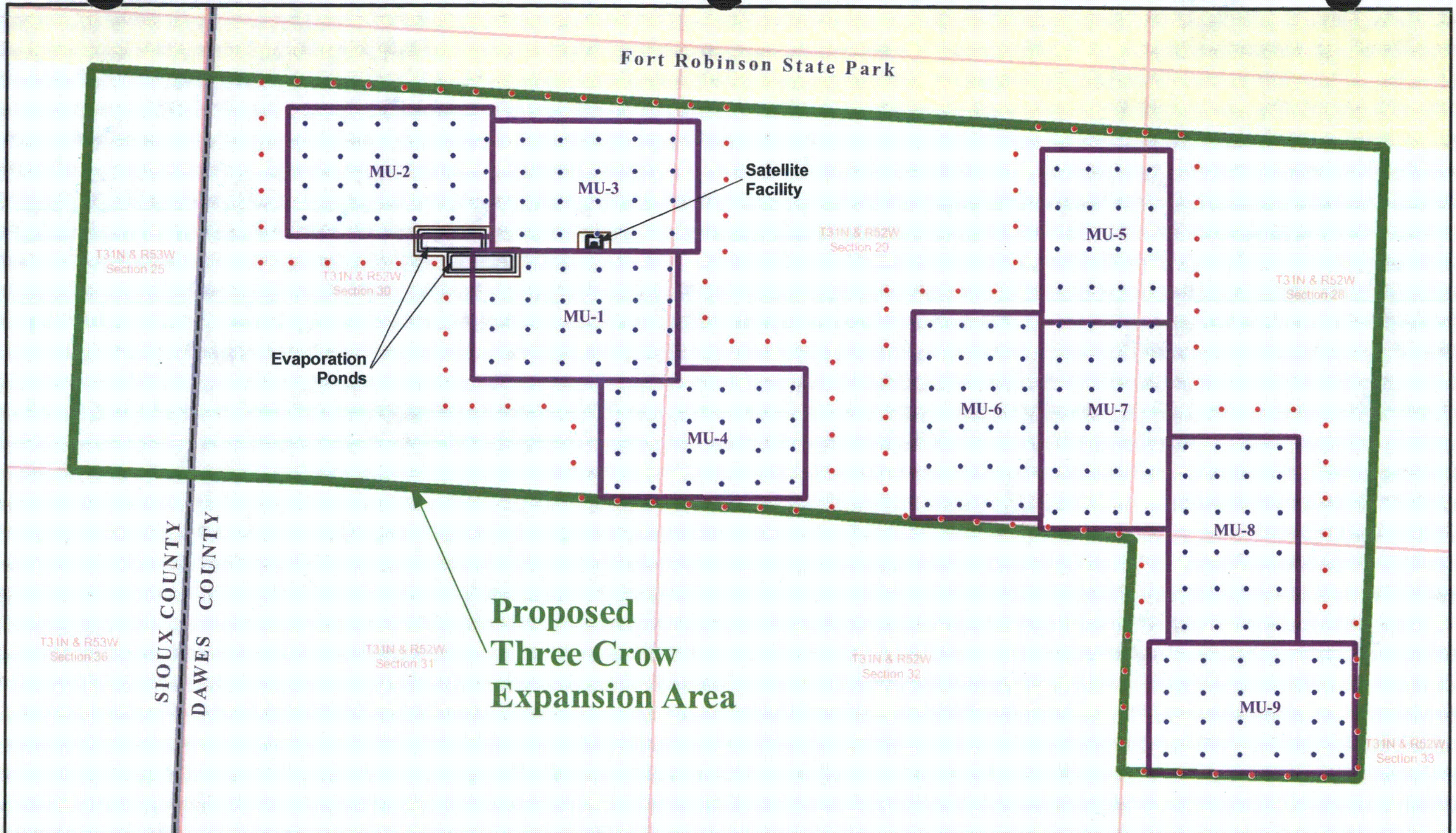

LEGEND

- Commercial Monitor Well
- Shallow Monitor Well
- Security Fence
- Satellite Facility
- Evaporation Ponds
- Proposed Three Crow Expansion Area
- Mine Unit Boundary
- Fort Robinson State Park

N W E

0 1,000 2,000

Scale in Feet

PROJECTION: NAD_1927_STATE_PLANE_NEBRASKA_NORTH_FIPS_2601

CROW BUTTE RESOURCES, INC.

