U.S. NUCLEAR REGULATORY COMMISSION

OFFICE OF NUCLEAR MATERIAL SAFETY AND SAFEGUARDS

DIVISION OF FUEL CYCLE SAFETY, SAFEGUARDS, AND ENVIRONMENTAL REVIEW

FINAL ENVIRONMENTAL ASSESSMENT FOR THE LICENSE RENEWAL OF U.S. NUCLEAR REGULATORY COMMISSION LICENSE NO. SUA–1534

DOCKET NO. 040-08943

CROW BUTTE RESOURCES, INC

October 2014

United States Nuclear Regulatory Commission Official Hearing Exhibit			
In the Matter of:	CROW BUTTE RESOURCES, INC. (License Renewal for the In Situ Leach Facility, Crawford, Nebraska)		
ASLBP #:	08-867-02-OLA-BD01		
Docket #:	04008943		
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Other:			

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EXECUTIVE SUMMARY

On November 27, 2007, Crow Butte Resources, Inc. (CBR) submitted an application to the U.S. Nuclear Regulatory Commission (NRC) requesting renewal of Source Materials License No. SUA-1534 for its in situ leach (ISL) uranium milling facility (Crow Butte) located in Crawford, Nebraska. CBR is requesting authorization to continue the currently licensed activities at the Crow Butte site for an additional 10 years. The purpose and need for the proposed action (issuance of a renewed license) are to provide an option that allows for continued operation of in situ uranium recovery (ISR).

NRC's federal action is the decision whether to renew the license for up to an additional 10 years. If approved, CBR would continue to perform ISR operations in accordance with the requirements in Title 10 of the Code of Federal Regulations (CFR) Part 40. This environmental assessment (EA) assesses the potential environmental impacts of the proposed license renewal and of reasonable alternatives on the following environmental resources: land use; historical and cultural resources; visual and scenic resources; climatology, meteorology and air quality; geology and soils; water resources; ecological resources; socioeconomics; environmental justice; noise; transportation; public and occupational health and safety; and waste management. Chapter 2 of this EA discusses the alternatives to the proposed action, Chapter 3 discusses the affected environment, and Chapter 4 discusses the impacts to the environmental resource areas.

The NRC staff prepared this EA in accordance with NRC regulations at 10 CFR Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions," that implement the National Environmental Policy Act of 1969 (NEPA), as amended (42 U.S.C. §4321), and NRC staff guidance in NUREG–1748, "Environmental Review Guidance for Licensing Actions Associated with NMSS Programs." The NRC staff reviewed previous EAs and environmental impact statements (EISs) prepared for the initial licensing of the Crow Butte facility and its first license renewal; consulted with other federal agencies, federally recognized Indian tribes, and state and local government agencies; conducted site visits; and reviewed responses to NRC requests for additional information.

Generally, in its NEPA evaluations, the NRC staff categorizes the potential environmental impacts of a proposed action as follows:

> SMALL—environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.
>
> MODERATE—environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.
>
> LARGE—environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

The NRC staff finds that the impacts from the proposed action would be small for all environmental resource areas. In addition, the NRC staff concludes that there would be no disproportionately high and adverse impacts to minority and low-income populations and that federally listed threatened and endangered species would not be affected by the continued operation of the Crow Butte facility during the proposed license renewal period.

The NRC staff also evaluated the potential environmental impacts from decommissioning, taking into consideration an additional 10 years of Crow Butte operation. Additionally, this EA analyzes cumulative impacts from past, present, and reasonably foreseeable future actions when combined with the environmental impacts from the proposed action.

Based on its review of the proposed action relative to the requirements set forth in 10 CFR Part 51, the NRC staff has determined that renewal of NRC license SUA-1534, which would authorize continued operation of the Crow Butte facility in Crawford, Nebraska for a period of up to 10 years will not significantly affect the quality of the human environment. Therefore, based on this assessment, an EIS is not warranted, and pursuant to 10 CFR Part 51.31, a Finding of No Significant Impact (FONSI) is appropriate. The NRC's final determination will be published in the *Federal Register*.

LIST OF ACRONYMS

ACHP	Advisory Council on Historic Preservation
ADAMS	Agencywide Document Access and Management System
AEA	Atomic Energy Act
ALARA	As low as reasonably achievable
Amsl	Above mean sea level
BLM	Bureau of Land Management
BPT	Best Practicable Technology
bgs	Below ground surface
BNSF	Burlington Northern Santa Fe
BMP	Best Management Practice
CAD	Computer Aided Design
CBR	Crow Butte Resources, Inc.
CDP	Census Designated Places
CFR	Code of Federal Regulations
CSA	Commercial Study Area
cfs	Cubic feet per second
cm	Centimeter
cm/sec	Centimeter per second
CESQG	Conditionally Exempt Small Quantity Generator
CO 2	Carbon Dioxide
DAC	Derived Air Concentration
DLG	Digital line graphic
DEM	Digital elevation model
dBA	A-weighted decibel
DOT	Department of Transportation
DQO	Data Quality Objective
ER	Environmental Report
EA	Environmental Assessment
USEPA	Environmental Protection Agency
EHSMS	Environmental, Health, and Safety Management System
ESRI	Environmental System Research Institute
EDR	Electro Dialysis Reversal
FEMA	Federal Emergency Management Act
FWS	U.S. Fish and Wildlife Service
GNIS	Geographical Names Information System
gpm	Gallons per minute
gpd	Gallons per day
gpdpp	Gallons per day per person
GIS	Geographic Information System
GPS	Geographic Positioning System
HP	Horse Power
HPRCC	High Plains Regional Climatic Center
HSMS	Health and Safety Management Systems in Inch
ISL	In situ leach

LIST OF ACRONYMS (continued)

km	Kilometer
LRA	License Renewal Application
mg/L	Milligrams per liter
m/s	Meters per second
mph	Miles per hour
MARLAP	Multi-Agency Radiological Laboratory Analytical Protocols Manual
MCL	Maximum contaminant level
MeV	Mega electronvolt
MIT	Mechanical integrity test
mREM	Miliroentgen equivalent, man
msl	Mean sea level
MWL	Maximum working levels
NUREG-1569	Standard Review Plan for In Situ Leach Uranium Extraction License Application
NGS	National Geodetic Survey
NDEQ	Nebraska Department of Environmental Quality
NDNR	Nebraska Department of Natural Resources
NRCS	Natural Resources Conservation Service
NASS	National Agricultural Statistics Service
NDED	Nebraska Department of Economic Development
NGPC	Nebraska Game and Parks Commission
NOU	Nebraska Ornithologists' Union's
NOAA	National Oceanic Atmospheric Association
NAAQS	National Ambient Air Quality Standards
NPDES	National Pollutant Discharge Elimination System
NRHP	National Register of Historic Places
NOI	Notice of Intent
pCi/g	Pico curies per gram
ppe	Personal protective equipment
ppm	Parts per million
PVC	Polyvinyl chloride
QA/QC	Quality Assurance/Quality Control
QAM	Quality Assurance Manual
R&D	Research and development
REM	Roentgen equivalent, man
RMP	Risk Management Program
RO	Reverse osmosis
ROI	Radius of Influence
RWP	Radiation Work Permit
RCRA	Resource Conservation and Recovery Act
SH	State Highway
SHPO	State Historic Preservation Office
SOP	Standard Operating Practice
SPCC	Spill Prevention, Control, and Countermeasure
SWPPP	Stormwater Pollution Prevention Plan
S.U.	Standard units

LIST OF ACRONYMS (continued)

SERP	Safety and Environmental Review Panel
SRWP	Standing radiation work permits
TDS	Total Dissolved Solids
TEDE	Total Effective Dose Equivalent
TR	Technical report
TSP	Total suspended particulates
U_3O_8	Triuranium octoxide
UIC	Underground injection control
USCB	United States Census Bureau
USEPA	United States National Environmental Policy Act
USGS	United States Geologic Survey
USDA	United States Department of Agriculture
USNRC	United States Nuclear Regulatory Commission
USFWS	United States Fish and Wildlife Service
UCL	Upper Control Limits
USDW	Underground source of drinking water
ng/m^3	Micrograms per cubic meter
VRM	Visual Resource Management
WFC	Wyoming Fuel Company
ww	Water well
WL	Working Levels

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1 INTRODUCTION

1.1 Background

The Crow Butte Resources, Inc. (CBR) commercial in situ recovery (ISR) uranium milling facility is located approximately 4 miles southeast of the city of Crawford, Nebraska in Dawes County. The CBR facility includes an in situ leach (ISL) central processing plant (CPP), which contains the entire ISL circuit. Under Source Materials License SUA-1534, CBR is authorized, through its ISL process, to produce up to 2 million pounds per year of yellowcake. CBR's current annual production is less than half of this limit. SUA-1534 permits CBR to conduct ISR operations only at the current licensed site.

The CBR facility was originally developed by Wyoming Fuel Corporation, which constructed a 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 Crow Butte Resources, Inc. CBR is the current owner and operator of the CBR facility. The original facility was located in the N1/2SE1/4 of Section 19, Township 31 North, Range 51 West, Dawes County, Nebraska. Operations at this facility were initiated in July 1986, and milling took place in two wellfields (WF-1 and WF-2). Milling 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. CBR has operated the current production area since commercial operations began in 1991. (CBR, 2007A)

1.2 Purpose and Need for the Proposed Action

The purpose and need for the proposed action (issuance of a renewed license) are to provide an option that allows for continued operation of in situ uranium recovery milling operations of the CBR facility under Source Materials License SUA-1534.

1.3 Description of the Proposed Action

CBR is proposing to renew current license SUA-1534 for its ISL uranium milling facility, which is situated approximately 4 miles southeast of the City of Crawford in Dawes County in Nebraska.

The CBR facility contains a licensed area of approximately 3,300 acres, of which approximately 1,100 acres are used for ISR operations. CBR has already obtained surface and mineral leases from the appropriate landowners, and these leases will continue through the proposed license renewal timeframe. Aquifer restoration and reclamation will be performed concurrent with operations, with an additional five years at the end of the project for final decommissioning activities and surface reclamation. The current CBR operation recovers uranium from the Basal Chadron Sandstone. The plant equipment would continue to include the following systems:

- Ion exchange;
- Filtration;
- Resin transfer; and
- Chemical addition.

(CBR, 2007A)

The ISL process consists of an oxidation step and a mobilization step. The oxidants utilized in the facility are hydrogen peroxide and/or gaseous oxygen. A sodium bicarbonate lixiviant is used for the dissolution step. These solutions are delivered to the uranium-bearing formation through a central injection well. The uranium-bearing solution resulting from the leaching of uranium underground is recovered by surrounding extraction wells in the well field and piped to the satellite facility for uranium capture via ion exchange resin. After the capture, the following steps are taken to remove the uranium from the facility and restore the mine field:

- Loading of uranium complexes onto an ion exchange resin;
- Reconstitution of the solution by the addition of sodium bicarbonate and oxygen;
- Shipment of loaded ion exchange resin from the mine field to the central processing plant; and
- Restoration of ground water following extraction activities.

1.4 Scope of Review

The NRC staff has reviewed CBR's request in accordance with the NRC's environmental protection regulations in 10 CFR Part 51. Those regulations implement Section 102(2) of the National Environmental Policy Act of 1969, as amended (NEPA). This EA provides the results of the NRC staff's environmental review. The NRC staff's radiation safety review of CBR's request was documented separately in a Safety Evaluation Report (SER) (NRC 2014).

The NRC staff has prepared this EA in accordance with NRC requirements in 10 CFR 51.21 and 51.30, and with the associated guidance in NRC report NUREG-1748, "Environmental Review Guidance for Licensing Actions Associated with Nuclear Material Safety and Safeguards Programs" (NRC, 2003). In 40 CFR Part 1508.9, the Council on Environmental Quality defines an EA as a concise public document that briefly provides sufficient evidence and analysis for determining whether to prepare an EIS or FONSI.

The NRC staff reviewed and considered the following documents in the development of this EA:

- CBR license renewal application dated November 27, 2007;
- CBR responses to NRC environmental RAIs;
- Previous NRC environmental and safety review documents for the CBR site; and
- NRC's consultation with Indian Tribes, and state and local government agencies under Section 106 of the National Historic Preservation Act (NHPA).
- NRC's consultation with the U.S. Fish and Wildlife Service (FWS) under Section 7 of the Endangered Species Act (ESA).

In addition, the development of this EA was closely coordinated with the SER development. Additional references may be found in Section 8.0 of this EA.

This EA documents the NRC staff's review and evaluation of the potential environmental impacts of the proposed license renewal as well as the no action alternative. The NRC staff is focusing on new and significant information, including changes as a result of the proposed action, changes in the affected environment, and the operating history.

1.5 Alternatives to the Proposed Action

1.5.1 No-Action Alternative

The no-action alternative would consist of denial of CBR's request to renew the license. Decommissioning of the CBR facility would commence upon NRC approval of the final decommissioning plan in accordance with 10 CFR Part 40.42. NRC approval of a final decommissioning plan would constitute a federal action under NEPA and would be subject to a site-specific environmental review. Potential environmental impacts associated with decommissioning the CBR facility would be similar to those described for decommissioning following the proposed action in Chapter 4 of this EA.

Additionally, the no-action alternative would have a negative impact on current and future satellite facility applications by CBR Inc. If the renewal of the CBR facility were not approved, the satellite expansions would be impacted because these proposed facilities plan on using the central processing plant and building offices currently located at the CBR facility.

1.5.2 Alternatives Considered But Eliminated

Underground and open pit mining coupled with conventional milling represent the currently available alternatives to ISR of uranium deposits in the project area. These alternative methods are not economically feasible at this time for several reasons, including the spatial characteristics of the mineral deposit along with associated 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. In addition, the physical characteristics of the deposit and the overlying materials make underground mining unfeasible for CBR. The costs of mill 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 processes involved with such methods) involve higher risks to employees, the public, and the environment. Regarding these two alternative methods, radiological exposure to the personnel involved would be increased, not only from the mining processes, but also from the resultant mill tailings. Moreover, the personnel injury rate is generally much higher in open pit and underground mills than has been experienced at ISR solution extraction operations. Finally, conventional milling (associated with both alternative mining methods) leaves a permanent tailings impoundment that would likely need to be inspected and maintained by a State or Federal government agency.

2 DESCRIPTION OF SITE AND ACTIVITIES

2.1 Site Description

The location of the Crow Butte License Area (License Area) is in portions of Sections 11, 12, 13, and 24 of Township 31 North, Range 52 West and Sections 18, 19, 20, 29, and 30 of Township 31 North, Range 51 West, Dawes County, Nebraska (Figure 1.3-1). The plant site is situated approximately 4.0 miles southeast of the City of Crawford. The wellfields are located within the License Area as shown in Figure 1.3-2. The process plant is located in Section 19, Township 31 North, Range 51 West, Dawes County, Nebraska. This original CBR facility occupies approximately 3,300 acres, and the surface area affected over the estimated life of the project is approximately 1,100 acres. Approximately 100 percent of the minerals leased in the currently licensed area are on private lands. Surface landownership includes federal (4 percent of the total), state/local government (9 percent of the total), and private ownership (89 percent of the total). Figure 1 is a map of the CBR facility and surrounding area; Figure 2 is a detailed map of the current CBR facility and associated mine units; and Figure 3 shows the CBR facility in relationship to the town of Crawford, NE. (CBR, 2007A)

The current Crow Butte ISR facility is capable of processing in excess of 9,000 gallons per minute (gpm) of leach solution. The original permit was for 5,000 gpm and was increased to 9,000 gpm via amendment 22. The flow does not include the restoration flow, which is covered under another permit. The current facilities use a number of cooperating operations to recover uranium from the recovered leach solutions. These unit operations consist of:

- Ion exchange;
- Uranium elution;
- Uranium precipitation;
- Uranium dewatering; and
- Uranium drying and packaging.

(CBR, 2007A)

The applicant estimates that by the end of 2014, production in the current CBR facility would begin to decrease dramatically and restoration and reclamation activities would become the primary activities. At the time that commercially-recoverable resources are 100 percent depleted in the current CBR facility (exact timeframe of this is unknown at this time) all activities at the Crow Butte site that are not associated with ground water restoration and decommissioning will be completed.

2.1.1 Current Facility Use

Operations at the current facility are allowed under NRC Source Materials License SUA-1534. A research and development (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 to be affected by the facility, if relicensed, will be approximately 1,100 acres. Facilities include the R&D facility, the commercial process facility and office building, evaporation ponds, parking, access roads and well fields. In the current license area, uranium is recovered by ISR from the Chadron Sandstone at a depth that varies from 400 feet to 800 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 percent U_3O_8. Production is currently in progress in Mine Units 6 through 10. Ground water restoration has been completed and received NRC approval in Mine Unit 1. Ground water restoration is currently underway in Mine Units 2 through 5. The current extraction plant is operating with a licensed flow rate of 9,000 gpm. Maximum allowable throughput for the currently licensed facility, under SUA-1534, is currently 2,000,000 pounds of U_3O_8 per year. (CBR, 2007A)

The central plant at the currently licensed facility is permitted to have a process flow rate of 9,000 gallons per minute (gpm), excluding restoration flow, under SUA- 1534. Total annual production is limited to 2 million pounds of yellowcake. The uranium-bearing solution extracted from the subsurface mine units is transported via pipeline to the central plant for elution, drying, and packaging. This cycle will continue until the ore zone is depleted or leach of the uranium is no longer economically viable. (CBR, 2007A)

2.1.2 Proposed Operating Schedule

Based on current plans, milling schedules, and reserve estimates, CBR could continue production at the present annual levels of approximately 800,000 pounds U_3O_8 until approximately the end of 2014, although the exact date is to be determined. At that time, the reserves would begin to deplete. Once depleted, ground water restoration, surface reclamation, and decommissioning would become the primary activities. Completion of ground water restoration in the currently licensed area is scheduled for 2023. Operations in the processing unit at the CBR facility would continue so that the expansion areas can process their uranium.

Projected production and restoration schedules for the current production area are shown as well as status of the current mine unit operations is shown in Table 1-1. The layout of the current and planned mine units in the licensed area is shown in Figure 3.

2.1.3 Lixiviant Chemistry

CBR will utilize a sodium bicarbonate lixiviant that is an alkaline solution. Where the ground water contains carbonate, as it does at the CBR facility, an alkaline lixiviant will mobilize fewer hazardous elements from the ore body and will require less chemical addition than an acidic lixiviant. Also, sodium bicarbonate has proven highly successful on the CBR R&D project and on commercial extraction operations to date.

2.1.4 In Situ Uranium Recovery Process

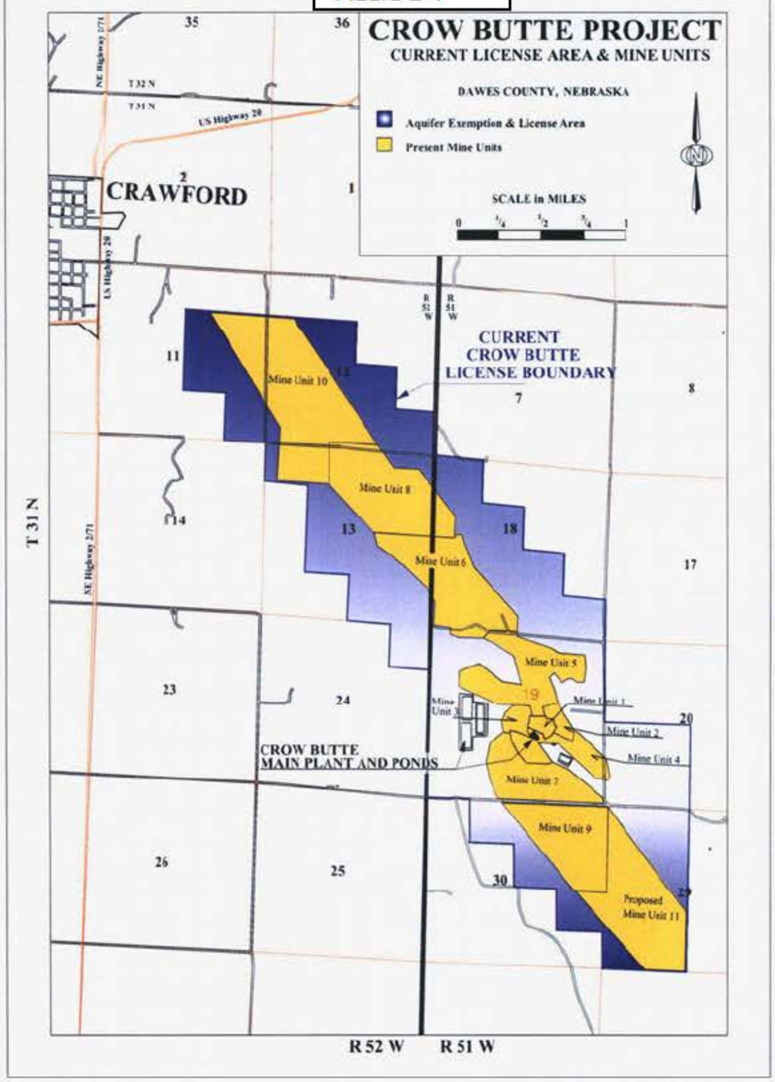
Production of uranium by ISR techniques involves an extraction step and a uranium recovery step. Extraction is accomplished by installing a series of injection wells through which the barren lixiviant is pumped into the ore body. Corresponding production wells and pumps promote flow through the ore body and allow for the collection of uranium-rich pregnant lixiviant. Uranium is removed from the leach solution by ion exchange, and then from the ion exchange resin by elution.

The leach solution can then be reused for milling purposes. The elution liquid containing the uranium (the "pregnant" eluant) is then processed by precipitation, dewatering, and drying to produce a transportable form of uranium. (Crow Butte Resources 2007a)

Table 2-1: Current Crow Butte Production Area Mine Unit Status

Mine Unit	Production Initiated	Current Status
Mine Unit 1	April1991	Ground water restored; Reclamation Underway
Mine Unit 2	March 1992	Ground water restoration
Mine Unit 3	January 1993	Ground water restoration
Mine Unit 4	March 1994	Ground water restoration
Mine Unit 5	January 1996	Ground water 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	2013	Production

Figure 2-1



Source: CBR, 2007A

2.2 Waste Generation, Management, and Disposal

2.2.1 Waste Management – Airborne

The only radioactive airborne effluent at the Crow Butte Project is radon-222 gas. As yellowcake drying and packaging are carried out using a vacuum dryer, there are no airborne effluents from that system. The radon-222 is contained in the pregnant lixiviant that comes from the wellfield to the process plant. The majority of this radon is released in the ion exchange columns and process tanks. These vessels are covered and vented to a manifold, which are in turn exhausted to atmosphere outside the building through stacks. The manifolds are equipped with an exhausting fan. (CBR, 2007A)

One stationary sample point would be established near the resin transfer station and would be sampled monthly for potential airborne uranium particulates. Radon-222 is found in the pregnant lixiviant that comes from the well field into the satellite facility for separation of uranium. The uranium will be separated from the ground water by passing the solution through fixed bed ion exchange (IX) units operated in a pressurized down flow mode. Vessel vents from the individual IX vessels will be directed to a manifold that is exhausted to atmosphere outside the satellite building. Venting any released radon-222 gas to the atmosphere outside the plant via high-volume exhaust fans minimizes employee exposure. Small amounts of radon-222 may be released via solution sampling and spills, filter changes, IX resin transfer, reverse osmosis (RO) system operation during ground water restoration, and maintenance activities. These are minimal radon gas releases on an infrequent basis. (CBR, 2007A)

There could also be maintenance activities on piping containing pregnant lixiviant that could result in release of radon and uranium. Any spills or releases during maintenance of these potential sources would be cleaned up promptly to avoid drying of the material and creation of particulates subject to dispersion. All non-routine operations or maintenance activities where the potential exists for significant exposure to radioactive materials and for which no Standard Operating Procedure (SOP) exists require a Radiation Work Permit (RWP). The RWP ensures that the applicable radiological safety measures are used by the workers and identifies the type of personnel monitoring that would be required for determining radiation exposure (i.e., internal and external radiation). (CBR, 2007A)

The general building ventilation system further reduces employee exposure. The air in the plant is sampled for radon daughters to assure that concentration levels of radon and radon daughters are maintained as low as reasonably achievable (ALARA). Injection wells would generally be closed and pressurized, but periodically vented releasing radon to the atmosphere. Production wells will be continually vented to the surface, but water levels will typically be low and radon venting will be minimal. Some venting would also occur from the meter houses. All of the well releases would be outside of buildings and directly vented to the atmosphere. Well houses would be vented so as to remove any radon releases from the building to the surrounding atmosphere. Any releases to the atmosphere from wells and well houses would result in radon emissions dispersing rapidly. Well field off gassing is not considered a significant source of radon or a safety issue. (CBR, 2007A)

2.2.2 Waste Management – Liquid

There are currently three permitted wastewater disposal options for the CBR facility: evaporation in solar evaporation ponds, deep well injection, and land application. The specific method utilized depends upon the volume and characterization of the waste stream. The operation of the process facility results in three sources of liquid effluent that are collected on the site. They include the following:

- Water generated during well development - This water is recovered ground water that has not been exposed to any ISR process or chemicals. The water is discharged directly to one of the solar evaporation ponds and silt, fines and other natural suspended matter collected during well development is settled out. This water may be used in plant processing, disposed of in a deep disposal well, or land applied following treatment.
- Liquid process waste - The operation of the process plant results in two primary sources of liquid waste, an eluant bleed and a production bleed. This water is also routed to the evaporation ponds or injected into the deep disposal well.
- Aquifer restoration - Following ISR operations, restoration of the affected aquifer commences which results in the production of wastewater. The restoration waste is primarily brine from the reverse osmosis unit, and sent to the waste disposal system. After the water leaves the waste disposal system, the water is either reinjected into the wellfield or sent to the waste disposal system.

(CBR, 2007A)

2.2.2.1 Liquid Waste Management - Deep Disposal Well

CBR operates a non-hazardous Class I injection well in the current license area for disposal of wastewater. The well is permitted under Nebraska Department of Environmental Quality (NDEQ) regulations in Title 122 and operated under a Class I UIC Permit. (CBR, 2007A)

2.2.2.2 Liquid Waste Management - Evaporation Pond

CBR maintains three commercial and two R&D evaporation ponds in the current license area. The ponds are constructed with a primary and secondary liner system. An under-drain system consisting of perforated piping between the primary and secondary liners is installed to monitor for leaks. The under-drain slopes gradually to the ends of the ponds where they are connected to a surface monitor pipe. (CBR, 2007A)

2.2.3 Waste Management – Solid

2.2.3.1 Waste Management – Contaminated Solid Waste

Solid wastes generated at the site consist of spent resin, resin fines, filters, empty reagent containers, miscellaneous pipe and fittings, and domestic waste. These wastes are classified as contaminated or non-contaminated waste according to their radiological survey results. Contaminated byproduct waste that cannot be decontaminated is packaged and stored until it can be shipped to a licensed waste disposal site or licensed mill tailings facility. Non-contaminated solid waste is collected at the site on a regular basis and disposed of in a sanitary landfill permitted by the NDEQ. Domestic waste is disposed of in an approved septic system. (CBR, 2007A)

The contaminated soil waste materials are stored onsite 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 licensed facility as License Condition 9.7 in 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 are made prior to releasing the material. The release limits for decontamination are discussed in more detail in the SER (NRC 2014). An area is maintained inside the restricted area boundary for storage of contaminated materials prior to their disposal. (CBR, 2007A)

2.2.3.2 Waste Management – Non-Contaminated Solid Waste

Non-contaminated solid waste is collected on the site in designated areas and disposed of in the nearest permitted sanitary landfill. (CBR, 2007A)

2.2.3.3 Waste Management – Hazardous Waste

CBR recently estimated that the current operation generates approximately 1,325 liters of waste oil per year. Waste oil is disposed by taking the oil to a recycling facility. (CBR, 2007A)

2.3 Restoration, Reclamation and Decommissioning

2.3.1 Aquifer Restoration

The current ground water restoration plan for the CBR facility mine units consists of four activities:

- Ground water transfer;
- Ground water sweep;
- Ground water treatment; and
- Well field circulation.

Ground water transfer is the process of transferring ground water from the underground aquifer to the wellhouses. During ground water sweep, water is extracted from the production zone with the injection system shutdown. This causes an influx of baseline quality water to sweep the affected extraction area. The extracted water must be sent to the wastewater disposal system during this activity. Ground water treatment activities involve the use of process equipment to lower the ion concentration of the ground water in the extraction area. A RO unit is used to reduce the total dissolved solids of the ground water. The RO unit produces clean water (permeate) and brine. The permeate is injected into the formation, reused in the process, or disposed of in the waste disposal system. Well field circulation is the process of returning the ground water back into the aquifers. (CBR, 2007A)

2.3.2 Land Reclamation

The principal objective of the surface reclamation plan is to return disturbed lands to the pre-extraction condition. Soils, vegetation, wildlife and radiological baseline data will be used as guidelines for the design, completion, and evaluation of surface reclamation. Final surface reclamation will blend affected areas with adjacent undisturbed lands so as to re-establish original slope and topography and present a natural appearance. Surface reclamation efforts will strive to limit soil erosion by wind and water, sedimentation, and re-establish natural trough drainage patterns. (CBR, 2007A)

In accordance with NDEQ requirements, topsoil is salvaged from building sites (including satellite buildings) and pond areas. Conventional rubber-tired, scraper-type earth moving equipment is typically used to accomplish such topsoil salvage operations. The exact location of topsoil salvage operations is determined by well field pattern emplacement and designated well field access roads within the well fields. Topsoil thickness varies within the CBR facility. Topsoil thickness is usually greatest in and along drainages where material has been deposited and deep soils have developed. Therefore, topsoil stripping depths may vary in depth, depending on location and the type of structure being constructed. Salvaged topsoil is stored in designated topsoil stockpiles. These stockpiles are generally located on the leeward side of hills to minimize wind erosion. Stockpiles are not located in drainage channels. The perimeter of large topsoil stockpiles may be bermed to control sediment runoff. Topsoil stockpiles are seeded as soon as possible after construction with the permanent seed mix. During mud pit excavation associated with well construction, exploration drilling and delineation drilling activities, topsoil is separated from subsoil with a backhoe. When use of the mud pit is complete, all subsoil is replaced and topsoil is applied. Mud pits generally remain open a short time. (CBR, 2007A)

Restoration of the original land surface, which is consistent with the pre- and post-ISR land use, the blending of affected areas with adjacent topography to approximate original contours, and the reestablishment of drainage patterns will be accomplished by returning the earthen materials moved during construction to their approximate original locations. Drainage channels that have been modified by the mill plan for operational purposes such as road crossings, will be re-established by removing fill materials and culverts, and reshaping to as close to pre-operational conditions as practical. Surface drainage of disturbed areas that have been located on terrain with varying degrees of slope will be accomplished by final grading and contouring appropriate to each location so as to allow for controlled surface run off and eliminate depressions where water could accumulate. (CBR, 2007A)

Re-vegetation practices are currently and will continue to be conducted in accordance with NDEQ requirements. During extraction operations the topsoil stockpiles and as much as practical of the disturbed well field and pond areas will be seeded with vegetation to minimize wind and water erosion. After placement of topsoil and contouring for final reclamation, an area will normally be seeded with a native seed mixture developed in consultation with the Natural Resource Conservation Service as required by the NDEQ. (CBR, 2007A)

Following removal of structures, subsoil and stockpiled topsoil will be replaced on the disturbed areas from which they were removed during construction, within practical limits. Areas to be backfilled will be ripped prior to backfilling to create an uneven surface for application of backfill. This process will provide a more cohesive surface to eliminate slipping and slumping. The less suitable subsoil and unsuitable topsoil, if any, will be backfilled first so as to place them in the deepest part of the excavation to be covered with more suitable reclamation materials. Subsoils will be replaced using paddle wheel scrapers, bulldozers or other appropriate equipment to transfer the earth from stockpile locations or areas of use and to spread it evenly on the ripped disturbances. Grader blades may be used to even the spread of backfill materials. Topsoil replacement will commence as soon as practical after a given disturbed surface has been prepared.

Topsoil will be picked up from storage locations by paddle wheel scrapers or other appropriate equipment and distributed evenly over the disturbed areas. The final grading of topsoil materials will be done so as to establish adequate drainage and the final prepared surface will be left in a roughened condition. (CBR, 2007A)

2.4 Evaporation Pond Decommissioning

2.4.1 Disposal of Pond Water

After restoration, the remaining water in the evaporation ponds which may have chemical and radiological characteristics, will be considered to determine the most practical disposal program. Disposal options for the pond liquid include evaporation, treatment and disposal, or transportation to another licensed facility or disposal site. The pond water from the later stages of ground water restoration may be treatable to within discharge limits under a National Pollutant Discharge Elimination System (NPDES) permit. Evaporation of the remaining water may be enhanced by use of non-potable water techniques such as sprinkler systems. Land application after wet weather events will not be utilized by CBR since it is not included in the current NPDES permit No. NE0130613 from the State of Nebraska. CBR has also stated that there are no current plans for treating and discharging the pond water under an NPDES permit. (CBR, 2007A)

If there is any land application activity associated with the disposal of the pond water that is not included in CBR's NPDES permit No. NE0130613, CBR will be required to apply for additional permits from the State of Nebraska.

2.4.2 Pond Sludge and Sediments

Pond sludge and sediments will contain milling process chemicals and radionuclides. Wind blown sand grains and dust blown into the ponds during their active life also add to the bulk of sludge. This material will be contained within the pond bottom and kept in a dampened condition at all times, especially during handling and removal operation, to prevent the spread of airborne contamination and potential worker exposure through inhalation. Dust abatement techniques will be used as necessary. The sludge will be removed from the ponds and loaded into roll off containers, dump trucks, or drums and transported to a 11e.(2) NRC-licensed disposal facility. (CBR, 2007A)

If there is any land application activity associated with the disposal of the pond water that is not included in Crow Butte's NPDES permit No. NE0130613, CBR will be required to apply for additional permits from the State of Nebraska.

2.4.3 Disposal of Pond Liners and Leak Detection Systems

Pond liners will be kept washed down and intact as much as practical during sludge removal to confine sludge and sediments to the pond bottom. Pond liners will be cut into strips and transported to an NRC-licensed disposal facility or will be decontaminated for release and disposed in other facilities. After removal of the pond liners, the pond leak detection system piping will be removed. Materials involved in the leak detection system will be surveyed and released for unrestricted use if not contaminated or transported to an NRC-licensed facility for disposal. The earthen material in the pond bottom and leak detection system trenches will be surveyed for soil contamination. Any soil contaminated in excess of either State of Nebraska regulations or NRC regulations will be removed and disposed of at an NRC-licensed disposal facility (NRC 2014). Following the removal of all pond materials and the disposal of any contaminated soils, surface preparation will take place prior to reclamation. (CBR, 2007A)

If there is any land application activity associated with the disposal of the pond water that is not included in Crow Butte's NPDES permit No. NE0130613, CBR will be required to apply for additional permits from the State of Nebraska

2.5 Well Field Decommissioning

Surface reclamation in the well field production units will vary in accordance with the development sequence and the milling/reclamation timetable. Final surface reclamation of each well field production unit will be completed after approval of ground water restoration stability and the completion of well abandonment activities discussed below. Surface preparation will be accomplished as needed so as to blend any disturbed areas into the contour of the surrounding landscape.

The first step of the well field decommissioning process will involve the removal of surface equipment. Surface equipment primarily consists of the injection and production feed lines, header houses, electrical and control distribution systems, well boxes, and wellhead equipment. Wellhead equipment such as valves, meters, or control fixtures will be salvaged.

Next, wells will be plugged and abandoned according to the procedures described below. The well field area may be re-contoured, if necessary, and a final radiological survey conducted over the entire well field area to identify any contaminated earthen materials requiring removal to disposal. Final re-vegetation of the well field areas will be conducted according to the re-vegetation plan. All piping, equipment, buildings, and wellhead equipment will be surveyed for contamination, prior to release, in accordance with the NRC guidelines. As discussed in the Liquid Waste Management section of this EA, other materials that are contaminated will be acid washed or decontaminated with other methods until they are releasable. If the equipment cannot be decontaminated to meet release limits, it will be disposed of at an NRC-licensed disposal facility.

Well field decommissioning will be an independent ongoing operation throughout the extraction phases. Once a production unit has been completely extracted and ground water restoration and stability have been accepted by the NRC and other State regulatory agencies, the well field will be scheduled for decommissioning and surface reclamation. (CBR, 2007A)

2.5.1 Well Plugging and Abandonment

All wells not used for milling or restoration operations will be abandoned. These include all injection and production wells, monitoring wells, and any other wells within the production unit used for the collection of hydrologic or water quality data or incidental monitoring purposes. CBR will attempt to seal and abandon all wells in such a manner as to assure the ground water supply is protected and to eliminate any potential physical hazard. Records of abandoned wells will be tabulated and reported by CBR after decommissioning. CBR must submit a notarized affidavit to the NDEQ detailing the significant data and the procedure used in connection with each well plugged. The Nebraska Department of Natural Resources (DNR) also requires filing a well abandonment notice for all registered wells.

2.5.2 Buried Trunk-lines, Pipes and Equipment

Buried process-related piping, such as injection and production lines, will be removed from the well field during decommissioning. Salvageable lines will be held for reuse in ongoing ISR operations at the CBR facility or for potential ISR operation at satellite facilities. Lines that are not reusable will be surveyed and disposed of in an unrestricted area if suitable or disposed of at a licensed disposal site.

2.6 Removal and Disposal of Structures, Waste Materials, and Equipment

2.6.1 Preliminary Radiological Surveys and Contamination Control

Prior to process plant decommissioning, a preliminary radiological survey will be conducted to characterize the levels of contamination on structures and equipment and to identify any potential hazards. The survey will support the development of procedures for dealing with such hazards prior to commencement of decommissioning activities, as well as after decommissioning. Chapter 3 of the SER provides more detail on the control program (NRC 2014).

Based on the results of the preliminary radiological surveys, gross decontamination techniques will be employed to remove loose contamination before decommissioning activities proceed. This gross decontamination will generally consist of washing all accessible surfaces with high-pressure water. In areas where contamination is not readily removed by high-pressure water, a decontamination solution (e.g., dilute acid) may be used. (CBR, 2007A)

2.6.2 Removal of Process Buildings and Equipment

The majority of the process equipment in the process building will be reusable, as well as the building itself. All process or potentially contaminated equipment and materials at the process facility including tanks, filters, pumps, piping, etc., will be inventoried, listed, and designated for one of the following removal alternatives:

- Removal to a new location within the Crow Butte site for further use or storage;
- Removal to another licensed facility for either use or permanent disposal; or
- Decontamination to meet unrestricted use criteria for release, sale, or other non-restricted use by others.

It is most likely that process buildings will be decontaminated, dismantled and released for use at another location. If decontamination efforts are unsuccessful, the material will be sent to a licensed disposal facility. Concrete foundation pads and footings will be broken up and trucked to a disposal site or licensed disposal facility if contaminated.

If a piece of equipment or structure is to be released for unrestricted use, it will be appropriately surveyed before leaving the licensed area. Both interior and exterior surfaces will be surveyed to detect potential contamination. If the shape, size, or presence of inaccessible surfaces prevents an accurate and representative survey, the material will be assumed contaminated and properly disposed of. Appropriate decontamination procedures will be used to clean any contaminated areas and the equipment resurveyed and documentation of the final survey retained to show that unrestricted use criteria were met prior to releasing the equipment or materials from the site. The current release criteria are based on NRC requirements and guidelines detailed in the SER. The criteria to be used for release to unrestricted use is also detailed in the SER. (NRC 2014)

If a process building is left onsite for unrestricted use by a landowner, the following basic decontamination procedures will be used:

- After the building has been emptied, the interior floors, ceiling and walls of the building and exterior surfaces at vent and stack locations will be checked for contamination. Any remaining removable contamination will be removed by washing. Areas where contamination is noted will be resurveyed to ensure removal of all contamination to appropriate levels. Chapter 5 of the SER discusses in detail the appropriate levels of contamination. (CBR, 2007A; NRC 2014)
- Process floor sump and drains will be washed out and decontaminated using water and, if necessary, acid solutions. If the appropriate decontamination levels cannot be achieved, it may be necessary to remove portions of the sump and floor to disposal. The appropriate decontamination levels are further discussed in Chapter 5 of the SER (NRC 2014).
- Excavations necessary to remove trunk-lines or drains will be surveyed for contaminated earthen material. Earthen material that is found to be contaminated will be removed to a licensed disposal facility prior to backfilling the excavated areas.
- The parking and storage areas around the building will be surveyed for surface contamination after all equipment has been removed.

Actual corrective procedures will be determined by field requirements, as defined by radiological surveys. (CBR, 2007A)

2.6.3 Waste Transportation and Disposal

Materials, equipment, and structures that cannot be decontaminated to meet the appropriate release criteria will be disposed of at a disposal site licensed to receive 11e.(2) byproduct material. CBR currently maintains agreements with two such facilities located in the states of Utah and Wyoming for disposal of 11e.(2) byproduct materials generated by milling operations. A contract for disposal at a minimum of one facility will be maintained current as required in SUA-1534. Transportation of all contaminated waste materials and equipment from the site to the approved licensed disposal facility or other licensed sites will be handled in accordance with the Department of Transportation (DOT) Hazardous Materials Regulations (49 CFR Part 172) and the NRC transportation regulations (10 CFR Part 71).

3 AFFECTED ENVIRONMENT

3.1 Land Use

The CBR site is located northwest of the Pine Ridge area in west central Dawes County, Nebraska. The CBR facility is approximately 4 miles southeast of the City of Crawford on Squaw Creek Road. State Highway 2/71 provides access to the CBR facility from points north and south of Crawford. U.S. Highway 20 provides access to Crawford and the CBR facility from points east and west.

3.1.1 Current License Area

Pastureland comprises the greatest portion of land use at 43 percent of the total within the CBR area and is primarily used for the production of hay. Cropland at 29 percent is the second largest land use and is primarily used for the production of wheat. Additionally, a small amount of cropland is used for producing alfalfa. In 2003, the total wheat production in Dawes County was 1,836,500 bushels. Forest land at 12 percent and wildlife habitat at 15 percent make up the other significant land uses areas. Forest land and wildlife habitats are discussed in section 3.5, Ecological Resources. (CBR, 2007A)

Rangeland accounts for approximately 4 percent of the total land acreage within the CBR facility. In 2006, an average of 52,000 head of livestock was reported in Dawes County (NASS 2007a). Native grasslands are used for grazing or for cut hay. Livestock values have remained consistent. In 2001, cash receipts for livestock and products totaled $21.0 million in Dawes County. Residential and industrial land uses in the county are concentrated within the city limits of Crawford and Chadron. Industrial land uses are located within the city limits of Crawford, and occur primarily around railroad facilities. (CBR, 2007A)

Figure 3-1 below is a map of the current land use areas at the CBR site. Table 3-1 below gives the definitions of the different types of land uses found.