FIGURE 1.3-6
THREE CROW MONITOR WELL LAYOUT

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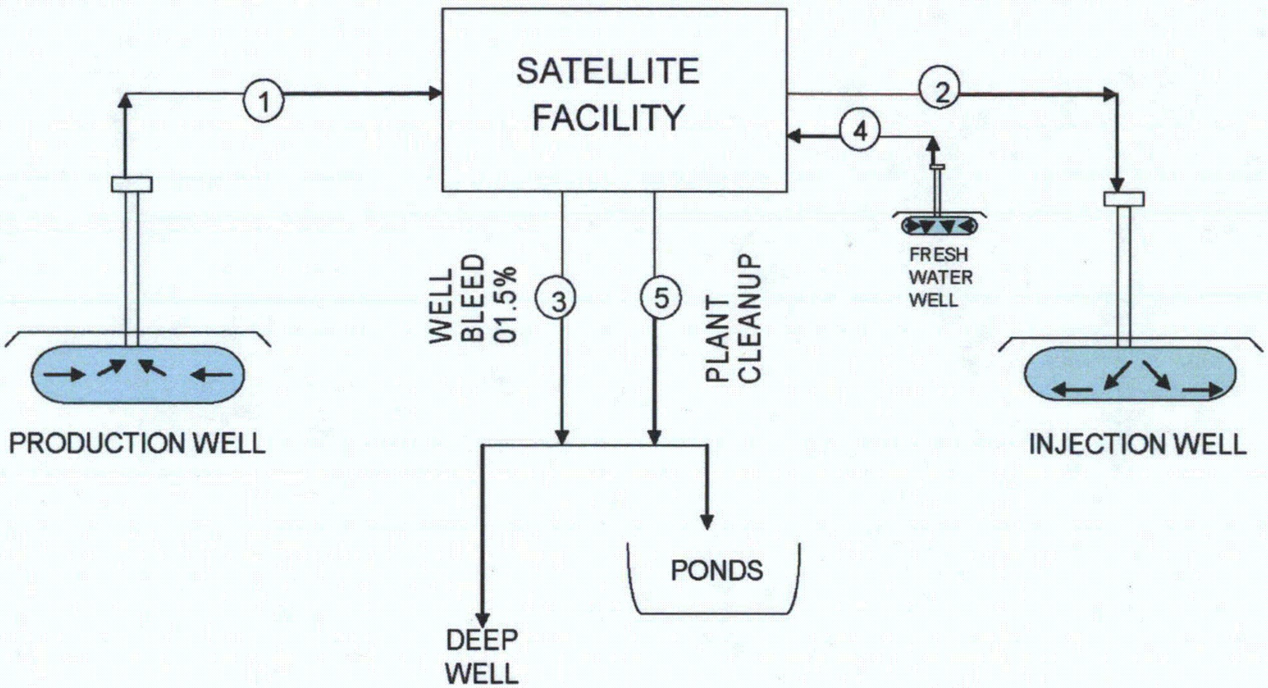
FOR 1.5% BLEED AND FULL PRODUCTION



STREAM #	1	2	3	4	5
SOLUTION GPM*	6,000	5,910	90	2	2

*BALANCE IS NOMINAL FOR A 1.5% BLEED. ACTUAL BALANCE MAY VARY ACCORDINGLY.

CROW BUTTE RESOURCES, INC.

FIGURE 1.3-7

THREE CROW WATER BALANCES

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K:\CBR_Projects\CO001396_ThreeCrow\3_IMAGES\Illustrator\ER_Fig_1_3-7 Three Crow Water Balances.ai @ 02/02/2010