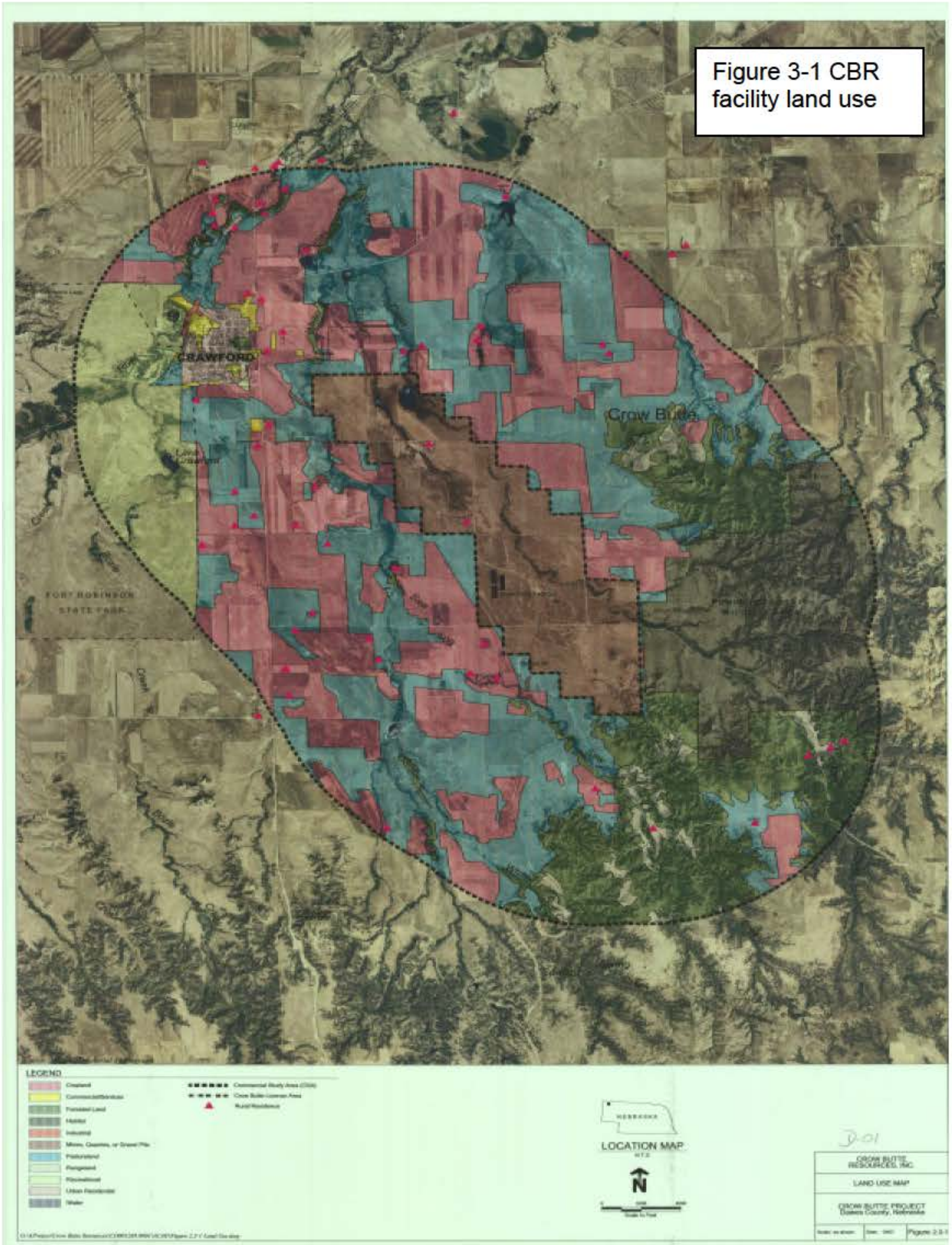


Figure 3-1 CBR facility land use

Source: CBR, 2007A

Table 3-1: Land Use Definitions

Land Use	Definition
Croplands (C)	Harvested cropland, including grasslands cut for hay, cultivated summer-fallow, and idle cropland.
Commercial and Services (C/S)	Those areas that are used predominantly for the sale of products and services. Institutional land uses, such as various educational, religious, health, and military facilities, are also components of this category.
Forested Land (F)	Areas with a tree-crown density of 10 percent or more are stocked with trees capable of producing timber or other wood products and exert an influence on the climate or water regime. This category does not indicate economic use.
Habitat (H)	Land dedicated wholly or partially to the production, protection, or management of species of fish or wildlife.
Industrial (I)	Areas such as rail yards, warehouses, and other facilities used for industrial manufacturing or other industrial purposes.
Mines, Quarries, or Gravel Pits (M)	Those extractive mining activities that have significant surface expression.
Pastureland (P)	Land used primarily for the long-term production of adapted, domesticated forage plants to be grazed by livestock or occasionally cut and cured for livestock feed.
Rangeland (R)	Land, roughly west of the lOOth meridian, where the natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs; which is used wholly or partially for the grazing of livestock. This category includes wooded areas where grasses are established in clearings and beneath the overstory.
Urban Residential (UR)	Residential land uses range from high-density, represented by multi-family units, to low-density, where houses are on lots of more than 1 acre. These areas are found in and around Crawford and Ft. Robinson. Areas of sparse residential land use, such as farmsteads, will be included in categories to which they are related.
Water(W)	Areas of land mass persistently covered with water.
Recreational (RC)	Land used for public or private leisure, including developed recreational facilities such as parks, camps, and amusement areas: as well as areas for less intensive use such as hiking, canoeing, and other undeveloped recreational uses.

Source: CBR, 2007A

3.1.2 Recreation

Federal and State recreational lands in Dawes County are an important component of the local economy. Fort Robinson State Park, the largest state park in Nebraska, is located within the 3.6-km (2.25-mile) review area. The portions of the park west of Crawford include portions of the Red Cloud Agency Historical Site, the White River Trail, and several scenic landforms in a rugged area of buttes and ponderosa pine forest. Other facilities at the park include lodging, showers, electrical hookups, pit toilets, ski and snowmobile trails, a rodeo arena, and a museum. Visitors to the park may go hunting, fishing, hiking, swimming, or horseback riding. Other recreational facilities in Dawes County include the Ponderosa Wildlife Management Area, Chadron State Park, Soldier Creek Management Unit, and the Red Cloud Picnic Area and associated trails in the Nebraska National Forest (NGPC 2007).

3.1.3 Agriculture

In Dawes County, soils are classified by the U.S. Soil Conservation Service (SCS) as prime farmland only if irrigated. According to 2004 Nebraska State Agricultural Statistics, only two percent of Dawes County agricultural land is irrigated, and about 10 percent of harvested cropland acreage is irrigated. The remainder of the irrigated land is used for pasture, habitat, or rangeland (Nebraska Crop and Livestock Reporting Service, 1980; 1981). Wheat and hay are the major crops grown on croplands within the area. Most of these crops are used for livestock feed while the remaining crops are commercially sold. The livestock inventory for Dawes County indicates that cattle account for more than 80 percent of all livestock.

3.1.4 Habitat

Habitat lands for the purposes of this EA are those dedicated to the production, protection, or management of species of fish or wildlife. The Ponderosa State Wildlife Management Area, which is south and adjacent to the CBR facility (Figure 3-1) is the closest significant habitat land. There is no land within the CBR site that is used for wildlife habitat. Range, forest, and recreational lands within the CBR site show secondary habitat land characteristics. (CBR, 2007A)

3.1.5 Residential

Two dwelling units are within 1 mile, which are the closest dwellings to the CBR facility, and another five dwelling units are within 2 miles of the center point of the CBR facility. According to 1980 USGS 7.5 minute quadrangle maps, on-site field investigations, and USGS aerial photos flown in 2006, there are 73 occupied dwelling units located in the rural area outside of Crawford but within an 8-km (5-mile) radius of the CBR facility (Table 3-2). An additional 997 persons reside in Crawford, approximately 4 miles from the site center point. According to U.S. Census 2010, the average persons per household for Dawes County is 2.87 people). (CBR, 2007A; USCB, 2010)

Table 3-2: Types of residences near the CBR facility

Sector (from the CBR site center	Residences	Nearest Residence (km)	Nearest VegetableGarden (km)	Nearest Project Boundary (km)
North	2	5.7	--	2.4
North-Northeast	1	4.0	--	2.0
Northeast	3	4.3	--	2.5
East-Northeast	6	0.6	0.6	2.1
East	0	--	--	2.1
East-Southeast	5	0.6	--	1.4
Southeast	1	4.5	--	2.9
South-Southeast	1	4.5	--	2.9
South	3	3.8	--	4.0
South-Southwest	2	5.0	--	2.3
Southwest	3	1.6	--	1.5
West-Southwest	3	3.1	--	1.3
West	3	2.5	--	1.3
West-Northwest	27	4.4	--	1.3
Northwest	510	3.1	--	5.4
North-Northwest	10	1.1	1.1	2.4

Source: CBR, 2007A

3.1.6 Commercial and Services

Retail and commercial establishments are located within Crawford and at Fort Robinson State Park. Commercial establishments are also secondary uses of some residential areas in Crawford. The four largest establishments include the Legend Buttes Health Clinic, the Ponderosa Villa Nursing Home, a livestock sale barn, and railroads. The Crawford Cemetery is located approximately 3 miles from the CBR site.

3.1.7 Industrial and Mining

No industrial or mining uses exist within the CBR area. There are six gravel pits within the 8-km (5-mile) radius of the CBR facility (Figure 3-1). Most of the pits are inactive, although a few are mined periodically for local road construction purposes. Crow Butte Resources, Conoco, Amoco Minerals, Sante Fe Mining, and Union Carbide have all drilled exploratory testing holes in Dawes County for a variety of natural resources. Other industrial facilities within the 8-km (5-mile) radius include the railroad station and maintenance yard at the City of Crawford. There are gravel pits on Fort Robinson State Park; however, most are inactive. Several of the pits are mined periodically for local road construction purposes. (CBR, 2007A)

3.2 Transportation

3.2.1 Highways

Nebraska Highway 2/71 and U.S. Highway 20 merge in Crawford. The 2003 average daily traffic counts are 360 vehicles on Nebraska Highway 2/71 and between 1,330 and

1,720 vehicles on U.S. Highway 20 at Crawford south of the CBR facility (CBR, 2007A). County roads throughout the area provide access to residences and agriculture within the CBR facility.

3.2.2 Railroads

The Burlington Northern Santa Fe (BNSF) Railroad along the eastern boundary is used for combining local "pusher" engines with south bound trains to assist them in climbing the Pine Ridge south of Crawford. This rail line rail traffic primarily from the coal mills in northeastern Wyoming. The Dakota, Minnesota and Eastern Railroad runs in a northeasterly direction, and forms a portion of the southeast boundary of the CBR facility. The junction of the two railroads is about 0.50 miles south of the CBR facility. (CBR, 2007A)

3.3 Meteorology, Air Quality and Noise

3.3.1 Meteorology Overview

Data sources for the meteorological conditions used for this EA come from the High Plains Regional Climatic Center (HPRCC) for a site located in Chadron, Nebraska (HPRCC, 2004) and from an on-site monitoring station near the CBR site. The period of record for the HPRCC data covers *56* years of observation between 1948 and 2003. The onsite monitoring data were collected between May 1982 and April 1984, and include temperature, precipitation, evaporation, wind speed, and wind direction. Data are also included from the National Weather Service Stations in Scottsbluff, Nebraska and Rapid City, South Dakota.

The weather patterns for the CBR site are typical of a semi-arid, continental climate. This climate is characterized by warm summers, cold winters, light precipitation, and frequent changes in the weather. The Rocky Mountains, located to the west of the site, and the Black Hills, located to the north, effectively block moisture from these directions, while moisture from the south is directed eastward by a plateau south of the region. As a result of this topography, the project area is generally drier than the rest of the panhandle. The HPRCC data were collected at the Chadron 1 NW site. The monitoring station is 1.4 km (0.9 miles) west northwest of Chadron, 37 km (23 miles) east northeast of Crawford, and 35 km (22 miles) east northeast of the CBR site.

3.3.2 Temperature

Table 3-3 shows the mean daily maximum and minimum temperatures, the mean monthly temperatures, and the temperature extremes. The months of November through March all have mean daily minimum temperatures below freezing, with January as the coldest month. December, January, and February all have monthly mean temperatures below freezing. The warmest months are July and August. The mean yearly temperature is 8.9^0 C. The temperature extremes for the period can exceed 100°F (38°C), and freezing or near-freezing temperatures can occur throughout the year. (CBR, 2007A)

Table 3-3: Local Temperatures

Month	Mean Daily Maximum (°C)	Mean Daily Minimum (°C)	Mean Monthly (°C)	Record High		Record Low	
				(°C)	Year	(°C)	Year
Jan	2.0	-11.8	-4.9	21.1	1989	-33.9	1949
Feb	5.0	-9.2	-2.1	24.4	1982	-32.8	1982
Mar	8.9	-5.4	1.8	28.3	1967	-32.2	1989
Apr	15.1	0.2	7.7	33.9	1989	-23.9	1975
May	20.9	6.3	13.6	36.7	1969	-8.9	1954
June	27.1	11.6	19.3	41.7	1989	-3.3	1969
July	31.8	15.2	23.5	43.3	1954	3.3	1971
Aug	31.3	14.3	22.8	42.2	1980	2.2	1962
Sept	25.3	8.1	16.7	40.0	1978	-8.3	1984
Oct	18.2	1.3	9.7	34.4	1953	-21.7	1991
Nov	8.9	-5.4	1.8	27.2	1999	-27.8	1959
Dec	3.6	-10.1	-3.3	22.2	1980	-40.0	1989
Year	**16.5**	**1.2**	**8.9**	**43.3**	**July-54**	**-40.0**	**Dec-89**

Source: CBR, 2007A

3.3.3 Precipitation

Precipitation in the region is generally light, with the heaviest occurrences in the spring and summer. Table 3-4 lists the monthly precipitation totals for the period of record. May has the heaviest precipitation, with good precipitation occurring through July. The driest months are November through February. The mean yearly precipitation is 40.79 cm (16.06 in). The mean annual snowfall is 107.44 cm (42.30 in). July and August are the only two months without a reported snowfall. The maximum mean monthly snowfall occurred in March. The CBR sites closest weather monitoring station is in Scottsbluff, Nebraska and is 98 km (60.9 mi) south and the site in Rapid City, South Dakota is 158 km (98.2 mi) north. These data indicate that precipitation in excess of 0.03 cm (.01 in) can be expected on an average of 91 and 96 days per year, respectively. (CBR, 2007A)

Table 3-4: Local Precipitation

Month	Water Equivalent		Snow	
	Mean r{cm)	Maximum 24-Hour	Mean (em)	Maximum Monthly
January	1.12	2.7	16.51	88.1
February	1.17	3.8	16.51	59.
March	2.16	3.5	21.84	88.1
April	4.47	6.2	13.21	49.2
May	7.52	6.5	1.5	23.6
June	7.14	5.3	0.0	3.0
July	5.41	5.0	0.0	0.0
August	3.48	4.6	0.0	0.
September	3.66	11.18	0.7	25.
October	2.36	3.8	5.5	28.4
November	1.24	1.7	13.21	42.
December	1.04	1.8	17.78	46.
Year	40.79	11.18	107.44	196.85

Source: CBR, 2007A

3.3.4 Winds

Wind analysis was taken from three locations; the CBR site, the nearby weather station in Scottsbluff, Nebraska, and the weather station in Rapid City, SD. These stations show predominant wind patterns that are similar; however, the finer details are greatly influenced by the local topography. Rapid City has a predominant wind from the north-northwest while Scottsbluff has a slightly bimodal distribution with the predominant winds from the west-northwest and the east-southeast. The least prevalent wind direction at Scottsbluff and Rapid City is from the southwest. The predominant air pollutant dispersion would be towards the north to northeast. The next most common directions would be towards the southwest to south-southwest. Local terrain will have a significant influence on the wind patterns in a given area. Because of this, a meteorological station was installed on the current Crow Butte project site. This station was capable of measuring wind speed, direction, and the standard deviation of the wind direction. Joint frequency data was compiled from this information. The predominant wind direction of the site is from a south-southwest direction approximately 45 percent of the time. Because of the differences among the site, Rapid City, and Scottsbluff, the two-year Crow Butte site wind record is considered the most representative. Precipitation was also recorded at the station with a heated tipping bucket rain gauge. Evaporation was measured using a 48" evaporation pan and an evaporation gauge with analog output. The air temperature was also recorded using a precision linear thermistor and fan-aspirated radiation shield. All of the information was recorded on strip chart recorders. In addition, the information was run through a microprocessor and recorded on magnetic tape. The information from the tape was transferred to a computer and then verified by comparison from the strip charts and from visual observation records. (CBR, 2007A)

3.3.5 Air Quality

Although there are no ambient air quality monitoring data for non-radiological pollutants in the CBR facility, PM10 concentrations have been measured in Rapid City, South

Dakota and in the Badlands National Park in South Dakota. Both locations are geographically similar to the CBR facility. The Rapid City data were collected at the National Guard Camp Armory site about 2 miles west of the city. This area is classified as suburban. The Badlands data were collected in an area classified as rural. Because of the degree of urbanization, the air quality at the CBR facility would probably fall somewhere between the air quality at these two locations. The National Ambient Air Quality Standards (NAAQS) for PM 10 are 150 micrograms per cubic meter (24-hour average), and 50 micrograms per cubic meter (annual average). (CBR, 2007A)

3.3.6 Noise

Noise standards and sound measurement equipment have been designed to account for the sensitivity of human hearing to different frequencies. In general, a residential area at night is 40 dBA; a residential area during the day is 50 dBA; a rural area during the day is 40 dBA and a typical construction site is 80 dBA (EPA 1974). As a comparison, a normal conversation at 5 feet is 60 dBA (EPA 1974). The town of Crawford is located approximately 2.5 miles south of the satellite plant. Construction activities associated with the project would be conducted outside of the City of Crawford limits. The existing ambient noise in the vicinity is dominated by the traffic noise from SH 2/71 and trains on the BNSF rail line. The BSNF rail line runs through the town of Crawford. The closest noise receptor, residence along SH 2/71, is located approximately 1.2 mile east of the BNSF. (CBR, 2007A)

3.4 Geology, Seismology, and Soils

3.4.1 Regional Geology

3.4.1.1 General Stratigraphy

General stratigraphy in northwestern Nebraska is, from oldest to youngest, Pierre Shale, Chadron Formation, Brule Formation, Arikaree Group, and Ogallala Group. Table 3.5 is a generalized stratigraphic chart for the region.

Table 3-5: Generalized Stratigraphic Chart for Northwest Nebraska

System	Series	Formation or Group	Rock Types	Thickness (feet)
Miocene		Ogallala	SS,Slt	1560*
		Arikaree	SS,Slt	1070*
Oligocene/Eocene		White River	SS, Sit, Cly	1450*
Cretaceous	Upper	Pierre	Sh	1500
		Niobrara	Chalk, Ls, Sh	300
		Carlile	Sh	200-250
		Greenhorn	Ls	30
		Graneros	Sh	250-280
		DSand	SS	5-30
		D Shale	Sh	60
		G Sand	SS	10-45
		Huntsman	Sh	60-80
	Lower	J Sand	SS	10-30
		Skull Creek	Sh	220
		Dakota	SS,Sh	180
Jurassic	Upper	Morrison	Sh,SS	300
		Sundance	SS,Sh,Ls	300
Permian	Guadalupe	Satanka	Ls, Sh, Anhy	450
	Leonard	Upper	Ls, Anhy	150
		Lower	Sh	150
	Wolfcamp	Chase	Anhy	80
		Council Grove	Anhy, Sh	300
		Admire	Dolo, Ls	70
Pennsylvanian	Virgil	Shawnee	Ls	80
	Missouri	Kansas City	Ls, Sh	80
	Des Moines	Mannaton/	Ls, Sh	130
		Cherokee		
	Atoka	Upper/Lower	Ls, Sh	200
Mississippian	Lower	Lower	Ls,Sh	30
Pre-Cambrian			Granite	

Source: CBR, 2007A

3.4.1.2 Pierre Shale

The Pierre Shale of Cretaceous age (63 to 93 million years before present (MYBP)) is the oldest formation of interest for the Crow Butte area since it is the lower confining unit. This unit is a dark gray to black marine shale, with relatively uniform composition. The Pierre outcrops extensively in Dawes and Sioux Counties along the South Dakota boundary 21 miles (34 km). The Pierre generally consists of black to dusty gray and brownish claystones that include thin layers of bentonite, shaley limes, concretionary zones, and occasional thin sandstone. While the Pierre can be as much as 5,000 ft (1,524 m) thick, it is approximately 1,500 to 2,000 feet (457 to 610 m) thick in Dawes County, and has been regionally divided into six members based on lithology, sequence, and fossil content. (CBR, 2007A)

3.4.1.3 White River Group

The stratigraphy of the White River Group is, from oldest to youngest, is Basal Chadron, Middle Chadron, Upper Chadron, and Brule Formation (Orella, Whitney, and Brown Sandstone members). (CBR, 2007A)

3.4.1.4 Basal Chadron

The Basal Chadron geologic unit consists of two facies, the channel sandstone and red overbank mudstone. The channel sandstone facies is approximately 26 feet (8m) thick and consists of yellowish, pale olive, and white, medium to coarse-grained sandstone. The mudstone facies is predominantly a red, massive mudstone overprinted by pedogenesis (soil formation). Mudstones are usually 3 to 6 feet (0.8 to 1.8 m) deep, and the red color provides a marker bed overlying the Pierre Shale. (CBR, 2007A)

3.4.1.5 Middle and Upper Chadron

The Middle Chadron geologic unit consists of approximately 28 ft (8.7 m) thick of bluish-green and gray mudstone with occasional pockets of red, green, and yellow mudstone. The upper Chadron unit consists of variegated, pedogenetically modified claystone, silty claystone,and siltstone with occasional isolated channel sandstone bodies (Terry, 1998).

3.4.1.6 Brule Formation

The Brule Formation lies conformably on top of the Chadron Formation and consists of interbedded siltstone, mudstone, and claystone with occasional sandstone. The Brule Formation is reported to range in thickness from 130 to 530 feet (Singler and Picard, 1980). Witzel (1974) indicates that the Brule, in Dawes County, has a maximum thickness of 480 feet. The Brule had previously been subdivided into two separate members, the lower Orella (middle Oligocene) and the upper Whitney (upper Oligocene) (Schultz and Stout, 1938; Witzel, 1974). More recently, the maximum thickness of the Brule Formation has been described as 1,150 feet. This is due to the inclusion of the Brown Siltstone beds.

The Orella is composed of interbedded siltstone, mudstone, and claystone with occasional sandstones. The color of the Orella grades from green-blue and green-browns upward to buff and browns. The Brown Siltstone member (former Gehring Formation) consists of pale brown and brown volcanistic sandy siltstones and volcantistic silty sandstone, very fine grained sandstones, and thinly bedded mudstone (LaGarry, 1998). This unit can achieve 135 m in thickness.

3.4.1.7 Arikaree Group

The Arikaree and Ogallala Groups are absent in the immediate North Trend project area. However, a general description for each group follows because they do occur on a regional scale. The Miocene Arikaree Group includes two sandstone formations that form the Pine Ridge escarpment, which trends from west to east across northwest Nebraska.

3.4.1.8 Monroe Creek Formation

The Monroe Creek Formation overlies the Gering and is the middle unit of the Arikaree Group. The Monroe Creek Formation is lithologically similar to the Gering with buff to brown fine-grained sandstone. The unique characteristic of the Monroe Creek is the presence of large "pipy" concretions. These concretions consist of fine-grained sand similar to the rest of the formation with calcium carbonate cement and are extremely hard and resistant to weathering. The reported thickness of the Monroe Creek Formation is 280 to 360 feet (Lugn, 1938, in Witzel, 1974).

3.4.1.9 Harrison Formation

The Harrison Formation is the youngest unit of the Arikaree Group. It is described as lithologically similar to the Gering and Monroe Creek Formations, with fine-grained unconsolidated sands, buff to light gray in color. The Harrison Formation is also noted for its abundance of fossil remains (Witzel, 1974).

3.4.1.10 Ogallala Group

The Miocene Ogallala Group overlies the Arikaree Group and is the outcropping unit south of the Pine Ridge. The Ogallala Group is composed primarily of sandstones that are coarser-grained, poorly sorted and contain only small amounts of volcanic material compared to the underlying Arikaree Group rocks (Souders, 1981). Some siltstone and mudstone is interbedded with the sandstones and gravels.

3.4.2 Regional Structure

Structural features in western Nebraska include the Chadron Arch, Pine Ridge Fault, the Toadstool Park Fault, and the Black Hills uplift in South Dakota (CBR, 2007). The CBR site is located within a structure feature known as the Crawford Basin, which is a triangular shaped basin bounded by the Toadstool Park Fault to the northwest, the Chadron Arch and Bordeau Fault to the east, and the Cochran Arch and Pine Ridge Fault to the south.

Six northeast trending faults are identified or proposed in Sioux and Dawes Counties (Figure 2.6-5). All of these faults are downthrown on the north side. One of these faults, the White River Fault, follows the White River north of Crawford and was postulated during the exploration drilling phase of the Crow Butte Project (Collings and Knode, 1984). The only other fault illustrated, the White Clay Fault, terminates the Arikaree Group rocks on the east from White Clay to about six miles east of Gordon (Nebraska Geological Survey, 1986). The Cochran Arch was also proposed by DeGraw (1969) on the basis of subsurface data. The Cochran Arch trends east-west through Sioux and Dawes Counties, parallel to the Pine Ridge Fault proposed by DeGraw. Structural features subparallel to the Cochran Arch have been recognized based on CBR drill hole data. The existence of the Cochran Arch may explain the structural high south of Crawford.

3.4.3 Seismology

The CBR facility in northwest Nebraska is within the Stable Interior of the United States. The project area along with most of Nebraska is in seismic risk Zone 1 on the Seismic Risk Map for the United States compiled by Algermissen (1969). Most of the central United States is within seismic risk Zone 1 and only minor damage is expected from earthquakes that occur within this area. The nearest area to the project area of higher seismic risk is in the southeastern part of Nebraska within the eastern part of the central Nebraska Basin (Burchett 1979) about 300 miles from the project area. (CBR, 2007A)

Although the CBR facility is within an area of low seismic risk occasional earthquakes have been reported. Over 1100 earthquakes have been catalogued within the Stable Interior of the U.S. since 1699 by Docekal (1970). This study, considered complete to 1966, noted several earthquake epicenters within northwest Nebraska. All but two of these earthquakes were classified within the lowest category, Intensity IIV, on the Modified Mercalli Intensity Scale of 1931. (CBR, 2007A)

The earthquakes that have been recorded along these two structural features are tabulated in Table 3-6.

Table 3-6: Local Earthquake Data

Date	Central Standard Time	>Locality·	Latitude Degrees North	'Longitude Degrees ·West	Modified Mercalli (MM) Intensity	Source
March 17, 1984	14:00	North Platte	41.133	100.75	IV	A
December 16, 1916	-----	Stapleton	41.55	100.467	II-III	A
September 24, 1924	5:00	Gothenburg	40.95	100.133	IV	A
August 8, 1933	-----	Scottsbluff	41.867	103.667	IV-V	A
July 30, 1934	1:20	Chadron	42.85	103	VI	A
March 24, 1938	7:11	Fort Robinson	42.683	103.417	IV	A
March 9, 1963	9:25	Chadron	42.85	103	II-III	A
March 28, 1964	4:21	Merriman	42.8	101.667	VII	A
May 7, 1978	10:06	SW Cherry County	42.26	101.95	V	B
May 6, 1983	0:15	NE Sheridan County	42.96	102.2	III	B
January 1, 1987	2:02	Crawford	42.79	103.48	III	B
February 8, 1989	23.16	Merriman	42.8	101.6	IV	B

Source: CBR, 2007A

The strongest earthquake in northwest Nebraska (No. 21) occurred July 30, 1934 with an intensity of VI and was centered near Chadron. This earthquake resulted in damaged chimneys, plaster, and china. Earthquake No. 25 occurred on March 24, 1938 near Fort Robinson. This earthquake had an intensity of VI and no additional information is available. An Intensity IV earthquake should be felt indoors by many and cause dishes, windows, and doors to be disturbed. Earthquake No. 29 occurred on March 9, 1962. This earthquake was reported to last about a second and was not accompanied by any damage or noise and was not even noticed by many of the residents of Chadron. Earthquake No. 31 occurred on March 28, 1964 near Merriman. The vibrations from this earthquake lasted about a minute and caused much alarm but no major damage occurred. Books were knocked off shelves and closet and cupboard doors swung open. On May 7, 1978 an earthquake (No. 34) with Intensity V occurred in southwestern Cherry County, also near the Chadron Arch. No major damage was reported from this earthquake. (CBR, 2007A)

Although the risk of major earthquakes in Nebraska is slight (Burchett 1979, p.14), some low to moderate tectonic activity is occurring (Rothe 1981). This tectonic movement is also suggested by geomorphic and sedimentation patterns during the Pleistocene (Rothe 1981). Recent seismicity on the Cambridge Arch appears to be related to secondary recovery in the Sleepy Hollow oil field (Rothe et al. 1981). Deeper events, however, suggest current low level tectonic activity on the Chadron and Cambridge Arches. This activity is not expected to affect the ISR operations.

The most recent earthquake recorded in Nebraska occurred April 16, 2007. The epicenter was about 45 miles north-northwest of McCook, Nebraska, and was about 180 miles southeast of Crawford. This earthquake had a recorded magnitude of 3.0, but was not felt at Crawford or the CBR facility. According to the USGS, no earthquakes have been felt in Nebraska since the April 16, 2007 event (USGS 2007). (CBR, 2007A)

3.4.4 Soils

The CBR facility is located in the semiarid west-central portion of Dawes County, Nebraska, southeast of the City of Crawford. Soils data for the CBR facility were obtained from the United States Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS), Soil Survey of Dawes County, Nebraska, published in February 1977, and field sampling for radionuclide, physical, and chemical properties was conducted (USDA 2006, NRCS 1977).

The CBR facility is situated in the White River watershed along the Squaw Creek tributary. The terrain is gently rolling to hilly. The terrain is generally flat with gentle rolling hills. To the south lies the Pine Ridge, an area of rough steep terrain dissected by steep drainageways. Vegetative cover is typically mixed grass and ponderosa pine trees, but they have been largely replaced by agricultural crops within the CBR facility (CBR, 2007A)

Dawes County soils were formed by weathering of materials of the underlying geologic formations or of materials deposited by wind and water. The Brule Formation is widely exposed on lower slopes, is soft and weathered rapidly, producing the Epping, Kadoka, Deota, Schamber and Mitchell soils. As this material weathered, it produced the Epping, Kodaka variant, Keota, and Mitchell soils. The overlying Tertiary-age bedrock at higher elevations is the Arikaree Group. This massive sandstone contains layers of compacted silt and clay. Soils formed from this fine-grained material are Alliance, Busher, Canyon, Oglala, Tassel, and Rosebud. Sandstone mixed with loess formed soils such as Bayard, Bridget, and Vetal formed in colluvial and alluvial materials. (CBR, 2007A)

A soil association is a landscape that has a distinctive proportional pattern of soils, consisting of one or more major soils and at least one minor soil. Three soil associations exist within the CBR facility: Kadoka-Keith-Mitchell, Busher-Tassel-Vetal, and Tripp-Haverson-Glenberg. The Kadoka-Keith-Mitchell soils are deep, nearly level to steep, well drained silty soils that formed in loess and in material weathered from siltstones, on uplands and foot slopes. The Busher-Tassel-Vetal soils are deep and shallow, very gently sloping to steep, well drained to somewhat excessively drained sandy soils that formed in colluvium and in material weathered from sandstone. The Tripp-Haverson-Glenberg soils are deep and shallow, very gently sloping to steep, well-drained to somewhat excessively-drained sandy soils that formed in colluvium and in material weathered from sandstone on uplands and foot slopes. (CBR, 2007A)

Table 3-7 summarizes those soils found within the CBR facility. The first capital letter is the initial of the soil name. The lower case letter that follows separates mapping units having names that begin with the same letter except that it does not separate sloping or eroded phases. The second capital letter indicates the class of the slope. Symbols without a slope letter are for soils that have a slope range of 0 to 2 percent or miscellaneous land types that have a wide range of slopes. A final number 2 in the symbol indicates that the soil is eroded. Those soils are also shown on Figure 3-4. (CBR, 2007A)

Table 3-7: Soil Identifications

Map Unit	Map :Unit Name	Percent of CBR facility
AcB	Alliance silt loam, 1 to 3 percent slopes	1.6
AcD	Alliance silt loam, 3 to 9 percent slopes	0.2
AcD2	Alliance silt loam, 3 to 9 percent slopes, eroded	1.5
Bg	Bridget silt loam, 0 to 1 percent slopes	1.9
BgB	Bridget silt loam, 1 to 3 percent slopes	0.5
BgD	Bridget silt loam, 3 to 9 percent slopes	1.3
BuC2	Busher loamy very fine sand, 1 to 5 percent slopes,	0.2
BuD	Busher loamy very fine sand, 5 to 9 percent slopes	2.1
BuD2	Busher loamy very fine sand, 5 to 9 percent slopes,	3.9
BuF	Busher loamy very fine sand, 9 to 20 percent slopes	7.0
BxF	Busher and tassel loamy very fine sands, 5 to 20 percent	13.0
CaG	Canyon-Bridget-Rock outcrop association, steep	5.4
DuB	Duroc very fine sandy loam, 1 to 3 percent slopes	0.8
EpF	Epping silt loam, 3 to 30 percent slopes	0.0
JvD	Jayem and Vetalloamy very fme sands, 5 to 9 percent	5.4
KaB	Kadoka silt loam, deep variant, 1 to 3 percent slopes	0.0
KaD	Kadoka silt loam, deep variant, 3 to 9 percent slopes	0.1
KaD2	Kadoka silt loam, deep variant, 3 to 9 percent slopes,	0.2
KeB	Keith silt loam, 1 to 3 percent slopes	1.9
KID	Keith and Ulysses silt loams, 3 to 9 percent slopes	0.8
KpD	Keota-Epping silt loams, 3 to 9 percent slopes	0.2
La	Las Animas soils, 0 to 2 percent slopes	3.3
Lo	Loamy alluvial land	0.2
MxF	Mitchell-Epping complex, 9 to 30 percent slopes	1.2
OhF	Oglala-Canyon loams, 9 to 20 percent slopes	0.4
RxD	Rosebud-Canyon loams, 3 to 9 percent slopes	4.6
Sn	Sandy alluvial land	5.9
SvF	Sarben and Vetalloamy very fine sands, 9 to 30 percent	9.2
SyF	Schamber soils, 3 to 30 percent slopes	0.7
TaF	Tassel soils, 3 to 30 percent slopes	1.1
Tr	Tripp silt loam, 0 to 1 percent slopes	0.9
Ts	Tripp silt loam, saline-alkali, 0 to 2 percent slopes	1.8
vee	Vetal and Bayard soils, 1 to 5 percent slopes	18.5
w	Water	0.9
Wx	Wet alluvial land	3.1

Source: CBR, 2007A

Source: CBR, 2007A

3.5 Water Resources

3.5.1 Surface Water

The CBR facility is located within the Crawford Basin, which is bounded on three sides by the Pine Ridge escarpment, which rises about 91 to 274 m (300 to 900 ft) above the basal plane (CBR, 2010a). Two major watersheds, the White River (U.S. Geological Survey (USGS) hydrologic unit code 10140201) and Hat Creek (USGS hydrologic unit code 10120108), drain the area north of the Pine Ridge escarpment. The White River and Hat Creek Basins cover 4,196 and 1,228 square kilometers (1,620 and 474 square miles), respectively, in Nebraska (NDNR, 2004). The White River originates near Harrison in Sioux County to the west of the CBR facility and flows northeasterly across Dawes County into South Dakota, where it flows through the Badlands National Park region.

Streams that originate along the north side of the Pine Ridge are fed by ground water from a shallow aquifer that is recharged from precipitation falling on the Pine Ridge escarpment. These streams converge to form the White River and Hat Creek. The CBR facility lies within the drainage basin of the White River. North- and west-flowing tributaries to the White River cross a gently sloping area marked with clay hills that in places have been extensively eroded and are underlain by the Pierre Shale. Since the permeability of the Pierre Shale is too low to provide recharge to the streams, these tributaries are usually dry except when carrying direct runoff from precipitation.

The CBR facility lies within the watersheds of White Clay Creek, Squaw Creek, and English Creek, which are small southern tributaries to the major regional water course, the White River. These creeks originate in the Pine Ridge south of the CBR facility. From their headwaters, the creeks drain north over forest, range, and agricultural land to the White River. Contributions to flow come from springs in the Arikaree Group, snowmelt, runoff, and the shallow Brule sands (CBR, 2009). Due to the temporal nature of these water sources, discharges at various points along the creeks may experience wide seasonal and yearly fluctuations. Squaw Creek is the closest tributary to the current ISR wellfield areas and enters the CBR facility on the southeast corner, traverses the entire length of the CBR facility approximately paralleling its long axis, and exits to the north.

In addition to the streams, eight surface impoundments have been constructed in the drainages within or near the CBR facility. The impoundments, seven of which are on creeks, are generally constructed of low-profile earthen dams. The impoundments are used for livestock watering and, to a lesser extent, crop irrigation (CBR, 2009).

3.5.1.1 Surface Water Flow

CBR (2010b) compared the mean monthly discharge of the White River (1931–2004) to mean monthly precipitation (1971–2000) and concluded that there is a general correlation between the direct precipitation and discharge. Furthermore, higher flows are observed in spring and early summer, with the lowest flows occurring in late summer to early fall, reflecting seasonal precipitation rates. There have been no significant long-term precipitation trends in the White River Basin (NDNR, 2004).

As reported by CBR (2010b), the Nebraska Department of Environmental Quality (NDEQ) has collected flow and water quality data for a number of years from the White River at the following NDEQ sampling stations: Fort Robinson (SW1WHITE325), Crawford (WH1WHITE208), and Chadron (WH1WHITE105). The Fort Robinson station is located approximately 10.4 kilometers (km) (6.5 miles (mi)) southwest and upstream of the Crawford sampling station. The Chadron sampling station is located approximately 48 km (30 mi) northeast and downstream of the Crawford sampling station.

CBR (2010b) provided USGS data collected at the gauging station near Crawford from 1931 to 2004. The mean annual discharge rate for the White River at Crawford was 0.57 ± 0.08 cubic meters per second (m^3/s) (20.3 ± 2.8 cubic feet per second (ft^3/s)). The maximum was 0.7 m^3/s (27 ft^3/s), and the minimum was 0.37 m^3/s (13 ft^3/s). The licensee provided additional streamflow data from the Nebraska Department of Natural Resources (NDNR) and USGS obtained at the Crawford gauging station from 1992 through 2007. The mean annual discharge rate from 1992 to 2007 is 0.56 m^3/s (19.9 ft^3/s), which is consistent with the mean annual discharge rate from 1931 to 2004. From 2003 to 2009, average flows at the White River at Crawford were consistently higher than at the White River at Chadron. CBR (2010b) attributed the lower flows to evaporation and water consumption for local use in this stretch of the river.

According to CBR, there is a minimum potential for flooding throughout the CBR facility (CBR, 2010b). The highest discharge and stream stage on record between 1920 and 2004 occurred on May 10, 1991 (CBR, 2010b). On that date, significant rainfall raised the stream stage to 4.98 meters (16.32 feet) and the stream flow exceeded 377 m^3/s (13,300 ft^3/s). The event was considered a “100-year” flood. The licensee reported that the CBR facility (as well as the proposed CBR ISR expansion areas) is outside the 100-year floodplain of the White River, based on 2007 data from the Federal Emergency Management Agency. The licensee noted that the CBR facility is more than 46 meters (m) (150 feet (ft)) topographically above the common river elevation. CBR also indicated that all existing and planned surface facilities at the CBR facility are least 15 m (50 ft) above the White River elevation. Based on these data, the NRC staff concluded that no portion of the CBR facility has a reasonable potential of flooding as a result of flooding of the White River.

3.5.1.2 Surface Water Quality

NDEQ provided CBR with water quality data it collected at the Fort Robinson, Crawford, and Chadron sampling stations from 2001 through 2009 (CBR, 2010b). According to CBR, the concentrations for most analytes, including calcium, chloride, magnesium, total suspended solids (TSS), sodium, total Kjeldahl nitrogen, and phosphorous, increase significantly from upstream to downstream. CBR also noted that ammonia concentrations do not show any notable year-to-year trends, and that downstream increases of TSS and ionic (calcium, chloride, magnesium, and sodium) concentrations are likely sources of the increasing turbidity and conductivity trends, respectively. CBR concluded that these trends are likely associated with increased amounts of agricultural runoff between the cities of Crawford and Chadron.

Prior to commercial operations, CBR conducted regional background surface water quality analysis on samples collected from the White River and all surface water bodies within the CBR facility. The data were reported in the original (1987) commercial license application (Ferret, 1987). The initial program included the analysis of physical indicator parameters, common cation and anion constituents, trace and minor metals, and radionuclides uranium and radium-226. Starting with the fourth quarter of 1994, CBR only monitored for natural uranium and radium-226, so monitoring for preoperational nonradiological parameters ceased. CBR submitted these data to the NRC in Semiannual Radiological Effluent and Environmental Monitoring Reports.

The U.S. Environmental Protection Agency (EPA) has listed the White River as an impaired stream from a water quality perspective (EPA, 2011). The causes of the impairment are *Escherichia coli* (E. coli), fecal coliform, nutrients, and total suspended solids. These impairments are only attributed to the White River in Nebraska and South Dakota. NDEQ attributed the E. coli impairment to point source discharges such as municipal wastewater treatment facilities and confined animal feeding operations (NDEQ, 2005). Other sources include natural sources as well as nonpoint sources. The White River is generally used to support agricultural production, wildlife habitat, and both warm- and cold-water fish (CBR, 2009). In 2010, the NDEQ indicated that stream water quality trends for dissolved oxygen have decreased in the White River and Chadron Creek and are stable for conductivity and ammonia (NDEQ, 2010). The NDEQ scored White River to have poor index of Biotic Integrity (IBI) due to low water levels and lack of in stream habitat but the river was placed in Category 2 on the Invertebrate Community Index (ICI) score and ambient water quality conditions. A Category 2 classification indicates that the water body meets some of the designated uses but there is insufficient information to determine if all uses are being met. (NDEQ, 2010)

3.5.2 Ground Water

3.5.2.1 Regional Ground Water Resources

CBR (2007) identified the alluvium, Brule Formation, and Basal Chadron Sandstone as the major water-bearing subsurface layers at the regional scale. The base of the regional hydrogeologic system is the Pierre Shale which acts as the lower confining formation. The Pierre Shale is a very low-permeability unit that is approximately 366 m (1,200 ft) to 457 m (1,500 ft) thick in Dawes County. The Brule, Chadron, and Pierre Shale crop out progressively northward from the Pine Ridge escarpment through the White River Basin. The NRC staff verified that that this information is consistent with the regional-scale hydrogeological description provided by Miller and Appel (1997).

Souders (2004) published a saturated thickness map of principal aquifers that indicates almost all of the area within the Hat Creek-White River drainage basin is underlain by aquifers that are either very thin or absent. A 1995 water table map shows that a ground water divide occurs to the south of the CBR facility along the Pine Ridge escarpment and that ground water north of this divide flows to the north, northwest, and northeast, depending upon location with respect to the White River (Souders, 2004).

The alluvium, Brule Formation, and Basal Chadron Sandstone are considered water-bearing units, although the alluvium occurs intermittently in ephemeral drainages and is not a reliable water source (CBR, 2009). The shallowest aquifer in the White River Basin is the Brule Formation, which is unconfined and produces usable amounts of water only from areas that are sufficiently jointed to form saturated zones. These saturated zones are generally discontinuous and of limited areal extent (CBR, 2011). The Orella Member of the Brule Formation also has discontinuous lenses of sandstones and siltstones that may provide localized sources of water (CBR, 2010). The Basal Chadron aquifer has limited use as a ground water supply because of its generally poor water quality and high radionuclide content.

Independent reviews of various documents (Miller and Appel, 1997; Weeks and Gutentag, 1981; Gutentag and Weeks, 1980; and Collings and Knode, 1984) all indicate that the Brule Formation is not an extensive aquifer near the CBR facility or in western Nebraska. All of the aforementioned references indicate that the Brule Formation is an aquifer only where it contains sufficient sand beds and where the secondary porosity is sufficient to transmit water. Regionally, the Brule Formation is part of the High Plains Aquifer (HPA) only where it contains saturated zones resulting from interconnected porosity; otherwise, it forms the base of the HPA (Gutentag and Weeks, 1980).

The Pierre Shale is essentially impermeable, which precludes its use as a water supply. A number of shallow wells in Township 32 North, Range 51–52 West are reported as being completed in the Pierre Shale bedrock unit (Spalding, 1982). These wells range in depth from 5.5 m (18 ft.) to 30.5 m (100 ft), with an average depth of 13.3 m (44 ft), and were drilled in areas that have considerable alluvium atop the Pierre Shale, including locations along Spring Creek and the White River between Crawford and Whitney Lake. These wells produce water from a few tens of feet of Quaternary alluvium overlying the Pierre Shale. Spalding (1982) states that, "In very shallow wells (a few tens of feet) significant amounts of water may be contained in the thin Quaternary sediments overlying the designated hydrogeologic unit. This situation is particularly true for those wells noted as completed in the Pierre Shale."