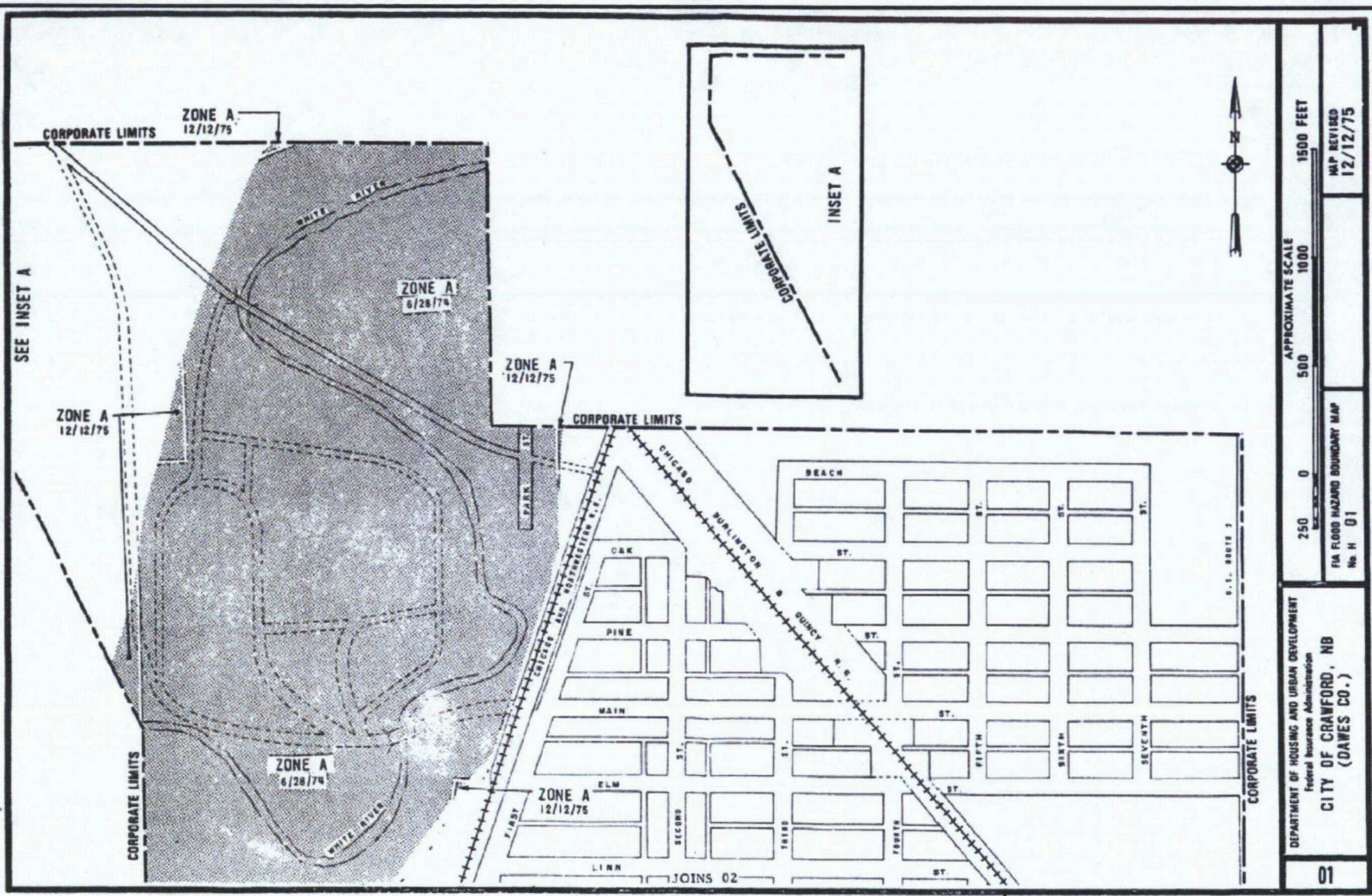

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FIGURE 1.3-8
FEMA FLOOD MAP

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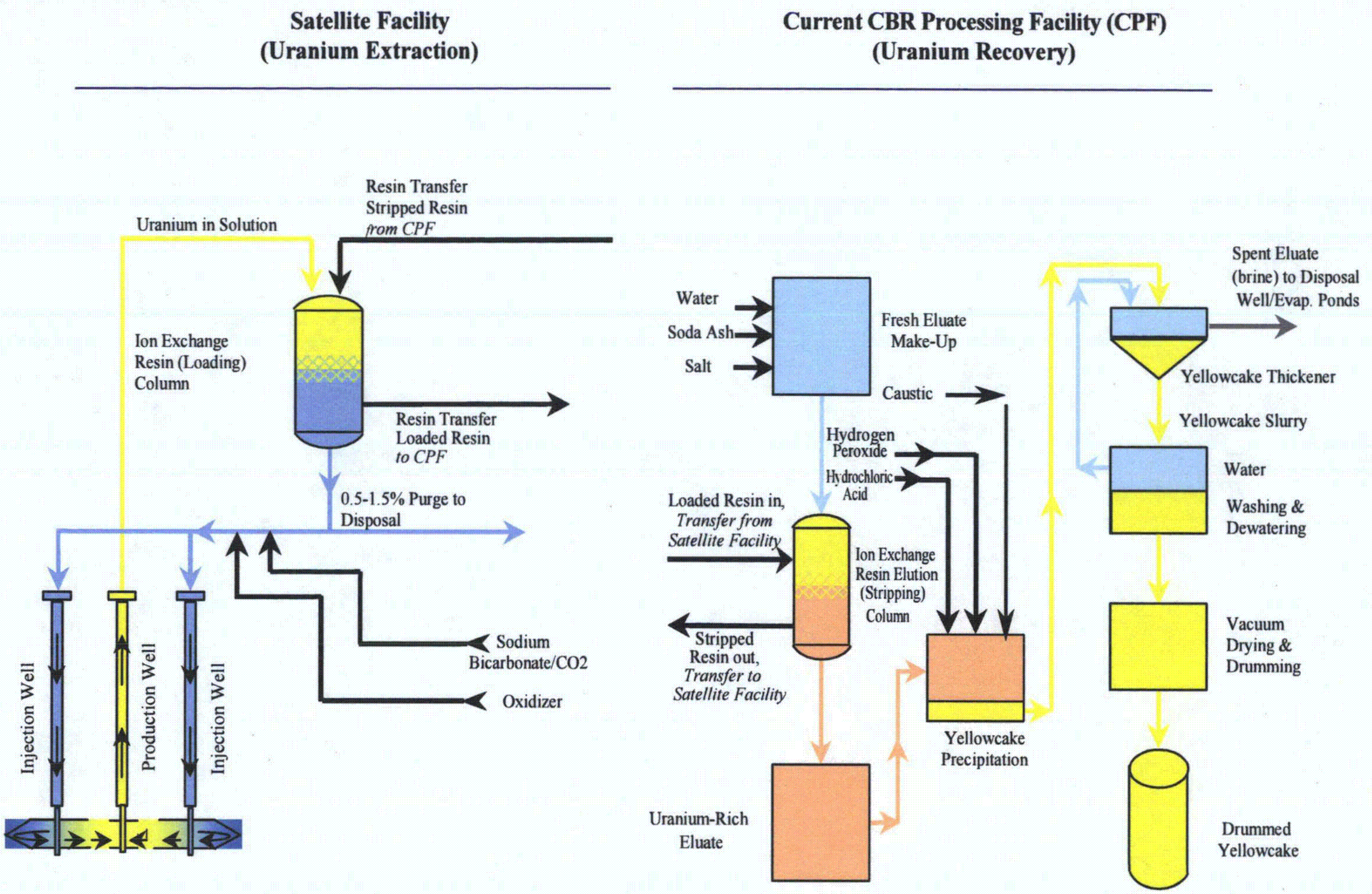
K:\CBR_Projects\CO001396_ThreeCrow\3_IMAGES\Illustrator\ER Fig_1_3-8 FEMA.ai @05/14/2010



CROW BUTTE
RESOURCES, INC.