The Sundance and Morrison Formations (bottom to top) are water-bearing layers below the Pierre Shale. These two layers are described as minor aquifers at Black Hills, South Dakota (CBR, 2009). Relatively less thick, the Dakota Formation is a geologically younger formation than the Morrison and Sundance Formations and underlies the Pierre Shale at Black Hills, South Dakota (Driscoll, et al., 2002). The stratigraphy below the Pierre Shale described in the environmental report (ER) is consistent with the stratigraphic column of Driscoll, et al. (2002) presented for Black Hills, South Dakota (CBR, 2007A).

The licensee reported that ground water quality in water-bearing layers below the Pierre Shale is not suitable for local water production due to high total dissolved solids levels. The licensee has received permits from NDEQ and installed two Class I non-hazardous deep injection wells in the Sundance and Morrison Formations within the CBR facility area (CBR, 2000; CBR, 2009).

3.5.2.2 Local Ground Water Resources

In general, ground water supplies in the vicinity of the CBR facility are limited due to the low permeability of the underlying lithology (University of Nebraska-Lincoln, 1986). As indicated in Table 3-8, the local aquifers are the Brule and Basal Chadron Formation. The Whitney and Orella members of the Brule Formation and the Middle and Upper Chadron Formations act as upper confining layers to the Basal Chadron Formation, with one exception. A sand layer near the bottom of the Upper Chadron Formation is more permeable, but it is also of limited areal extent and produces insufficient water to be considered an aquifer (CBR 2010). Over most of the CBR facility, the Brule Formation crops out and is underlain by the Chadron Formation (including the Basal Chadron Sandstone) and the Pierre Shale (CBR, 2009).

Table 3-8 Hydrostratigraphy at the CBR Facility

Strata	Hydrogeologic Function
Alluvium	Unsaturated
Brule—Brown Siltstone Member	Uppermost Aquifer—Unconfined
Brule—Whitney and Orella Members	Upper Confining Layer
Upper Chadron Formation	Upper Confining Layer
Middle Chadron Formation	Upper Confining Layer
Basal Chadron Formation	Extraction Zone—Confined Aquifer
Pierre Shale	Lower Confining Layer

Source: CBR, 2007A

A pre-operational (1982–1983) potentiometric surface study for the Brule Formation indicates that, under natural conditions, ground water flows to the northwest towards the White River at a gradient of about 1.0 percent (0.012) (CBR, 2009). A series of more recent potentiometric surfaces constructed by CBR with water-level data collected in 2008 and 2009 shows similar trends, with somewhat higher hydraulic gradients ranging from 0.025 to 0.043 (in 2008). CBR (2009) concluded that it is highly likely that the White River is a significant discharge point for the Brule Formation. North of the CBR facility, the licensee reported water levels that are nearly 4.5 m (15 ft) higher in recent years than in 1982–1983. Based on recent ground water elevation contour maps for the Brule Formation in the ER, there were no significant seasonal variations in water levels in 2008 (CBR, 2007A).

The Basal Chadron Sandstone is the only water-bearing strata in the Chadron Formation that can be considered an aquifer. The Basal Chadron Formation is a confined aquifer that is, in some areas, artesian. Hydraulic heads in the Basal Chadron Formation are approximately 27 m (90 ft) higher than those in the Brule Formation, and in some cases they are higher than ground elevation, causing flowing artesian conditions. Pre-operational (1982–1983) ground water elevation data show that ground water flow in the Basal Chadron Formation was to the north at a gradient of about 0.001 (CBR, 2009). Potentiometric surfaces created during active ISR operations (2008–2009) indicate localized gradients within the CBR facility, with southeast-directed flow south of Mine Unit 10 and predominantly north- and northeast-directed flow south of Mine Unit 8 (CBR, 2009). The licensee reported that ground water levels in the Basal Chadron Sandstone have decreased by 12–18 m (40–60 ft) throughout the CBR facility since 1982–1983 (CBR, 2009).

Locally, some ground water is obtained from shallow alluvial sediments in areas along Spring Creek and the White River between Crawford and Whitney Lake, where the alluvium is of sufficient thickness and permeability to provide domestic water supplies (Souder, 2004). The primary ground water supply, however, is the Brule Formation, typically encountered at depths from 60 to 100 ft (CBR, 2007). The Brule is a tight formation with a hydraulic conductivity of less than 7.6 m/day (25 ft/day) and is not considered a major source of ground water (Souder, 2004). Spalding (1982) noted that ground water from the local Brule sands is commonly used as a domestic and livestock water source because of its good chemical quality, low total dissolved solids, and shallow depth. A majority of the wells are less than 30.5 m (100 ft) deep (Spalding, 1982). Souder also notes that in some places the Brule Formation may have a significant saturated thickness that could contain a “great deal of water,” although the unfractured hydraulic conductivity is very low. The licensee stated that sandstones and sandy siltstones in the upper part of the Brule Formation may be an important source of water (CBR, 2009).

The underlying Basal Chadron Sandstone aquifer, at a depth of 122 to 274 m (400 to 900 ft), acts as a local supply of stock water. However, because of its greater depth and inferior water quality, the Basal Chadron aquifer is not used as a domestic water supply locally or at the CBR facility (CBR, 2007).

3.5.2.3 Uranium Bearing Aquifer

3.5.2.3.1 Hydrogeologic Characteristics

The mineralized zone at all mine units is within the Basal Chadron Sandstone. The thickness of the Basal Chadron Sandstone within the CBR facility varies from 12 m (40 ft) to 24 m (80 ft), with an average thickness of 18 m (60 ft). The thickness of the Basal Chadron Sandstone decreases to zero approximately 1 mile northeast of the CBR facility. The depth to the mineralized zone varies between 122 m (400 ft) and 274 m (900 ft) and increases in the southeastern direction.

CBR conducted four aquifer tests in the permit area to determine the hydraulic characteristics (storativity, transmissivity, and hydraulic conductivity) of the ore-bearing Basal Chadron Sandstone aquifer and the integrity of the confining layers over the CBR facility. The first test was conducted in November 1982; the second took place in June 1987 at a site located approximately 850 m (2,800 ft) north of the initial aquifer test site; the third test was completed in September 1996 at a location approximately 2,630 m (8,600 ft) northwest of the second test; and the final test was conducted in August 2002 at a location approximately 1,220 m (4,000 ft) southwest of the first test. The aquifer test results demonstrate that the zones of influence overlap slightly; therefore, the results of these tests estimate the hydraulic conditions over a majority of the CBR facility.

The licensee used the aquifer testing drawdown and recovery data to estimate the hydrogeological properties of the ore-bearing aquifer and confining layers using one or more combinations of the Theis' recovery method, Jacob's modified nonequilibrium method, Cooper and Jacob's distance-drawdown method, Hantush's method, and the Neuman and Witherspoon method.

The results of four aquifer tests were similar and show that the Basal Chadron Sandstone is a nonleaky, confined, slightly anisotropic aquifer (CBR, 2009). The radius of influence in these aquifer tests varied in the range of 1,220–1,740 m (4,000–5,700 ft). The licensee estimated the average transmissivity, hydraulic conductivity, and the storativity of the ore-bearing aquifer to be 44.5 square meters per day (m^2/d) (479 square feet per day (ft^2/d)), 3.7 m/d (12.13 ft/d), and 8.8×10^{-5}, respectively. The reported average hydraulic conductivity for the Basal Chadron Sandstone (equivalent to 4.2×10^{-3} centimeters per second (cm/s) or (13.8×10^{-3} feet per second (ft/s)) falls in the range of typical hydraulic conductivity for silty-sand to clean sand (Freeze and Cherry, 1979, p. 29). Considering the arkosic nature of the Basal Chadron Sandstone and the presence of interbedded clay layers (Collings and Knode, 1984), the reported average hydraulic conductivity for the Basal Chadron Sandstone described in the ER is within a typical range and consistent with ranged discussed in Collings and Knode (1984) (CBR, 2007A). Furthermore, according to Driscoll, the storativity value of 8.8×10^{-5} reveals the confining nature of the Basal Chadron Aquifer, because typical storativity values for confined aquifers range from 10^{-5} to 10^{-3} (Driscoll, 1986, p. 68). The licensee reported that the average thickness of the ore-bearing aquifer was 12 m (40 ft) at the test sites, and the reported aquifer thickness is consistent with the thickness reported by Collings and Knode (1984).

3.5.2.3.2 Level of Confinement

Lower confinement of the Basal Chadron Sandstone in the CBR facility is achieved by over 305 m (1000 ft) of Pierre Shale. The upper confinement is composed of the Chadron Formation above the Basal Chadron Sandstone (Middle and Upper Chadron) and that portion of the Brule Formation that underlies the intermittent Brule Sandstone (Orella Member). These units isolate the Basal Chadron Sandstone from overlying aquifers with several hundred feet of clay and siltstones. Thicknesses range from about 30 m (100 ft) in the northeastern part of the permit area to 150 m (500 ft) in both the southern and northern parts of the area. The clay and siltstone is about 60 to 90 m (200 to 300 ft) thick.

Based on the results of the aquifer tests, the licensee reported the average vertical hydraulic conductivity of the overlying confining layer ranges from 2.8×10^{-12} to 3.49×10^{-13} m/s ((0.85 to 1.06 ft/s) and the average vertical hydraulic conductivity of the underlying confining layer ranges from 3.4×10^{-13} to 6.3×10^{-13} m/s ((1.04 to 1.92 ft/s) (CBR, 2007A). Laboratory testing of the overlying confining layers indicates that these layers may exhibit a minor amount of leakage. However, during the aquifer testing, there was no pressure response that would indicate the occurrence of such leakage. Similarly, the underlying confining layer response attributable to the aquifer testing indicated no leakage (CBR, 2007A).

The licensee reported hydraulic interactions between Squaw Creek and the Shallow Brule sand. The ER submitted by CBR shows that the Basal Chadron Sandstone is separated from the shallow Brule sand by a thick impermeable layer, and that Squaw Creek is usually dry except for runoff flows; thus, hydraulic interaction between Squaw Creek and Basal Chadron Sandstone is unlikely (CBR, 2007A).

The aquifer testing indicates that ground water flow will be contained by the confining strata and concentrated within the production zone. Vertical control of the process solutions is reasonably ensured by the confining layer characteristics, associated hydraulic conductivities, and continuous extent of the confining beds. Finally, vertical excursions detected to date during commercial operations have resulted from issues with well completion, testing, or abandonment, not integrity of the confining layers. These findings support the aquifer testing results, which demonstrate the integrity of the upper confining layers (CBR, 2007A).

3.5.2.3.3 Ground water Modeling of the White River Structural Feature

During the exploration drilling phase of the CBR project, the licensee identified a structural feature known as the White River Fault, which follows the White River north of Crawford and passes along the southeast permit boundary of the proposed North Trend expansion area, approximately 3.2 km (2 mi) from the northern boundary of the CBR facility. In the ER, the applicant expressed uncertainty as to whether this feature is expressed as a fault through the Brule and Basal Chadron formations or a fold (CBR, 2007A). If the feature is present as a conductive fault, it could provide a pathway for fluids to flow between the two formations. The licensee proposed that recent close spaced drilling data indicate that the feature could be interpreted as a fold in these formations. The applicant provided updated cross sections and a discussion that supported this interpretation (CBR 2009).

To evaluate this issue, the NRC staff performed an independent ground water modeling exercise to assess the nature of the White River structural feature in the Basal Chadron and Brule formations. As described in Section 2.4.3.3.1 of the SER, the NRC staff developed a base ground water flow model using Ground water Modeling System (GMS) Version 6.0. Field data used to construct the model included boring log data, hydraulic properties of the geologic units, and water level data. Because this model was developed for analysis of the North Trend Expansion Area, data used for model development came from North Trend geologic and hydrogeologic information. After model development, the staff calibrated the model using PEST (parameter estimation and automated calibration software included in GMS). Calibration results indicated to the staff that the ground water model calibration to observed data was acceptable (NRC 2014).

The NRC staff subsequently developed four other models to evaluate the effect of a potential fault on the Basal Chadron aquifer flow system. Two models assumed the fault was present and acted as flow boundary, and two models assumed it was a no-flow or restricted-flow boundary. These scenarios were developed by altering the conditions of the southern boundary of the base ground water flow model of the proposed North Trend Expansion Area, which is near the fault location. The NRC staff performed a maximum likelihood analysis using all the models described above—the base model plus the four scenario models as described in Section 2.4.3.3.1 of the SER (NRC 2014). Procedures for this analysis are documented in NUREG/CR-6940 (Meyer, et al, 2007).

The results of the NRC staff’s analysis indicate that the highest probability is the base model scenario, where no boundary exists at the location of the fault. The lowest probability and therefore most unlikely scenarios are those with the fault acting as a flow boundary. This conclusion matches the current physical state of the Basal Chadron aquifer. The Basal Chadron aquifer is a highly pressurized confined aquifer into which some wells have been drilled that flow without assistance (artesian wells). If a conduit such as a fault existed, water would be forced upward out of the Basal Chadron aquifer and would produce a significantly different piezometric surface than the currently observed piezometric surface of the Basal Chadron aquifer. In addition, the influx of lower quality Basal Chadron water into the Brule would impact water quality. Therefore, the NRC staff concluded that the presence of a fault that penetrates the Pierre Shale through the Brule Formation is unlikely, and if one exists it does not convey water from the Basal Chadron Formation to the Brule Formation (NRC 2014).

3.5.2.4 Ground Water Quality

Prior to commercial operations, CBR conducted regional background groundwater quality analysis on samples collected from 18 private wells and 11 wells drilled by a previous owner of the property. The data were reported in the original (1987) commercial license application (Ferret, 1987). The initial monitoring included the analysis of physical indicator parameters, common cation and anion constituents, trace and minor metals, radionuclides uranium and radium-226, and water elevation. It included data from the Brule and Basal Chadron aquifers. CBR has conducted additional monitoring of ground water in private wells near wellfields during the prior licensing periods, although the analytical parameters are limited to the radionuclides. (NRC 2014)

The baseline monitoring data indicate that the Basal Chadron aquifer is regionally of good quality and has been defined by NDEQ as an underground source of drinking water (NRC, 1989a). However, in the vicinity of the mineralized zone, uranium and radium concentrations are elevated. In the wells that were used to determine baseline water quality in the Basal Chadron aquifer, radium-226 values ranged from 0.1 to 619 picocuries per liter (pCi/L), with a mean of 53 pCi/L. Similarly, within the ISR wellfield, radium-226 concentrations had a baseline mean of 859 pCi/L. These values are well above the EPA primary drinking water standard of 5 pCi/L. As a result, water drawn from the Basal Chadron aquifer does not meet the standards for human consumption (NRC 2014).

3.5.3 Water Use

3.5.3.1 Dawes County Water Use

Every 5 years since 1950, USGS has assessed U.S. water use (USGS, 2009), including water-use estimates for the State of Nebraska. To obtain Nebraska water-use data, USGS works in cooperation with NDNR. The most recent USGS report, from 2005, presents water usage in each state by county (according to the USGS Web site (http://water.usgs.gov/watuse/), the 2010 report will not be available until late 2014).

USGS estimated water use in 2005 for Dawes County, including both ground water and surface water use, at 2.59 million gallons per day (Mgal/d). Irrigation using ground water and surface water accounted for a total of 24.55 Mgal/d to irrigate an estimated 13,000 acres.

CBR (2011) indicated that Dawes County has a total of 5,512 registered water wells used for a variety of purposes. According to NDNR, a total of 226 domestic and 224 livestock wells are located in Dawes County. The county also has 37 public water supply wells (NDNR, 2010a).

3.5.3.2 City of Crawford Community Water Supply

The White River and associated tributaries indirectly supply some of the drinking water to the citizens of the City of Crawford via three infiltration galleries. The City of Crawford's municipal water system, which consists of this infiltration gallery (850 gallons per minute (gpm)), is also supplied by two water supply wells (City of Crawford, 2010a; NDHHS, 2010). These wells have an average depth of 100 feet. The water system has a pumping capacity of 155 gpm and serves approximately 90 percent of the city's population of 1,028 (City-Data.com, 2010). The overhead storage capacity is 1,750,000 gallons, and the raw water storage capacity is 500,000 gallons. The average daily demand is 250,000 gallons, with an historic peak daily demand of 1,000,000 gallons. The system has a maximum capacity of 2,830,000 gpd.

Based on the Crawford Municipal Water Conservation Plan (spring 2003), the average per capita water use in 2002 (including residential and business customers; public facilities, including parks, etc.; and water lost to system leaks) was 323 gpd.

The City of Crawford has a designated wellhead protection area and adopted controls pursuant to the Nebraska Wellhead Protection Area Act (Nebraska Revised Statutes § 46-1501 – 46-1509) for the purpose of protecting the public water supply system. The boundaries of the wellhead protection area (WHPA) are described in City of Crawford Ordinance 575, dated May 10, 2005 (City of Crawford, 2010b). The WHPA includes 960 acres in Sections 15, 16, 21, and 22 of T31N R52W, in Dawes County. Two public water supply wells are located within the designated WHPA (Wells 454 and 455).

3.5.3.3 CBR Facility Water Use

Groundwater within 8-km (5-mile) of CBR facility is supplied by either the Brule or Basal Chadron Formations (Williams 1982). A water well survey conducted by Wyoming Fuel Company (WFC) indicated that most of the groundwater pumped from 123 wells surveyed within the 3.6-km (2.25-mi) radius of the commercial CBR facility is used either to water livestock or for domestic purposes. A spring, located in Fort Robinson State Park, produces an average of 972,000 gpd (Storbeck 1987).

3.6 Socioeconomics

3.6.1 Demography

The city of Chadron and the city of Crawford in Dawes County are the largest populated communities closest to the CBR facility. In 2010, the population of the city of Chadron, located approximately 25 miles (40 km) northeast of the CBR facility, was recorded at 5,851, which is an increase of 3.9 percent from 2000 (USCB, 2001; USCB, 2011). The city of Crawford, located within 4 miles (6 km) to the northwest of the CBR facility, had a population of 997 in 2010, which is an 11-percent decrease from 2000 (USCB, 2001; USCB, 2011). The population decline in the city of Crawford contrasts with the 1.3-percent growth rate of Dawes County as a whole (USCB, 2001; USCB, 2011).

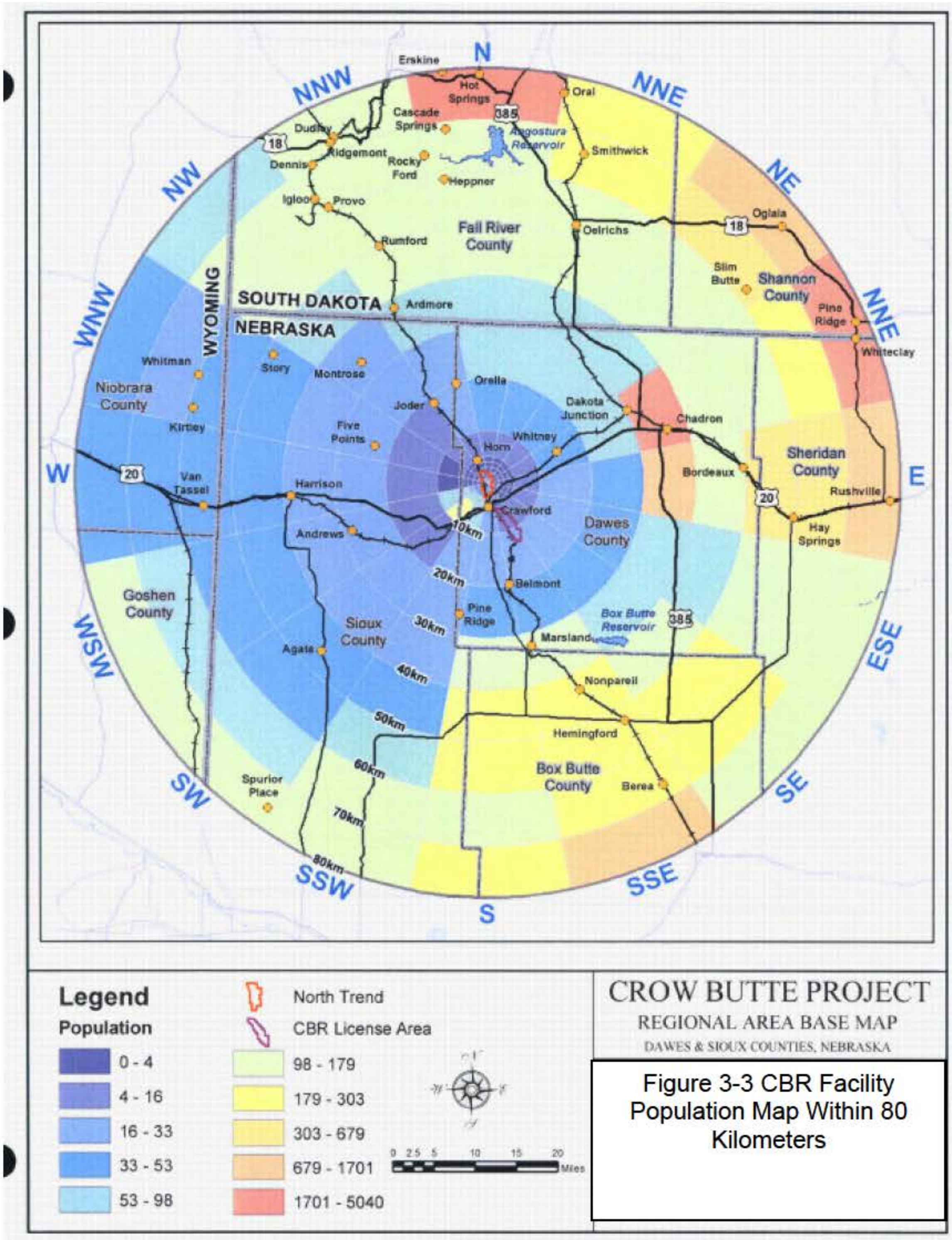


Figure 3-3 CBR Facility Population Map Within 80 Kilometers

Source: CBR, 2007A

3.6.2 Population Characteristics

The CBR facility is located in a rural agricultural area in Dawes County, Nebraska. The area within a 50-mile (80-km) radius of the CBR facility includes portions of seven counties in northwestern Nebraska, two counties in southwestern South Dakota, and two counties in eastern Wyoming (Figure 3-3).