FIGURE 1.3-9
THREE CROW SATELLITE FACILITY AND CURRENT CBR PROCESSING FACILITY PROCESS FLOW DIAGRAM

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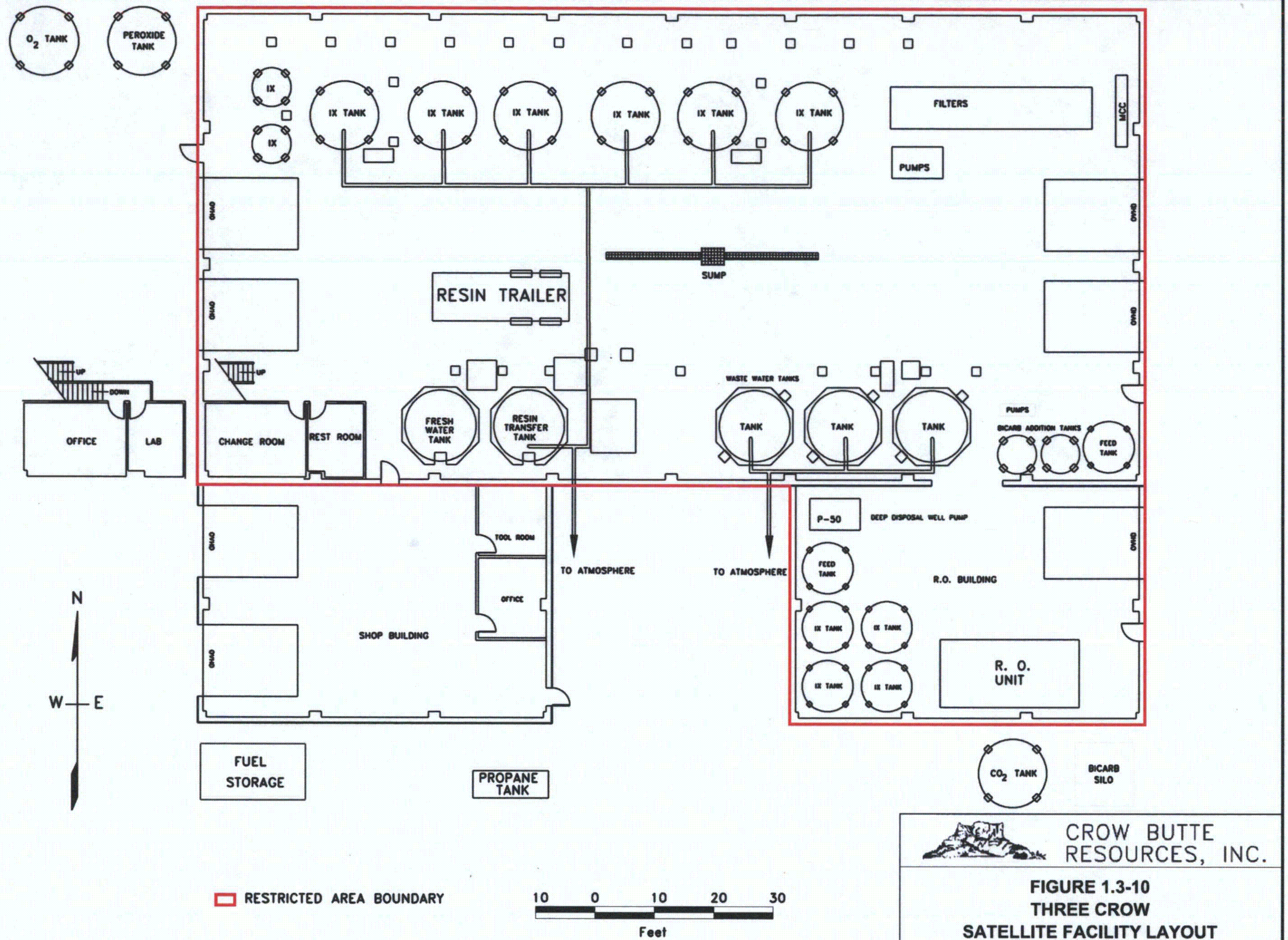

CROW BUTTE RESOURCES, INC.

FIGURE 1.3-10
THREE CROW
SATELLITE FACILITY LAYOUT