Overall, a review of the census results from 1970 through 2010 (USCB, 1995a; USCB, 1995b; USCB, 1995c; USCB, 2001, Table P1; USCB, 2011, Table P1) indicate that the populations of the counties within the 50-mile (80-km) radius of the CBR facility have been declining. This decline is a result of decreases in the rural farming-based economy and limited economic opportunities for the young adult population. Persistent drought conditions have also contributed to the reduction in the agriculture-based economy and have increased the out-migration of rural residents. Because many of the people migrating out of the state are young adults and families, this has resulted in the increasing proportion of the elderly population in the state/region. The declining population trends of the last two decades are expected to continue into the foreseeable future (UNRI, 2005).

The 2010 census (USCB, 2011, Tables P12, P13, and PCT12) found that more than 85 percent of the population in each of the counties within the 50-mile (80-km) radius of the CBR facility was white, with the exception of Shannon County, South Dakota, which is 96 percent Native American. Shannon County is entirely within the Pine Ridge Indian Reservation. Native American populations make up the largest non-white classification in the area. This group comprises nearly 4 percent of the population of Dawes County, including about 5 percent in Chadron and about 1 percent in Crawford. Overall, more than 70 percent of the population in each county was more than 18 years old in 2010, again with the exception of Shannon County, which had about 39 percent of its population under 18 years old. In Dawes County, about 19 percent of the population was under 18 years old.

3.6.3 Population Projections

The population is expected to decrease in the Nebraska Counties of Box Butte, Sheridan, and Sioux. These counties are primarily rural, with agriculture-based economies. It is anticipated that the declining population trends of the last two decades will continue into the foreseeable future for these counties. The projected population for Dawes County is expected to increase at an annual rate of less than 1 percent over the next 20 years. This rate reflects recent increases in the population of Chadron that are expected to continue. (USCB, 2011, Tables P12, P13, and PCT12)

3.7 Economic Factors

3.7.1 Major Economic Sectors

In 2010, Dawes County’s unemployment rate was 4.4 percent (BLS, 2013a), an increase from the 2000 rate of 3.0 percent (BLS, 2013b). The unemployment rate in Box Butte County was 5.5 percent in 2010, an increase from the 2000 rate of 3.9 percent. These compare to the 2010 unemployment rate for the State of Nebraska of 4.7 percent (BLS, 2013c).

In 2010, per capita personal income in Dawes County was $28,384, which was 72 percent of the State average of $39,445. In Box Butte County, per capita personal income was $33,506 in 2010, which was 90 percent of the State average (BEA, 2012a; BEA, 2012b).

In 2000, Dawes and Box Butte Counties had homeowner vacancy rates of 3.0 and 2.2 percent, respectively, which changed to 2.3 and 2.4 percent, respectively, in 2010. In 2010, the rental vacancy rate in Dawes County was 10.2 percent and in Box Butte County was 17.7 percent (USCB, 2001; USCB, 2011).

Table 3.10.5 summarizes unemployment rates and employment in the Nebraska project area counties. Dawes and Box Butte Counties exhibited unemployment rates at 3.8 percent in Dawes County and 5.0 percent in Box Butte County. Unemployment rates for both counties increased between 1994 and 2002. In 1994, unemployment levels declined from February 1987 levels. These rates were a little higher than the statewide rate of 3.5 percent. Dawes County was close to the state unemployment rate, while the Box Butte rate was higher (CBR, 2007A).

The major economic sectors in the project area have changed little in recent years, although individual sectors have shifted in their relative proportion in the overall economy. The area continues to depend on trades, government, and services. Economic activities in the Crawford area include farming, ranching, cattle feed lots, tourism, and retail sales. Agriculture accounts for slightly more than 1 percent of the total employed labor force in Dawes County, while farm employment was 14 percent of total employment in Box Butte County. Government employment in Dawes County makes up 37 percent of total nonfarm employment, followed by trade (16 percent), leisure and hospitality services (14 percent), and education and health services (9 percent). Construction and milling account for *5* percent. In Box Butte County, the largest four non-farm employment sectors are transportation *(25* percent), government (22 percent), trade (16 percent), and manufacturing (9 percent). Agriculture employment has a small share of total employment in both counties. However, agriculture provides the economic base for the counties, as other economic sectors support the agricultural industry. Events that affect agriculture are generally felt throughout rural economies. Per capita personal income is the income that is received by persons from all sources, including wages and other income over the course of 1 year. In 2002, personal income in Dawes County was $19,760, which was 68 percent of the state average of $29,182. The county ranks 84th out of 93 counties in the state (BEA, 2004) for personal income. (CBR, 2007A)

Table 3-11: Annual Average Labor Force and Employment Economic Sectors for Dawes and Box Buttes Counties, 1994 and 2002

	Dawes		Box Butte	
	1994	2002	1994	2002
Labor Force	4,490	4,663	6,156	5,670
Unemployment	149	175	235	282
Unemployment Rate	3.3	3.8	3.8	5.0
Employment	4,341	4,489	5,921	5,387
Farm Employment	564	550	763	760
Non-Farm Employment Total	3,479	3,903	5,446	5,241
Manufacturing	165	201	402	465
Construction and Mining	136	179	80	0
Transportation, Communication, and Utilities	N/A	N/A	1,909	1,288
Trade	952	N/A	1,106	825
Retail	824	636	840	539
Wholesale	128	N/A	265	286
Financial, Insurance, and Real Estate	77	117	215	205
Services	548	N/A	779	N/A
Information	N/A	0	N/A	110
Professional and Business Services	N/A	N/A	N/A	219
Education and Health Services	N/A	358	N/A	424
Leisure and Hospitality	N/A	533	N/A	372
Other Services	N/A	133	N/A	203
Government	1,384	1,450	955	1,130
Federal	144	161	65	67
State	721	719	67	62
Local	519	571	824	1,001

*: Industry employment estimates are based on the Standard Industry Classification System before 2001, and on the North American Industry Classification System after 2001.
N/A = not available

Source: CBR, 2007A

3.8 Housing and Public Infrastructure

3.8.1 Housing

Between 1970 and 1980, total housing units increased by 17 percent in Dawes County from 3,388 to 3,965 units. By 2002, the growth of the preceding decades had slowed, and total housing units increased by 2.4 percent to 4,004 units from 3,909 units in 1990. Chadron, the largest community in Dawes County and within 40 km (25 miles) of the project site, experienced a 25 percent increase in housing stock between 1970 and 1980, and a *5* percent increase between 1990 and 2000. Crawford housing stock decreased by nearly *7* percent from 576 units in 1990. By 2000, there were 2,441 housing units in Chadron and 537 units in Crawford. Alliance, in Box Butte County (approximately 72 km [45 miles] from the project site) exhibited a 1 percent loss in total housing units between 1990 and 2000. In 2000, there were 4,062 housing units in Box

Butte County. In 2000, Dawes and Box Butte Counties had homeowner vacancy rates of 1.7 and 1.4 percent, respectively. Housing prices averaged $53,915 in 1999. According to the Dawes County Tax Assessor, no new houses are being built, as current housing needs are being met. (CBR, 2007A)

On the Pine Ridge Indian Reservation, there is a need for at least 3,000 new homes that Tribal members can occupy through home-ownership or rental. The Oglala Sioux Lakota Housing manages public housing on the reservation and has constructed housing over the years for the approximate 43 percent of the 2300 tribal families residing on the reservation. (Testimony of the President of the Oglala Sioux Tribe to the Senate Committee on Indian Affairs – March 2007). In the Pine Ridge area of Shannon County (zip code area of 57770), the average household size is 4.3 persons. (CBR, 2007A)

3.8.2 Education Resources

Crawford is served by the Crawford Public School District. The Crawford High School and grade school are presently under capacity. Total enrollment in these two schools as of fall 2001 was 146 in the high school and 140 in the elementary school with maximum capacities of 545 and 185, respectively (CBR, 2007A). In 2007 enrollment numbers were 134 in the grade school and 134 in the high school and are comparable to annual enrollments since 1987 for both schools. The grade school currently has a student to teacher ratio of 13 to 1 and the high school has a ratio of 8 to 1. No historical high enrollment was given for the grade school. However, it was estimated in 1995 that the high school historical high enrollment was more than 200 pupils. There is one rural school supporting grades one through eight within the Crawford district. The Belmont School is a two-room schoolhouse. Students living in the rural district attend Crawford High School. There were 6 pupils as of fall 2007 at the Belmont School from which Crawford High School draws, a decline from the 1995 enrollment of an estimated 100 pupils in seven rural school districts. (CBR, 2007A)

The Red Cloud Indian School, located in Shannon County, South Dakota, is a non-profit corporation operating as an accredited private school and organized under the laws of the state of South Dakota. The school received no Federal, State or Tribal funds. The Red Cloud Indian School provides education for approximately 573 Native American students. The Red Cloud Indian School provides education from kindergarten through high school to the Native American children on the Pine Ridge Reservation. The school currently has a teacher to student ratio of 1 to I0. The course work includes a basic educational curriculum as well as courses in ethics, religion, Lakota culture, Lakota religion and Lakota language. (CBR, 2007A)

The Pine Ridge school is located on the Pine Ridge Indian Reservation, Oglala Lakota Nation in the southwest corner of South Dakota. It provides accredited educational services for approximately 1000 Oglala Lakota children in grades kindergarten through twelve. (CBR, 2007A)

3.9 Cultural Resources

3.9.1 Historic and Cultural Resources

Section 106 of the National Historic Preservation Act of 1966, as amended (NHPA), requires that Federal agencies take into account the effect of an undertaking on any district, site, building, structure, or object that is included in or eligible for inclusion in the

National Register of Historic Places. As part of this required evaluation, Federal agencies must consult with Tribes to determine whether there are historic properties of cultural and religious significance to Tribes that may be adversely affected by a proposed undertaking.

3.9.2 Federal Undertaking

By letter dated November 27, 2007, Crow Butte Resources, Inc., (CBR) submitted to the U.S. Nuclear Regulatory Commission (NRC) staff a request to renew its source material license for its uranium in situ recovery (ISR) facility located in Crawford, Nebraska. License No. SUA-1534 authorizes the licensee to operate an ISR uranium recovery facility to produce yellowcake. In response to the NRC staff's requests for additional information and open issues, CBR supplemented the application by letters dated May 12, 2009, July 13, 2009, September 17, 2010, and September 28, 2010.

For the CBR facility, the NRC staff considers the area of potential effect (APE) to be contained within the 2,560-acre area CBR facility boundary.

3.9.3 Cultural Resources Background

Adequate summaries of the cultural background for the area of western Nebraska where the Crow Butte Resources (CBR) In Situ Uranium Recovery Facility is located can be found in NUREG-1910, "Generic Environmental Impact Statement for In Situ Leach Uranium Milling Facilities" (GEIS) (NRC 2009), available CBR project specific cultural resources reports (Bozell and Pepperl 1987; Späth 2007a, b), and elsewhere (Koch 2000, Louis Berger 2005). What follows is a general overview of relevant cultural background information.

Prehistoric Periods

The prehistoric cultural background is categorized into the following sequential developments, which are generally recognized in terms of archeology as occurring over a large area of the central plains:

- <u>Paleo-Indian Big Game Hunters (12,000 to 8,000 years before the present (BP))</u>. This cultural tradition began as humans gradually entered the plains following deglaciation of the region, sometime after 14,000 B.P. The economy was focused on the hunting of big game animals, notably mammoth and mastodon, and ancient forms of bison. Toward the end of the period, a transition in subsistence modes toward the modern form of bison took place, along with increased reliance on plant foods.

- <u>Archaic foragers (8,500 to 2,000 BP)</u>. The Plains Archaic period represents a continuation of the change in subsistence patterns that occurred in the latter part of the Paleo-Indian era. The diversity in dietary sources was more pronounced, and settlement patterns became more associated with highly productive food resource areas.

- <u>Plains Woodland (2,000 to 1,000 BP)</u>. The Plains Woodland period is characterized by largely sedentary lifestyles, with a mixed economy based on wild game animals, wild plants, and the beginnings of maize and bean horticulture. The defining settlement pattern of this period consists of earth lodge villages, located along the larger drainages. This period marked the appearance in the region of ceramic containers.

- Plains Village (1,000 to 600 BP). This period continued the trend toward increasing sedentism and increasing reliance on domesticated plants. Villages were primarily located along major river systems and larger tributaries. By the end of this period, the basic tribal structure of the later historic period on the plains was in place.

(Bozell and Pepperl 1987; Späth 2007a, b), and elsewhere (Koch 2000, Louis Berger 2005)

Proto-Historic and Post-Contact Tribes (400 BP to Present)

The post-contact period on the central plains is that period after initial contacts with Europeans and later Americans. The earliest documented contact in the region is by Spanish and French explorers in the early 1700s. Western Nebraska was home to “nomadic” people who resided in tepee villages and depended on bison hunting. At various times, these Tribes included the Apache, Crow, Kiowa, Cheyenne, Teton (Sioux), Comanche, and Arapaho. The Lakota Sioux, Northern Cheyenne, and Arapaho resided in northwestern Nebraska, and the Oglala and Sicangu Brule Sioux were concentrated around the Black Hills in northern Sioux country. By the mid-1800s, the Oglala and Brule bands had extended their range southward to the Platte River region of Nebraska.

The predominant Tribe in the region that includes the project area was formed by linguistically and regionally based groups and several subgroups of what has been termed the “Great Sioux Nation.” These groups and subgroups include the following:

- Lakota (Lak□óta, Teton)
  - Northern Lakota (Húkpap□a, Sihásapa)
  - Central Lakota (Mnik□ówožu, Itázipčho, Oóhenuŋpa)
  - Southern Lakota (Oglála, Sičháŋ□u)
- Western Dakota (Yankton-Yanktonai or Dak□óta)
  - Yankton (Iháŋkt□uŋwaŋ)
  - Yanktonai (Iháŋkt□uŋwaŋna)
- Eastern Dakota (Santee-Sisseton or Dakhóta)
  - Santee (Isáŋyáthi: Bdewákhathuŋwaŋ, Wa□pékhute)
  - Sisseton (Sisíthuŋwaŋ, Wa□péthuŋwaŋ)

(Bozell and Pepperl 1987; Späth 2007a, b), and elsewhere (Koch 2000, Louis Berger 2005)

Article 5 of the Fort Laramie Treaty of 1851 defined territories of each participating tribe, including the Sioux Nations of Rosebud, Standing Rock, Pine Ridge (Oglala), Crow Creek, Lower Brule, Cheyenne River, Santee, and Fort Peck, and indicated that the Sioux territory included land in northwestern Nebraska north of the North Platte River. By the Fort Laramie Treaty of 1868 between the United States and the Oglala, Miniconjou, and Brule bands of Lakota people; Yanktonai Dakota; and Arapaho Nation, land located in the future Dawes County, Nebraska, was included in “unceded” territory that was reserved by the Sioux Nation for the right to hunt and travel, but not for occupation. The 1868 Fort Laramie treaty created the Great Sioux Reservation, essentially all of present-day South Dakota, for the various Sioux groups and subgroups to occupy.

Many Lakota refused to recognize the 1868 Fort Laramie treaty, saying it provided little to the people, and pointed out that non-Indians continued to use Lakota land, and the Government did not honor treaty provisions that promised rations, clothing, and schools. These people continued to live in their traditional areas in the unceded lands, followed the buffalo, and maintained their traditional ways of life.

Following the 1868 Fort Laramie treaty, the Red Cloud Agency was established in August 1873, just west of the present town of Crawford in Dawes County, Nebraska. While members of the Oglala Lakota were placed at the agency, members of other Tribes such as the Northern Cheyenne and Arapaho were also sent to the agency.

In 1887, the U.S. Congress passed the General Allotment Act (Dawes Act) to break up communal Indian lands into individual family holdings within the Great Sioux Reservation. On March 2, 1889, Congress passed another act partitioning the former reservation into five smaller reservations, mostly in South Dakota:

- the Standing Rock Reservation, with its agency at Fort Yates
- the Cheyenne River Reservation, with its agency on the Missouri River near the mouth of the Cheyenne River (later moved to Eagle Butte following the construction of Oahe Reservoir)
- the Lower Brule Reservation, with its agency near Fort Thompson
- the Upper Brule or Rosebud Indian Reservation, with its agency near Mission
- the Pine Ridge Reservation (Oglala Sioux), with its agency at Pine Ridge near the Nebraska border

(Bozell and Pepperl 1987; Späth 2007a, b), and elsewhere (Koch 2000, Louis Berger 2005)

Euro-Americans (300 BP to Present)

As American settlers began emigrating through Nebraska on trails to the western United States in the mid-1800s, increasing conflicts arose in what had previously been Tribal use lands. The establishment of forts on Indian lands and an influx of settlers into the Nebraska Panhandle led to further agitation. Lack of enforcement by the U.S. Government of the Fort Laramie Treaty of 1851 resulted in conflict, eventually leading to the Fort Laramie Treaty of 1868. Continued disagreements between the United States and Tribes led to the construction of Fort Robinson adjacent to the Red Cloud Agency to keep peace. Fort Robinson served a vital role during the Sioux Wars of 1876–1877 and was the place of the Cheyenne Outbreak of September 9, 1878. Fort Robinson was also the setting for the tragic death of the Oglala Lakota leader Crazy Horse on September 5, 1877. In 1878, the Red Cloud Agency was moved to the newly created reservation in South Dakota, where it was renamed the Pine Ridge Agency and Reservation. Use of Fort Robinson continued through World War I, and in World War II, it was a training site for soldiers and a camp for German prisoners of war. It ceased use as a military camp in 1948, and today is a Nebraska State park and historic site.

The town of Crawford began about 1866 as a civilian tent camp to support Fort Robinson. The town was formally established and named in 1886, and by then it was the hub of an area of active ranching and farming. Throughout its early history, Crawford and the immediate area included several significant regional transportation routes:

- the Fort Laramie, WY, to Fort Pierre, SD, Trail (1837 to 1880s)
- the Sidney, NE, to Deadwood, Black Hills, SD, Trail (1876 to 1880)
- the Fort Robinson/Red Cloud Agency to Camp Sheridan/Spotted Tail Agency Road (1874 to 1880s)
- the Fremont, Elkhorn, and Missouri Valley Railroad, then a subsidiary of the Chicago and Northwestern Railroad (1886)
- the Chicago, Burlington and Quincy Railroad (1887)

3.9.4 Identified Historic and Cultural Resources

Information for known or previously recorded historic and cultural properties comes from several sources, including the National Register of Historic Places (NRHP), State registers, and project-specific field inventories. Administered by the National Park Service, the NRHP is the official Federal list of districts, sites, buildings, structures, and objects significant in American history, architecture, archeology, engineering, and culture. NRHP properties have significance to the history of their community, their State, or the Nation. The State of Nebraska does not have a formal State register, but it does maintain a list of the State’s historic significant events, people, places, sites, movements, and traditions through the Nebraska Historical Marker Program, overseen by the Nebraska State Historical Society.

The final source for previously known and recorded historic and cultural sites results from past field inventories of the project lands. Earlier field surveys of the CBR research and development area (1982) and the CBR Commercial Study Area (1987) resulted in the recording of 21 prehistoric and historic resource sites (Bozell and Pepperl 1987).

3.9.5 National Register of Historic Places and State Registers

National Register

Five historic period sites within 10 miles of the CBR facility have been nominated to and listed in the NRHP. In addition to being included on the NRHP, the Fort Robinson and the Red Cloud Agency property, located west of the town of Crawford within the boundaries of the Fort Robinson State Park, is also designated a National Historic Landmark (NHL) by the U.S. Department of the Interior. NHLs are nationally significant historic places designated by the Secretary of the Interior because they possess exceptional value or quality in illustrating or interpreting the heritage of the United States.

No NRHP-listed properties are present within the boundaries of the Crow Butte APE (Louis Berger 2005), although six archaeological and historic architecture sites are evaluated as being "potentially eligible" for listing.

Table 3-12: NRHP-Listed Properties in Proximity to the CBR In Situ Uranium Recovery Facility (All in Dawes County)

NRHP-Listed Properties	Date Listed	Approximate Distance/Direction from the CBR In Situ Uranium Recovery Facility
Army Theater, Fort Robinson State Park	July 7, 1988	6 mi. W/NW
Co-Operative Block Building, Crawford, NE	September 12, 1985	4 mi. NW
Fort Robinson and Red Cloud Agency	October 15, 1966	6 mi. W/NW
U.S. Post Office, Crawford, NE	May 11, 1992	4 mi. NW
Henry Wohlers, Sr. Homestead, south of Crawford, NE	October 15, 2004	2.5 mi. N/NW

Source: CBR, 2007A

Nebraska State Register

The *Nebraska Revised Statutes*, Sections 82-119 through 82-124, authorize the Nebraska State Historical Society to mark and preserve the historical landmarks of Nebraska. This effort is coordinated through the Nebraska Historical Markers Program. Evaluation criteria for qualification for the Historical Markers Program are found in *Nebraska Revised Statutes*, Section 82-120.

Historical markers have been placed at 21 sites and places in proximity to the town of Crawford; however none of these sites fall within the 2560-acre APE. All but three of these are related to events, places, and buildings associated with Fort Robinson and the Red Cloud Agency. All of the locales marked by the State program are fenced off and protected.

3.9.6 Previous Cultural Resources Survey

Intensive (100-percent coverage) field surveys for historical and archaeological sites within the CBR facility (see Figure 1-1) were conducted in two phases. The University of Nebraska conducted identification and assessment of cultural resources in the CBR research and development area in March and April 1982. The Nebraska State Historical Society surveyed the remainder of the CBR license area (the Commercial Study Area) during April and May 1987. The results of the two surveys were presented in a single report (Bozell and Pepperl 1987).