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

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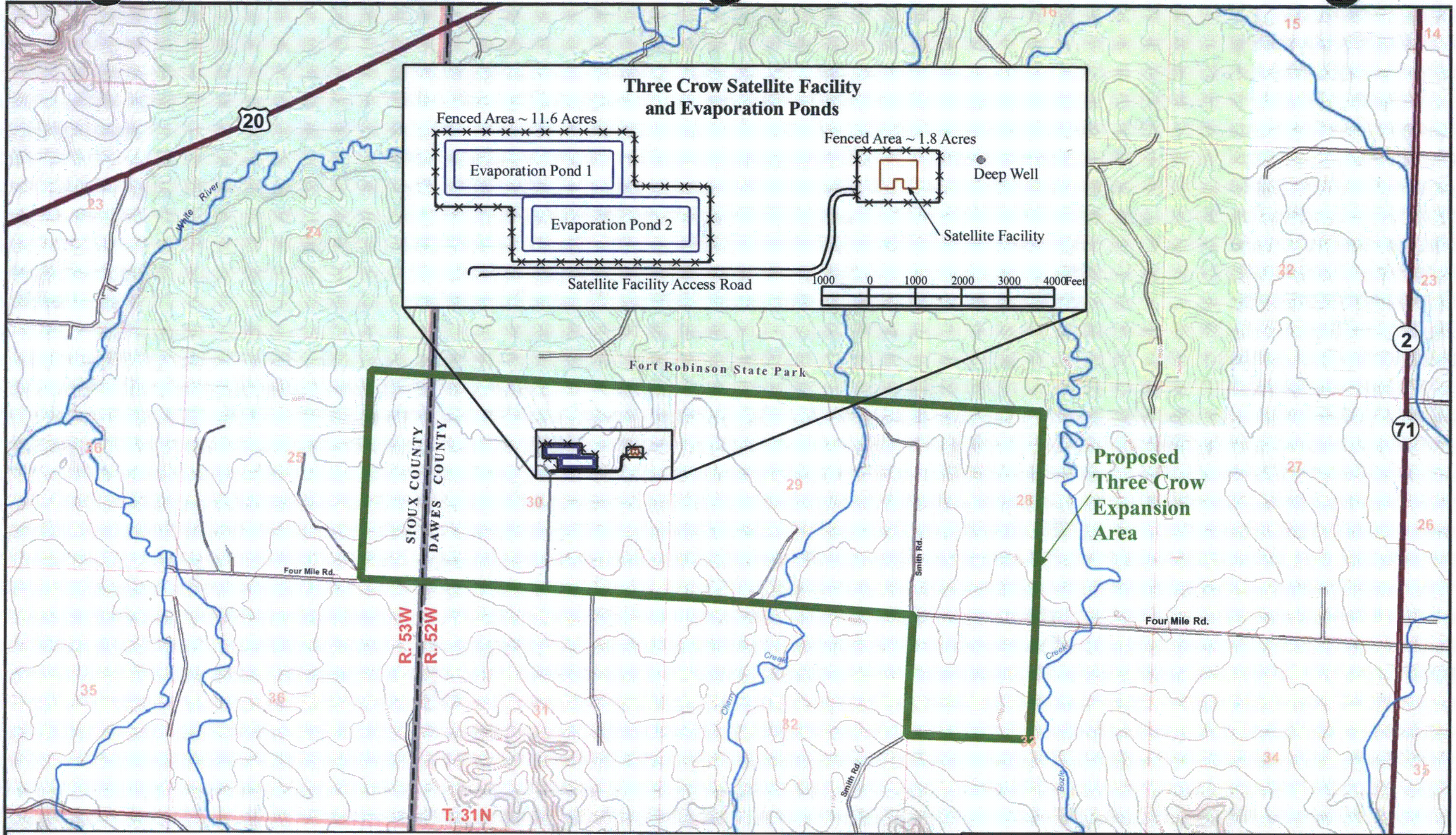
PATH: K:\CBR_Projects\CO001396_ThreeCrow1_ACAD\ARCADIS_NewDrawings\3CrowSatelliteLayout.dwg LAYOUT: ER DATE/TIME: 7/9/2010 11:43 AM



LEGEND

- Proposed Three Crow Expansion Area
- Fort Robinson State Park
- River/Creek
- Security Fence
- Highway
- County Boundary
- Elevation Contour (10-Ft Interval)
- Road

0 1,000 2,000

Scale in Feet

PROJECTION:
NAD 1927 STATE PLANE
NEBRASKA NORTH, FIPS 2601

N
W E

CROW BUTTE RESOURCES, INC.

FIGURE 1.3-11
GENERAL ARRANGEMENT
SATELLITE FACILITY VIEW

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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 in-situ leach (ISL) uranium mining operation located approximately 4 miles southeast of the City of Crawford in Dawes County, Nebraska. Operation is allowed under NRC) Source Materials License SUA-1534.

A 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 original license area is 3,300 acres and the surface area affected by the current commercial project is approximately 1,100 acres. Facilities include the R&D facility (which now houses the Restoration Circuit), the commercial process facility 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 Chadron Sandstone at a depth that varies from 400 feet to 900 feet. The overall width of the mineralized area varies from 1000 feet to 5000 feet. The ore body ranges in grade from less than 0.05 percent to greater than 0.5 percent U_3O_8, with an average grade estimated at 0.27% U_3O_8. Production is currently in progress in Mine Units 6 through 10. Groundwater restoration has been completed and regulatory approval has been received in Mine Unit 1. Groundwater restoration is currently underway in Mine Units 2 through 5. Planning and construction is underway for Mine Unit 11 with production planned to begin in mid-year 2010.

The CPF is operating with a licensed flow rate 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. Based on current plans and mining schedules discussed in Section 1 (**Table 1.1-1** and **Figure 1.1-4**), 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. Restoration and reclamation activities would become the primary activities, with final restoration and reclamation completed in 2025.

Assuming favorable regulatory action by the NRC and State of Nebraska, mining operations are estimated to begin at the proposed NTEA satellite facilities in 2013 and last for approximately 8 1/2 years (2021). 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 2021.

At the time that commercially-recoverable resources are depleted in the CPF license area, all activities at the site that are 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, many of these jobs would be lost well 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 activities, all employment opportunities at the mine would be terminated. If approved, mining operations at the NTEA would extend current employment levels through 2021 before a portion of jobs are lost as the reserves decline. The impacts to the local economy from the approval of mining operations at NTEA, including employment opportunities, are evaluated in the NTEA 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 Section 7, the CPF currently provides a significant economic impact to the local Dawes County economy as shown in **Table 7.2-2**.