The efforts in 1982 and 1987 recorded a total of 21 prehistoric and historic period archaeological sites. Cultural affiliation of the recorded sites included eight with Native American components, 12 historic period locations, and a buried bone deposit of undetermined cultural association.

Investigators from the University of Nebraska and the State Historical Society found that 15 of the newly recorded sites, including four Native American and nine historic period locales, contained limited scientifically important cultural remains or were not determined to be of significant historic value based on archival research. These 15 sites were evaluated as being “not eligible” for nomination and potential listing on the NRHP. Six sites, including three Native American and three historic period locales, were evaluated as being “potentially eligible” for the NRHP, requiring further field assessment for a full evaluation as being “eligible.” Four of these sites (25DW114, 25DW192, 25DW194, and 25DW198) were evaluated as having potential importance for the recovery of archaeological data, and sites 25DW112 and 25DW00-25 have possible architectural values.

“Potentially eligible” Native American and historic period sites would be treated as “eligible,” pending further actual determination of their eligibility status. Since CBR was able to avoid each of the “potentially eligible” archaeological sites during the construction and operation phases of the project, full assessments of the eligibility status of these six sites were not conducted. Documented field visits in 2010, 2011, and 2012 made to each of the six “potentially eligible” sites confirmed that the sites did not incur any impacts during the CBR construction phase and the early operation phase (through 1995) (Crow Butte Resources 1995).

Table 3-13: Prehistoric and Historic Cultural Resources Recorded during the 1982 and 1987 Field Investigations at the Crow Butte Project

Site Number	Year Recorded	Site Type/Age	NRHP Finding
25DW111	1982	Harvey Homestead; historic period	Not eligible
25DW112/ 00-17	1982	Wulf/Daniels Farmstead; historic period	Potentially eligible
25DW113	1982	Fiandt Homestead; historic period	Not eligible
25DW114	1982	Prehistoric lithic tools, flaking debris, trade goods, and nonhuman bone; Paleo-Indian, Middle Archaic, Late Archaic, Late Prehistoric, and Historic Components	Potentially eligible
25DW115	1982	School District No. 25; former location of First Presbyterian Church; historic period	Not eligible
25 DW116	1982	Surface lithic scatter; unassigned Native	Not eligible

Site Number	Year Recorded	Site Type/Age	NRHP Finding
		American	
25 DW117	1982	Fleming Homestead; historic period	Not eligible
FN-1	1982	Isolated stone flake; unassigned Native American	Not eligible
FN-2	1982	Buried nonhuman bone and charcoal; unknown cultural Association	Not eligible
FN-3	1982	Crow Butte Cemetery; historic period	Not eligible
25DW191	1987	Dougherty/Smith Farmstead; historic period	Not eligible
25DW192	1987	Stetson/Roby Farmstead; historic Period	Potentially eligible
25DW193	1987	Surface/buried school foundation, artifact scatter; historic period	Not eligible
25DW194	1987	Surface/buried lithic tools, nonhuman bone, human remains; Plains Equestrian Period and unassigned Native American	Potentially eligible
25DW195	1987	Surface lithic tools, flaking debris, and fire-cracked rock; unassigned Native American (possibly Archaic)	Not eligible
25DW196	1987	Surface lithic tools, flaking debris, and nonhuman bone; unassigned Native American	Not eligible
25DW197	1987	Surface lithic tools, flaking debris, and nonhuman bone; unassigned Native American	Not eligible
25DW198	1987	Surface/buried (plow zone only) lithic tools and flaking debris; unassigned Native American	Potentially eligible
25DW199	1987	Crawford Ice House; historic period	Not eligible
25DW00-25	1987	Stetson Place; occupied historic period farmstead	Potentially eligible
25DW00-26	1987	Gibbons/Ehlers Place; occupied historic period farmstead	Not eligible

Source: CBR, 2007A

3.9.7 Tribal Consultation

The table below lists previous tribal contacts made by either the applicant or the NRC for the purpose of consultation under NHPA Section 106 or to acquire information from Tribal experts concerning the existence of potential traditional cultural properties (TCPs) within the Crow Butte APE.

Traditional Cultural Properties

A TCP is associated with cultural practices or beliefs of a living community that (1) are rooted in that community's history and (2) are important in maintaining the continuing cultural identity of the community (Parker and King 1998). A TCP may be a building, site, district, object, or landscape. The significance must stretch beyond the past 50 years yet retain ongoing significance. Although the same aspects of integrity are relevant (e.g., integrity of location, design, setting, materials, workmanship, feeling, and association), National Register Bulletin 38, "Guidelines for Evaluating and Documenting Traditional Cultural Properties" (Parker and King 1998), notes that the concept of integrity is applied somewhat differently for TCPs than it is for historic buildings or archaeological sites:

> In the case of a TCP, there are two fundamental questions to ask about integrity. First, does the property have an integral relationship to

traditional cultural practices or beliefs; and second, is the condition of the property such that the relevant relationships survive?

American Indian researcher and Lakota tribal member Mr. Vine Deloria, Jr., offers the following classification that reflects the wide-ranging variability for TCPs (Deloria and Stoffle 1995):

- creation story locations and boundaries
- sacred portals recounting star migrations
- universal center locations
- historic migration destiny locations
- places of prehistoric revelations
- traditional vision quest sites
- plant-animal relationship locations
- mourning and condolence sites
- historic past occupancy sites
- spirit sites
- recent historic event locations
- plant, animal, and mineral gathering sites
- sanctified ground

Table 3-14: CBR In Situ Recovery Facility: Summary of Tribal Contacts for NHPA Section 106 Consultation

Tribal Nation	Contacted for 1998 TCP Evaluation[1]	Invitation To Be a Consulting Party under NHPA Section 106[2]	Invited to June 2011 Informal Information Gathering Meeting[3]	Attended June 2011 Informal Information Gathering Meeting[4]
Oglala Sioux Tribe	X	X	X	X
Standing Rock Sioux Tribe		X	X	X
Yankton Sioux Tribe		X	X	
Rosebud Sioux Tribe		X	X	X
Cheyenne River Sioux Tribe		X	X	X
Crow Creek Sioux Tribe		X	X	
Flandreau Santee Sioux Tribe			X	X
Lower Brule Sioux Tribe		X	X	
Sisseton Wahpeton Oyate			X	
Spirit Lake Tribe			X	
Lower Sioux Indian Community			X	
Northern Cheyenne Tribe	X	X	X	

1 Letters sent by the CBR cultural resources consultant, April 30, 2004 (Resource Technologies Group 1998).

2 Letters sent by the NRC Office of Federal and State Materials and Environmental Management Programs, January 13, 2011.

3 Letters sent by the NRC Office of Federal and State Materials and Environmental Management Programs, May 12, 2011.

4 The Crow Butte Project site visit and information-gathering meeting took place June 7–8, 2011, in Crawford, NE, and Pine Ridge, SD (NRC 2011).

Tribal Nation	Contacted for 1998 TCP Evaluation[1]	Invitation To Be a Consulting Party under NHPA Section 106[2]	Invited to June 2011 Informal Information Gathering Meeting[3]	Attended June 2011 Informal Information Gathering Meeting[4]
Northern Arapaho Tribe		X	X	
Eastern Shoshone Tribe		X	X	
Santee Sioux Nation		X	X	
Ponca Tribe of Nebraska		X	X	
Crow Nation	X	X	X	
Three Affiliated Tribes (Mandan, Hidatsa, Arikara)		X	X	
Pawnee Nation of Oklahoma	X		X	
Assiniboine Sioux, Fort Peck Tribes			X	
Cheyenne and Arapaho Tribes of Oklahoma	X	X	X	
Kiowa Tribe of Oklahoma		X	X	
Southern Cheyenne	X			
Apache Tribe of Oklahoma		X	X	
Comanche Nation		X	X	

Previous Tribal Consultations for the Crow Butte Project Area

As part of the 1998 initial renewal of the CBR license to continue operation of the then-active CBR In Situ Uranium Recovery Facility, a consultant for the applicant conducted a limited TCP study that involved sending letters to six tribal governments and requesting any information on localities of potential traditional concern or value to Native American groups (Resource Technologies Group 1998). The letter informed the recipients that an archaeological survey was completed in 1986 but did not provide them with a copy of the results of that survey. The applicant received no responses from the six Tribes contacted, which included the Oglala Sioux (South Dakota), Crow (Montana), Southern Cheyenne and Arapaho (Oklahoma), Southern Cheyenne (Oklahoma), Southern Arapahoe (Oklahoma), and Pawnee (Oklahoma).

For the current application for a renewal of the CBR license, the NRC sent a letter to 18 Tribes on January 13, 2011, inviting the tribal governments to a formal consultation for the license renewal environmental review under NHPA Section 106. These letters requested any known information on any areas on the project site that the Tribes believe have religious and cultural significance. A map of the current Crow Butte CBR facility boundary and the proposed North Trend Expansion Area (NTEA) boundary was attached. The letter directed the Tribes to the NRC Agencywide Documents Access and Management System (ADAMS), where the CBR ER is available for electronic review. Following receipt of this letter, the Cheyenne River Sioux Tribe, Comanche Nation, Crow Creek Sioux Tribe, Crow Tribe of Montana, Eastern Shoshone Tribe, Flandreau Santee Sioux, Fort Peck Assiniboine Sioux Tribe, Kiowa Indian Tribe of Oklahoma, Lower Brule Sioux Tribe, Lower Sioux Tribe, Northern Arapaho Tribe, Northern Cheyenne Tribe, Oglala Sioux Tribe, Pawnee Nation of Oklahoma, Rosebud Sioux Tribe, Santee Sioux

Nation, Sisseton Wahpeton Tribe, Spirit Lake Tribe, Standing Rock Sioux Tribe, Turtle Mountain Chippewa Nation, and the Yankton Sioux Tribe formally requested status as consulting parties under NHPA Section 106.

On May 12, 2011, the NRC sent letters to 24 Tribes inviting them to attend an informal information gathering meeting and a site visit June 7–9, 2011, at the Pine Ridge Reservation in South Dakota. The letter of invitation included a CD with publicly available[5] archaeological surveys for the Crow Butte project area and a map of the project area.

Six consulting Tribes attended the meeting and site visit. Each of these Tribes inhabits reservations located in South Dakota. Tribes in attendance took a tour of the CBR In Situ Uranium Recovery Facility project area near Crawford, Nebraska, on June 7, 2011, as well as a tour of the proposed CBR NTEA that is the subject of a separate ongoing NRC Section 106 consultation process.

As stated earlier, the NRC staff met with the Tribal Historic Preservation Offices (THPOs) to gather information on June 8, 2011. The purpose of the meeting was to help the NRC staff identify tribal historic sites and cultural resources that may be affected by actions associated with renewal of the CBR facility, the proposed CBR expansion areas in Nebraska, and the proposed Dewey-Burdock ISR project. Representatives of six tribes (Oglala, Sioux, Standing Rock Sioux, Flandreau-Santee Sioux, Siston-Whapeton Oyate, Cheyenne River Sioux, and Rosebud Sioux) attended.

During the June 8 meeting to discuss several different projects, including the relicensing of the CBR facility, tribal officials expressed concerns about the identification and preservation of historic properties of traditional religious and cultural importance to tribes at the CBR facility. Tribal officials stated that historic and cultural resources studies of sites should be conducted with tribal involvement. A transcript of this meeting (NRC, 2011) is available through the NRC ADAMS database on the NRC website (www.nrc.gov/reading-rm/adams.html) (ML111721938).

On January 19, 2012, the NRC staff sent letters to 24 Tribes inviting them to attend a meeting on February 14th and 15th 2012 to continue ongoing consultation and discuss hear the views of the Tribes about potential Traditional Cultural Properties. Representatives of 19 Tribes attended the meetings.

3.9.8 Potential Places of Cultural Significance

In addition to the previously recorded archaeological sites within the Crow Butte APE that were evaluated as having a Native American cultural affiliation, other potential places of cultural significance are located in the vicinity of the Crow Butte APE. The identification of these potential TCPs comes from the tribal information-gathering meeting held in June 2011, supplemented by literature searches:

- Crow Butte—The Crow Butte itself is located about 0.5 miles east of the CBR project area. Crow Butte was the site of a legendary 1849 battle between

5 The term "publicly available" refers to a redacted version of the archaeological reports in which information, such as location data, is removed to prevent unlawful damage or vandalism to archaeological sites.

members of the Lakota and the Crow Tribes. Although exact details of the event differ in accounts over time, it is well remembered through Native American memory and by non-Indians as well (Cross 1916; Hanson and Wyatt 2009).

- Vision Quest Sites—A long ridge adjacent to Crow Butte was used in earlier years as a place that young Lakota men went to for vision quests. This locale would be about 1 mile east of the CBR project area.

- Medicinal Herbs—According to Tribal representatives at the information-gathering meeting, unspecified herbs used in traditional medical practices to treat ailments such as headache, stomachache, and arthritis grow on the CBR project area and around Crow Butte. Tribal members believe these herbs do not grow elsewhere.

- Cultural Landscape—The general region in which the CBR In Situ Uranium Recovery Facility and appurtenant well fields are located is steeped in history, especially during the period of Fort Robinson and the Red Cloud Agency (1873–1877) and the Great Sioux War (1876–1877). For Native Americans, the CBR project area and the surrounding area includes land involved in the 1851 and 1868 Fort Laramie Treaties, having been traditionally occupied by various Lakota bands of the Great Sioux Nation. Oglala Lakota Chief Little Wound (ca. 1835–1899) is said to have camped around Crow Butte during that time. During the Red Cloud Agency era, other Tribes were brought to and occupied this general area as well, including Arapaho and Northern Cheyenne people.

On October 31, 2012, NRC invited all the consulting Tribes to complete a TCP field Survey of the CBR facility and proposed expansion areas in the vicinity of the Crow Butte APE. In November and December of 2012, a TCP field survey was completed by the Santee Sioux Nation and the Crow Nation. A TCP report (ML13064A481) was submitted to the NRC by the Santee Sioux Nation on behalf of both Tribes (SSN 2013). The report concluded that there were no eligible sites of cultural or religious significance to the Tribes at the CBR facility and the proposed Marsland and Three Crow expansion areas. Several other consulting Tribes responded to this report disagreeing with the findings (From Cheyenne River Sioux – ML13123A089 (Our response- ML13157A297); From Yankton Sioux – ML13126A309 (Our response ML13157A221); From Standing Rock Sioux – ML13126A327 (Our response- ML13157A263)). A detailed assessment of the report and the comments are found in the environmental impacts section of this EA.

In October, 2013 all Tribes were sent a copy of the NRC staff's preliminary documentation of its NHPA review for the CBR license renewal. The only comments that the NRC staff received were general in nature, pertaining to NRC staff's overall NHPA consultation.

3.10 Ecology

3.10.1 Terrestrial Ecology

3.10.1.1 Vegetation and Land Cover Types

The CBR facility is located within the Pine Ridge area of Nebraska and is represented by two principal vegetation regions (CBR, 2007A). The Pine Ridge area is also the region for the Black Hills of South Dakota, an ecologically significant area for the region.

<u>Plains and Prairie Flora</u>

The main features that describe this vegetation region are a dominance of grasses, absence of trees, rolling topography, and a characteristic xerophytic flora. Species occurring on the study area include big bluestem, little bluestem, Canada wild rye, Kentucky bluegrass, sage, purple cornflower, breadrood scurf pea, golden rod and related species. (CBR, 2007A)

<u>Rocky Mountain Forest Flora</u> (Black Hills Montane Element)

Although geographically separated from the Rocky Mountains, the Pine Ridge and Black Hills have affinities to this region, which lies principally 200 km to the west. Floral species suggest that the two areas were contiguous during Pleistocene times. Species on the study area typical of this region include Oregon grape, Rocky Mountain juniper, ponderosa pine and Mariposa lily. (CBR, 2007A)

Many non-native plant species occur in the study area. A 1982 study conducted by CBR estimated that 30 percent of species and more than 50 percent of plant cover consists of non-native plant species that are conspicuously successful and include smooth brome, cheatgrass, white sweetclover, yellow sweetclover and several Brassicaciae, including the species tumble mustard, tansy mustard, pennycress charlock, and Shephard's purse. Cultivated species include wheat, oats, rye, corn, milo and alfalfa. plants. (CBR, 2007A)

According to the Great Plains Flora Association about 1,020 species of plants should be expected to occur within 80-km of the CSA. During the baseline survey study conducted by CBR between March and Mid-July, 1982, more than 400 species of plant were collected within the study area. Of that number, 163 species were recorded within a specific Section 19 study. (CBR, 2007A)

Wetlands are ecosystems determined by their hydric soils, vegetation characterization, and hydrology. Wetlands are important ecosystems for species diversity and protected by the US Army Coprs of Engineers. Wetlands make up less than 4 percent of the CBR site (CBR, 2007A).

3.10.1.2 Mammals

Thirty six species of wild mammals were documented during the 1982 baseline study, and another 28 species, mostly bats, insectivores, and small rodents, were deemed likely to occur in the region. (CBR, 2007A)

Big Game

According to the application, big game species that are expected to occur in suitable habitats throughout the project area include pronghorn antelope, white-tailed deer, and mule deer. Elk and bighorn sheep may occur as transient species because of their known distribution in the Pine Ridge area. (CBR, 2007A)

Pronghorn Antelope

Pronghorn typically inhabit grasslands and semi-desert shrublands of the western and southwestern United States. This species is most abundant in short- and mixed-grass habitats and is less abundant in more dry habitats. Home ranges for pronghorn can vary between 400 and 5,600 acres, according to several factors including season, habitat quality, population characteristics, and local livestock occurrence. Typically, daily movement does not exceed 6 miles. Some pronghorn migrate seasonally between summer and winter habitats, but these migrations are often triggered by availability of succulent plants and not local weather conditions (Fitzgerald et al. 1994). Nebraska is on the eastern fringe of the pronghorn's range, and there are large areas within the range boundary where pronghorns do not occur. The highest densities of pronghorn are in the northern and southern Panhandle, primarily in the short-grass prairies and badlands. The Nebraska Game and Parks Commission (NGPC) allow pronghorn hunting in 11 units, and the project area is within the North Sioux unit. Antelope harvest information available from the NGPC reveals that 310 firearm permits were issued in 2002, followed by a decrease to 264 permits issued in 2003. The population trend for the pronghorn inhabiting the region has seen an overall decline in herd numbers (Hams 2004). This trend is attributed to extreme drought that has limited forage availability along with low breeding success. (CBR, 2007A)

Mule Deer

Mule deer occur throughout western North America from central Mexico to northern Canada. Typical habitats include short grass and mixed-grass prairies, sagebrush and other shrublands, coniferous forests, and forested and shrubby riparian areas. In Nebraska, mule deer occur in foothills, broken hill country, prairie grasslands, and shrublands. Browsing is an important component of the mule deer's diet throughout the year, making up as much as 60 percent of total intake during autumn, while forbs and grasses typically make up the rest of their diet. This species tends to be more migratory than white-tailed deer, traveling from higher elevations in the summer to winter ranges that provide more food and cover. Fawn mortality is typically caused by predation or starvation. Adult mortality often occurs from hunting, winter starvation, and automobile collisions. Typical predators may include coyotes, bobcats, golden eagles, mountain lions, bears, and domestic dogs. Mule deer are distributed primarily along the foothills and escarpments, ranging outward into mixed-grass prairie and cultivated land. (CBR, 2007A)

White-Tailed Deer

White-tailed deer occur throughout North America from the southern United States to Hudson Bay in Canada. Across much of its range, this species inhabits forests, swamps, brushy areas, and nearby open fields. White-tailed deer are found throughout the state of Nebraska, typically concentrated in riparian woodlands, mixed shrubs riparian, and associated irrigated agricultural lands, and are generally absent from dry grasslands and coniferous forests. Their diet is diverse, capitalizing on the most nutritious plant matter available at any time. In addition to native browse, grass, and forbs, this species would rely on agricultural crops, fruits, acorns, and other nuts. Mortality to white-tailed deer is typically related to hunting, winter starvation, collisions with automobiles, and predation. Predators may include coyotes, mountain lions, wolves, and, occasionally, bears, bobcats, and eagles. (CBR, 2007A)

Elk

Elk formerly ranged over much of central and western North America from the southern Canadian Provinces and Alaska south to the southern United States, and eastward into the deciduous forests. In Nebraska, this species occurs primarily in the northwestern region in a variety of habitats, including coniferous forests, meadows, short- and mixed-grass prairies, and sagebrush and other shrub lands. Similar to other members of the deer family, this species relies on a combination of browse, grasses, and forbs, depending on their availability throughout the seasons. Elk tend to be migratory, moving between summer and winter ranges. Typically, mortality is a result of predation on calves, hunting, and winter starvation. Predators may include coyotes, mountain lions, bobcats, bears, and golden eagles. (CBR, 2007A)

Bighorn Sheep

Prior to the 1900s, the Audubon bighorn sheep inhabited parts of western Nebraska including the Wildcat Hills, the Pine Ridge, along the North Platte River to eastern Lincoln County, and along the Niobrara River. It is thought that the Audubon bighorn probably became extinct in the early 1900s with its last stronghold being the South Dakota badlands. In 1981, the Nebraska Game and Parks Commission began introducing bighorn sheep in the Pine Ridge area. A dozen bighorns were released into a 500-acre enclosure at Fort Robinson State Park near Crawford. In December 1988, 21 sheep were released from the pen and in January 1993, the remaining 23 sheep were released. Nebraska's bighorn sheep population is now estimated to be between 80 and 140. (CBR, 2007A)

Carnivores

Low numbers of coyotes, red fox, and long-tailed weasel are expected to range freely and widely throughout the project area. Bobcat, badger, and striped skunk may also occur in the project area, but they are less common. (CBR, 2007A)

Small Mammals

The deer mouse, white-footed mouse, thirteen-lined ground squirrel, meadow jumping mouse, northern pocket gopher, and meadow vole are expected to occur in the highest abundances. The highest densities of these small mammals are expected to occur in the deciduous forest areas, whereas the lowest abundance of small mammals would most likely occur in the cultivated fields. Muskrat may occur along watercourses, and beaver may occur in the White River Basin. Porcupine, fox squirrel, white-tailed jackrabbit, black-tailed jackrabbit and eastern cottontail are also expected to occur throughout the project area. (CBR, 2007A)