If this amendment request is denied, the negative impact on the Dawes County economy would be felt as early as 2010 when employment levels for drilling and construction activities would be cut and purchases of services and materials would diminish. In the event that NTEA is approved, employment levels would continue at current levels. The potential positive economic impact to the local economy from construction and operation of the TCEA is demonstrated in **Table 7.2-2.**

A decision to not amend SUA-1534 to allow mining in the TCEA would leave a large resource unavailable for energy production supplies. The estimated recoverable resource at the TCEA is nearly 3,750,000 pounds U_3O_8, with an annual production rate of approximately 600,000 pounds. The current estimated recoverable resource at NTEA is also approximately 5,000,000 pounds U_3O_8, with an annual production rate of approximately 500,000 to 600,000 pounds.

In 2008, total domestic U.S. uranium production was approximately 3.9 million pounds U_3O_8, of which over 590,000 pounds (or approximately 15 percent) was produced at the CPF (EIA 2010a). During the same year, purchases of domestic U.S. uranium by U.S. civilian nuclear power reactors were approximately 53 million pounds U_3O_8e (equivalent) with approximately 14% supplied by domestic producers (EIA 2010b). Foreign-origin uranium accounted for the remaining 86 percent of deliveries. The CPF (including the TCEA and NTEA) represents an important source of new domestic uranium supplies that are essential to provide 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 affect on the individuals that have surface leases with CBR and own the mineral rights in the TCEA.

2.2 Proposed Action

The proposed TCEA contains a licensed area of approximately 1,643 acres. Of this potential licensed area, the total surface area to be affected by mining operations will be approximately 671 acres for the satellite facility including the wellfields and evaporation ponds. The satellite facility will be located within a 1.8-acre fenced area in the SE1/4 NE1/4, Section 30, T31N, R52W. This area will also contain the chemical storage areas. The evaporation ponds will be located approximately 3,000 feet west of the satellite facilities (nearest fence to fence) in the SW1/4 NE1/4 and SE1/4 NW1/4 of Section 30, T31N R52W. The ponds will be enclosed within a fenced area consisting of approximately 11.6 acres.

The TCEA will be developed and operated by CBR. All land within the proposed license boundary of the TCEA is privately owned. CBR has obtained surface and mineral leases from the appropriate landowners.

Commercial production at the CPF including the proposed NTEA is expected to extend over the next ten years with the uranium reserves at both areas depleted by 2020. Commercial production at the proposed TCEA would occur over seven years between from late 2014 through 2021, extending production by seven years. Aquifer restoration and reclamation will be done concurrent with operations, plus an additional time period at the end of the project for final decommissioning activities and surface reclamation. All three projects would be completely restored and reclaimed by 2025. More detailed schedules are provided in Section 1.

The CPF recovers uranium from the Chadron Sandstone. In the TCEA, uranium will also be recovered from the Chadron Sandstone. The depth in the TCEA ranges from 580 to 940 feet. The width varies from 70 feet to 250 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; and
- Chemical addition.

The in-situ process consists of an oxidation step and a dissolution step. The oxidants utilized in the facility are hydrogen peroxide and/or gaseous oxygen. A sodium bicarbonate 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 utilizes the following steps:

- Loading of uranium complexes onto an IX resin;
- Reconstitution of the solution by the addition of sodium bicarbonate and oxygen;
- Shipment of loaded IX resin to the CPF; and,
- Restoration of groundwater following mining activities.

The satellite facility will be designed for a maximum flow rate, excluding restoration flow, of 6,000 gpm (restoration would account for another 1,500 gpm). Uranium-bearing resin will be transferred 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; and
- Aquifer recirculation.

Groundwater restoration will take place concurrently with development and production activities. The goal of the groundwater restoration is to return the water quality of the affected zone to a chemical quality consistent with baseline conditions or, as a secondary goal, to the quality level specified by the NDEQ.

Following groundwater restoration activities, 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, ponds and roads.

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. The release of radon 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 central process facility using a vacuum drying system, thereby minimizing the potential for radioactive air particulate releases at TCEA.

In situ leach mining of uranium 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 7 include short-term and long-term impacts. However, it should be noted that in situ leach mining technique allows the entire mine site to be decommissioned and returned to unrestricted use within a relatively short time.

2.3 Reasonable Alternatives

2.3.1 Process Alternatives

2.3.1.1 Lixiviant Chemistry

CBR is utilizing a sodium bicarbonate 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 sodium bicarbonate has proven highly successful on the CBR R&D project and on commercial mining operations to date. 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. Therefore 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 Mine Unit 1, and the current restoration activities in Mine Units 2 through 5 at the current licensed CPF exhibit the effectiveness of the restoration methods. These methods (groundwater sweep, permeate/reductant injection and aquifer recirculation) have been shown to restore groundwater to pre-mining quality. No feasible alternative groundwater restoration method is currently available for the CPF and proposed NTEA and TCEA. The NRC and NDEQ consider the method currently employed at the CPF as the BPT available.

2.3.1.3 Waste Management

Liquid wastes generated from production and restoration activities are handled by one of three methods: solar evaporation ponds, deep disposal well injection, or land application. All three methods are permitted at the CPF; however, only solar evaporation ponds and deep disposal have been used to date. The use of deep waste disposal wells in conjunction with storage/evaporation ponds to dispose of the high total dissolved solids (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. The Three Crow deep disposal well would be completed at an approximate depth of 3,500 to 4,000 ft, isolated from any underground source of drinking water by approximately 2,500 feet of shale (Pierre and Graneros Shales). These discharges must be authorized by the State of Nebraska under a Class I UIC Permit to receive such wastes. CBR considered and rejected using land application as a disposal method at Three Crow due to required treatment and monitoring costs and potential environmental impacts from a surface discharge.

Alternative pond design and locations for the CPF have been considered. The design is such that any seepage of toxic materials into the subsurface soils or hydrologic system would be prevented.

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 a NRC-approved facility for disposal. Should a NRC (or Agreement State)-licensed disposal facility not be available to CBR at the time of decommissioning, the alternative of on-site burial may be necessary. This alternative could incur long term monitoring requirements and more expensive reclamation costs.

At this time, CBR believes that off-site disposal of 11(e)2 byproduct material from Three Crow at a licensed disposal facility is the best alternative and there are no plans for onsite 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 Three Crow 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 solution mining for the uranium deposits in the project area. Neither of these methods is economically viable for producing the Three Crow reserves at this time. These alternative methods are not economically feasible for several reasons including the spatial characteristics of the mineral deposit and environmental factors. The depth of the deposit and subsequent overburden ratio makes surface mining impractical. Surface mining is commonly undertaken on large, shallow (less than 300 feet) ore deposits. At the TCEA, uranium is recovered from depths ranging from 580 to 940 feet.

In addition, the physical characteristics of the deposit and the overlying materials make underground mining infeasible for the TCEA or CPF. 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 traditionally much higher in open pit and underground mines than has been the experience at ISL solution mining operations.

Both open pit and underground mining methods would require substantial de-watering to depress the potentiometric surface of the local aquifers to provide access to the ore. The groundwater would contain naturally high levels of ra-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 to 10 million tons of solid tailings waste from the uranium mill would also be required.

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

Significantly less surface area is disturbed than in surface mining, and the degree of disruption is much less.

1. No mill tailings are produced and the volume of solid wastes is reduced significantly. The gross quantity of solid wastes produced by in situ leaching is generally less than 1% 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.

2. 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.
3. The tailings produced by conventional mills contain essentially all of the radium-226 originally present in the ore. By comparison, less than 5% of the radium in an ore body is brought to the surface when in-situ leaching 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 less than that associated with conventional mining and milling.
4. 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.
5. Solution mining results in significantly less water consumption than conventional mining and milling.
6. The socioeconomic advantages of in situ leaching include:
    - The ability to mine a lower grade ore;
    - A lower capital investment;
    - Less risk to the miner;
    - Shorter lead time before production begins; and,
    - 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 Three Crow at this time.

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 the licensed flow 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 Nov. 30, 2007.

The only environmental impact of the increased flow rate 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 resource areas in the region near the CPF that could conceivably be developed as satellite facilities. Development of these facilities is dependent upon further site investigations by CBR and the future of the uranium market. If conditions warrant, CBR may 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 Three Crow are depleted.

2.6 Comparison of the Predicted Environmental Impacts

Table 2.6-1 provides a summary of the environmental impacts for the no-action alternative (Section 2.1), the preferred alternative (Section 2.2), and the process alternatives (Section 2.3). 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

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 14 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 671 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 500 trips per year; additional 6 – 8 VTPD light duty trucks.	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 50 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.

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
Air Quality Impacts	None	Additional 16.9 tons per year total dust emissions due to vehicle traffic on gravel roads.	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.
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 \$13.9M to the local area as reserves deplete in the current licensed operation	Extension of the current annual direct economic impact of \$13.9M plus the addition of between \$5.3M and \$6.3M 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	22% increase in estimated maximum dose from additional radon gas released at Three Crow.	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**
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.
Mineral Resource Recovery Impacts	Loss of a valuable domestic energy resource. CBR estimated reserves are under development but the current estimated recoverable resource is 5.0 million pounds with a current spot market value of $225 million.	Recovery and use of a domestic energy resource.	Same as Preferred Alternative.	Same as Preferred Alternative.

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