3.10.1.3 Birds

The Nebraska Ornithologists' Union's (NOU) "Official" lists 434 birds (including two extinct species - passenger pigeon and Carolina parakeet) occurring in Nebraska (NOU, 1997). Of the NOU 434 birds sighted in Nebraska, approximately 200 species breed in the state. Common birds anticipated to occur within the cultivated fields include the American robin, red-winged blackbird, mourning dove, house wren, violet-green swallow, and horned lark. Birds associated with riparian and woodland habitats include pine siskin, red crossbill black-capped chickadee, rufous-sided towhee, yellow warbler, and house wren. Several raptors are expected to occur in the area, including golden eagles, red-tailed hawk, American kestrel, northern harrier, prairie falcon, turkey vulture and great horned owl. (CBR, 2007A)

Upland Game Birds

Wild turkey range now includes most major river drainages in the state and the Pine Ridge area. Populations of turkeys in the Pine Ridge and Niobrara River valley are primarily Merriam's turkey. (CBR, 2007A)

Ring-necked pheasants range from fairly abundant to common throughout the project area with preferred habitats occurring in shelterbelts, drainages, and edges of cultivated fields. (CBR, 2007A)

Sharp-tailed grouse are most commonly found in short- and mixed- prairie grassland areas interspersed with serviceberry, chokecherry, and snowberry. Shrubs and small trees play an important role in sharp-tailed grouse ecology, especially in winter when they provide both food and cover. (CBR, 2007A)

Waterfowl

Waterfowl may occur throughout the region primarily during both the spring and fall migrations. However, because of the lack of wetlands and their associated habitats, the diversity and abundance is extremely low in the project area. Outside of the reaches of open water associated with the White River, impoundments and wetland habitats are absent from the project area. (CBR, 2007A)

3.10.1.4 Reptiles and Amphibians

There are 22 species of reptiles and amphibians were recorded in Dawes and Sioux Counties. Documented toads and frogs included Woodhouse's toad, Great Plains Toad, plains spadefoot, western striped chorus frog, northern leopard frog and bullfrog. There were also two species of turtles observed, these included the snapping turtle and painted turtle. Reptiles identified included the bullsnake, plains garter snake, red-sided garter snake and racer. There are no threatened or endangered reptiles, amphibians or fish species within the project area. (CBR, 2007A)

3.10.1.5 Threatened, Endangered, or Candidate Species

There are no known Threatened or Endangered Species on the CBR site. According to the U.S. Fish & Wildlife Service, there are 4 species that have the potential to occur in the project area of Dawes County, NE. and are listed in Table 3-16

Table 3-16: Threatened and Endangered Species Near the CBR Facility

Species	Federal/State Listing Status		Habitat	Critical Habitat
	Federal	State		
Swift fox (*Valeesvelox)*	Not Listed	Endangered	Large tracts of short- and mid-grass prairie habitats.	None designated
Bald eagle *(Haliaeetus leucoceehal*	Delisted	Threatened	Migrates spring and fall statewide, but primarily along the major river courses.	None designated
Black-Footed Ferret	Endangered	Endangered	Closely associated with prairie dogs found in short and mid-grass prairies.	None designated
Whooping Crane (*Grus Americana)*	Endangered	Endangered	Slow-moving rivers/streams with sandbars/islands; nearby wet meadows, croplands and marshlands.	None designated

Source: CBR, 2007A

Bald eagles occur throughout North America from Alaska to Newfoundland and from the southern tip of Florida to southern California. In Nebraska, this species builds large nests in the crown of large mature trees such as cottonwoods or pines. Fish and waterfowl are the primary sources of food where eagles occur along rivers and lakes. Big game and livestock carrion, as well as larger rodents (for example, prairie dogs) can also be important dietary components where these resources are available. This species is an uncommon breeding resident in Nebraska, using mixed coniferous and mature cottonwood riparian areas near large lakes or rivers as nesting habitat. Eagles are expected to winter in areas of suitable habitat within the region, especially in the Pine Ridge area. Feeding areas, diurnal perches, and night roosts are fundamental elements of bald eagle winter habitats. The availability of food is probably the single most important factor in the winter distribution and abundance of the eagle. In Nebraska, the diet of bald eagles is more varied than in other regions where fish are the primary food source. Nebraska grassland and shrub land habitats support a variety of suitable bald eagle prey species, including prairie dogs, lagomorphs, big game and livestock carrion. They also prey on fish and waterfowl when available. However, no bald eagle nests and winter nighttime roosts have been documented within the project area. (CBR, 2007A)

Within Nebraska, the swift fox is listed as threatened under the Nongame and Endangered Species Conservation Act. The swift fox is found in short- and mid-grass prairie habitats. It appears to prefer flat to gently rolling terrain. Swift fox feed primarily on lagomorphs, but arthropods and birds are also included in their diets. They mate between late December and February. A mating pair can bear two to five pups late March to early May, and pups emerge from the den in June. Dens are generally located along slopes or ridges that offer good views of the surrounding area. The home range size of an adult swift fox was approximately 9 square kilometers at night, and their day ranges are typically much smaller. The swift fox is found in native shortgrass in northwestern Nebraska. Unlike coyotes or red fox, the swift fox uses dens in the ground the entire year. Where coyotes are abundant, predation by coyotes is a significant source of mortality for swift fox and den availability is an important aspect of swift fox survival. Sightings of swift fox have been documented in northwestern Nebraska since the late 1970's. Most of these sightings have occurred in and around Oglala National Grasslands primarily in large tracts of native prairie. (CBR, 2007A)

3.10.1.6 Aquatic Resources

Aquatic Ecology

During the 1982 and 1996 baseline collections, fish were collected in various streams, including the White River, to document their occurrence. Fifteen species of fish were collected during the 1982 and 1996 collection periods. Game fish collected in the White River included rainbow trout, brown trout, and white sucker. Minnow species collected in the White River include longnose dace, common shiner, fathead minnow, and creek chub. There are habitats for fish and macroinvertebrates exists within portions of the White River. (CBR, 2007A)

3.11 Public and Occupational Health and Safety

3.11.1 Non-Radiological Activities Associated with Current Operations

The current operations at the central plant involve the use of hazardous chemicals that could present a hazard to workers and the environment. The design of storage and handling facilities is in accordance with acceptable codes and standards. As a result there has not been a serious incident involving hazardous chemicals at the CBR facility. During production, injection of the lixiviant into the well field results in temporary degradation of water quality in the exempted aquifer. The movement of this water out of the well field results in an excursion. To date there have been several horizontal excursions in the Basal Chadron Sandstone at the CBR facility, which were recovered through overproduction in the immediate vicinity (CBR, 2007A). In no case did the excursions threaten the water quality of an underground source of drinking water since the monitoring wells are located well within the aquifer exemption area approved by the EPA and NDEQ.

3.11.2 Radiological Activities Associated with Current Operations

Since this project is an ISR operation, the usual emission sources normally associated with a conventional uranium mill are not present. The CBR facility uses a vacuum dryer which works on the principle that gases or particulates released into the system are collected in a liquid condenser and there is no release of particulates. There is a 100 percent effluent collection efficiency for this dryer system. The routine radioactive emission will therefore, be radon-222 (radon) gas. Radon gas is dissolved in the leaching solution and may be released as the solution is brought to the surface and processed in the plant. Unplanned emissions from the site are possible as a result of accidents and engineered structure failure.

Approximately 9000 gpm of the process solution will be passed through upflow ion exchange columns which will vent the majority of the radon into the exhaust manifold. From these columns, the solution will be transferred to an injection surge tank, where it will be refortified with chemicals before being pumped to the wellfield. This tank will be vented in a manner similar to the ion exchange (IX) column and if any additional radon leaves the solution, it would be vented at this location.

With pressurized columns the radon will remain in solution and be returned to the formation and will not be released to the atmosphere. There will be minor releases of radon during the air blowdown prior to elution and during the filling of the columns after elution has been completed. The air blowdown and the gas released from the vent during column filling will be vented into the exhaust manifold and will be discharged via the main exhaust stack along with the radon from the upflow columns. It is estimated that less than 10 percent of the radon contained in the process solutions will be vented to atmosphere.

CBR performed a calculation analysis of radon release, which was verified and detailed in the NRC staff's SER (NRC 2014). In the source term calculation, CBR has adjusted the radon release value to show that all of the contained radon in the 5000 gpm flow processed by upflow IX will be released to the environment and that 10 percent of the contained radon found in the 4000 gpm flow processed by pressurized downflow IX columns will be released to the environment during regeneration and venting.

There are three commercial and two R&D evaporation ponds located at the current plant building. These are lined with impermeable synthetic liners and monitored with a leak detection system. These ponds are not considered to be a source of liquid radioactive effluents. In addition, the Crow Butte plant is located on a curbed concrete pad to avoid any liquids from entering the environment. All solutions used to wash down equipment are drained to a sump and pumped to the ponds.

4 ENVIRONMENTAL IMPACTS

The NRC staff reviewed the applicant's ER; collected information from federal, state, and local government agencies; and evaluated the environmental impacts to the various resources of the affected environment from the proposed action.

The NRC staff used the guidance outlined in NUREG–1748 (NRC, 2003) in its evaluation. In accordance with this guidance, the staff evaluated the direct effects and indirect effects that each resource area may encounter from the proposed action and the No-Action alternative. The NRC staff categorizes the impacts in terms of small, moderate, or large, defined as follows:

- SMALL—environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.

- MODERATE—environmental effects are sufficient to alter noticeably, but not to destabilize important attributes of the resource.

- LARGE—environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

4.1 Land Use Impacts

There will be no additional construction activities associated with operation of the CBR facility under the renewed license; therefore, the current land use in this region (discussed in Section 3.1) will be unchanged. No additional land disturbances are expected to occur from the proposed action; therefore, the impacts to land use from the operation of the CBR facility under the renewed license are expected to be SMALL.

4.1.1 No-Action Alternative

If the renewal of the license is not granted, decommissioning of the CBR facility would commence upon NRC approval of the final decommissioning plan in accordance with 10 CFR Part 40.42. NRC approval of a final decommissioning plan would constitute a federal action under NEPA and would be subject to a site-specific environmental review. Upon completion of decommissioning, the land associated with the CBR facility would return to its original uses. Potential impacts on land use associated with decommissioning activities on the CBR facility are expected to be SMALL.

4.2 Transportation Impacts

4.2.1 Impacts to Roads

The CBR facility is in a rural area of Nebraska with low traffic. No additional access roads will be needed to be constructed from the existing transportation corridors. The proposed action would not change current traffic conditions. Currently used major access roads are designed to allow for the safe access from current roads used by employees, contractors, and delivery vehicles. Transportation impacts on roads are expected to be SMALL.

4.2.2 Impacts to Rail Lines

The Burlington Northern Santa Fe (BNSF) Railroad runs in a northwesterly direction through the west side of the CBR facility. The BNSF rail line along the western boundary is used for combining local "pusher" engines with southbound trains to assist them in climbing the Pine Ridge south of Crawford. This rail line accommodates a significant amount of rail traffic, primarily from the coal mines in northeastern Wyoming. Additionally, the DM&E Railroad runs in a northeasterly direction and a portion of the railway lies on the southeast boundary of the current CBR facility. The junction of the two railroads is about 0.50 miles south of the CBR facility. The continued operation of the CBR facility under the renewed license will have no impact on current railroad operations in the area.

4.2.3 No-Action Alternative

If the renewal of the license is not granted, decommissioning of the CBR facility would commence upon NRC approval of the final decommissioning plan in accordance with 10 CFR Part 40.42. NRC approval of a final decommissioning plan would constitute a federal action under NEPA and would be subject to a site-specific environmental review. Potential impacts on transportation associated with decommissioning activities on the CBR facility are expected to be SMALL. Mitigation measures taken by CBR pertaining to transportation would further reduce potential impacts.

4.3 Geology and Soils Impacts

4.3.1 Geology Impacts

No significant matrix compression or ground subsidence will occur with continued operation of the CBR site. The net withdrawal of fluid from the Basal Chadron Sandstone will be less than one percent and over the full term of the renewal, drawdown of the available head will be less than ten percent. Geological impacts associated with the renewal of the CBR facility license will be SMALL.

4.3.2 Soils Impacts

Clearing of vegetation, excavating, leveling, stockpiling, compacting, and redistributing soils during construction and reclamation are all activities that could lead to impacts to soils from the CBR facility. Impacts to soils from the CBR facility are split into two groups: the 1,310 acres that have been disturbed by construction of the central plant and the 1,280 acres of wellfield production. Potential impacts would be more significant from construction disturbance because the severity of soil impacts depend on the number of acres disturbed and the type of disturbance. Potential impacts include loss of soil, sedimentation of the soil, compaction, salinity, productivity, and contamination to the soils.

Soil erosion due to wind at the CBR facility has the potential for adverse impacts. Various soils meet the criteria for severe wind erosion hazard due to the soils' ease of being picked up by the spread of wind (USDA 1977). Impacts are greatest from wind erosion during construction, and construction has been completed for the CBR facility. Wind erosion will continue to be monitored by CBR, and vegetation, which limits impacts from wind erosion, will only be removed when necessary. Clearing of land and grading on already eroded areas will only be performed by CBR, Inc. when necessary.

Soil erosion due to water at the CBR facility also has the potential for adverse impacts. Various soils meet the criteria for severe water erosion hazard (USDA 1977). Impacts are greatest during construction and therefore a low risk at the CBR facility due to construction being completed already. Keeping vegetation present on top of the soil is helpful in limiting erosion due to water. CBR, Inc. will only remove vegetation when necessary, and removal of vegetation will be limited. Additional methods for reducing soil erosion due to water include avoiding high erosion areas and placing roads only on areas where the surrounding areas have high vegetation CBR will install drainage on roads to further decrease erosion potential where possible.

CBR's State NPDES permit for the CBR facility will help reduce impacts to soils. There are however a number of allowed activities within that permit which have the potential to cause adverse impacts to soils. A number of erosion and productivity problems resulting from the Crow Butte site may cause a long-term declining trend in soil resources. Long-term impacts to soils include productivity and stability amongst others, which would occur as a result of large-scale surface grading and leveling. Reduction in soil fertility levels and reduced productivity would affect diversity of reestablished vegetative communities. Moisture infiltration would be reduced, creating soil drought conditions. Vegetation would undergo physiological drought reactions.

If there were to be a spill of hazardous materials at the CBR facility, impacts to soils could occur. CBR has a spill Prevention, Control, and Countermeasure (SPCC) Plan in place if a situation were to occur. The SPCC plan includes accidental discharge reporting procedures, spill response, and cleanup measures.

The NRC staff concludes that overall impacts to soils from the continued operation of the CBR facility will be SMALL. CBR's continued use of best management practices (BMPs) and mitigation where applicable will reduce the impacts to soils even further.

4.3.3 No-Action Alternative

If the renewal of the license is not granted, decommissioning of the CBR facility would commence upon NRC approval of the final decommissioning plan in accordance with 10 CFR Part 40.42. NRC approval of a final decommissioning plan would constitute a federal action under NEPA and would be subject to a site-specific environmental review. Potential impacts on geology and soils associated with decommissioning activities on the CBR facility are expected to be SMALL. Mitigation measures taken by CBR pertaining to geology and soils would further reduce potential impacts.

4.4 Air Quality Impacts

Any construction activities (e.g., new wellfields and central plant improvements) at the Crow Butte Project would cause minimal impacts on local air quality. Impacts on air quality would include increased suspended particulates from vehicular traffic on unpaved roads, in addition to existing fugitive dust caused by wind erosion, and diesel emissions from heavy equipment. As needed, the application of water to unpaved roads reduces the amount of fugitive dust to levels equal to or less than the existing condition. Diesel emissions from heavy equipment during operations (e.g., maintenance and new wellfield construction/development) are expected to be short term only.

Although there are no ambient air quality monitoring data for these non-radiological pollutants in the CBR facility, PM10 concentrations have been measured in Rapid City, South Dakota and Badlands National Park in South Dakota. Both locations are geographically similar to the CBR facility.

The Rapid City data were collected at the National Guard Camp Armory site about 2 miles west of the city. This area is classified as suburban. The Badlands data were collected in an area classified as rural. Because of the degree of urbanization, the air quality at the CBR facility would probably fall somewhere between the air quality at these two locations. The data in the table below were obtained from the EPA's air quality monitoring database (EPA 2007).

Table 4-1: PM10 Monitoring Summary

Year	Maximum 24-hr Average		Annual Average	
	Black Hills, SD	Rapid City, SD	Black Hills, SD	Rapid City, SD
1998	-	87.4	-	30.7
1999	-	116.9	-	28.2
2000	38.5	97.4	12.0	31.3
2001	47.9	81.5	12.6	34.6
2002	26.0	104.7	9.9	34.9
2003	74.4	91.8	16.3	36.2
2004	24.0	72.0	10.0	30.0
2005	40.0	94.00	9.0	27.0
2006	30.0	124.0	10.0	29.0

Source: CBR, 2007A The National Ambient Air Quality Standards (NAAQS) for PM10 are 150 micrograms per cubic meter (24-hour average), and 50 micrograms per cubic meter (annual average). All counties within the 80-km radius of the project are in attainment of NAAQS.

There will be an increase in the total suspended particulates (TSP) in the region as a result of the continued operation of the CBR facility. Revegetation will be performed where possible to mitigate the problems associated with the resuspension of dust and dirt from disturbed areas. All areas disturbed during construction are revegetated with the exception of plant pad areas, roads, and areas covered by the pond liners. Of these, the only significant source of TSP is dust emissions from unpaved roads. The amount of dust can be estimated from the following equation taken from "Supplement No. 8 For Compilation of Air Pollutant Emission Factors" (USEPA 1974).

$$E(0.81s)\ \S.\ \underline{365-\ w}$$
$$30\ w$$

Where:

E emission factor, lb per vehicle-mile
s silt content of road surface material, 40 percent
w mean number of days with 0.01 inches or more of rainfall, 85

Using the values stated above, the emission factor is equal to 0.25 lb/vehicle-mile. The distance from the facility to Highway 71 is 3 miles away traveling due west and 4.5 miles through Crawford. Assuming 35 employees, a five workday week and a 33 percent increase to allow for additional traffic (deliveries, etc.), the total mileage on dirt roads is estimated to be 1,000 miles/week. This corresponds to a dust emission of 6.5 tons/year as a result of the increased traffic on dirt roads. Traffic counts made by the Nebraska Department of Roads in 1987 indicated that there were 119 daily trips on the County Road that employees would take to Crawford (4.5 miles) from the plant. This results in over 2,000 miles per week at the present time. If the increased dust should present a problem, either due to current operations or due to possible future expansions, the emissions can be reduced through mitigation measures including appropriate State approved control procedures such as the use of dust control chemicals on the road surface.

All of the airborne emissions presented above will have a minimal impact of the environment. At no time during the life of the project it is anticipated that the ambient air quality standard of the State of Nebraska will be exceeded. Other operational activities may have impacts on surrounding air quality. The only atmospheric emission from the production and process facilities will be radon gas.

The NRC staff concludes that impacts to air quality from continued operation of the CBR facility would be SMALL.

4.4.1 No-Action Alternative

If the renewal of the license is not granted, decommissioning of the CBR facility would commence upon NRC approval of the final decommissioning plan in accordance with 10 CFR Part 40.42. NRC approval of a final decommissioning plan would constitute a federal action under NEPA and would be subject to a site-specific environmental review. Potential impacts on air quality associated with decommissioning activities on the CBR facility are expected to be SMALL. Mitigation measures taken by CBR pertaining to air quality would further reduce potential impacts.

4.5 Noise Impacts

The majority of the impacts to noise from the CBR facility were in the construction of the main plant, which has been completed. Noise impacts at a distance of 2,880 feet, the approximate location of the closest receptor from construction equipment located at the CBR facility, were calculated to be 49 dBA. Because the CBR facility is bounded on the west by the Burlington Northern Santa Fe (BNSF) rail line, there is an existing ambient noise generated from the trains on the BNSF rail line. CBR uses the rail line for transportation of materials to and from the CBR facility.

Construction associated with the current CBR facility has been, and will continue to be, minimal (e.g., heavy equipment used for periodic maintenance and construction of new wellfields). Such activities involve minimal equipment at any one time and are short-term impacts.

Noise sources have increased slightly due to increased vehicle travel from an increase in the number of employees at the CBR facility. In addition, there is some additional noise due to periodic truck deliveries and shipments associated with operations. BNSF rail line train usage has not increased as a result of operations. Increases in noise levels due to operation are less than noise levels generated during construction.

The NRC staff concludes that overall impacts on noise from the relicensing of the CBR facility would be SMALL.

4.5.1 No-Action Alternative

If the renewal of the license is not granted, decommissioning of the CBR facility would commence upon NRC approval of the final decommissioning plan in accordance with 10 CFR Part 40.42. The NRC approval of a final decommissioning plan would constitute a federal action under NEPA and would be subject to a site-specific environmental review. Potential impacts on noise associated with decommissioning activities on the CBR facility are expected to be SMALL. Mitigation measures taken by CBR pertaining to noise would further reduce potential impacts.

4.6 Water Resources Impacts

4.6.1 Surface Water Impacts

4.6.1.1 Construction Impacts on Surface Water

Potential impacts to surface waters from construction involve road crossings of construction equipment, increased sedimentation, erosion, runoff, and spills or leaks of fuels and lubricants from construction equipment. The accumulation of sediment or the erosion of existing soils can lead to potential releases of pollutants to surface water. The likelihood of significant sediment or erosion problems is greatest during construction activities; however, no further construction activities are anticipated at the CBR facility.

Construction activities related to the CBR facility to date have had a minimal impact on the local surface water. CBR routinely implements administrative and engineering controls of stormwater discharge during construction activities under their National Pollutant Discharge Elimination System (NPDES) permit (CBR, 2009). Under NDEQ General Construction Stormwater NPDES Permit NER 100000, CBR is required to implement procedures that control runoff and the deposition of sediment in surface water features during construction activities. Spills of petroleum products or hazardous chemicals into surface waters or related habitats must be reported to NDEQ. CBR also has in place a Storm Water Pollution Prevention Plan (SWPPP) that provides a detailed description of the sediment and erosion controls, in addition to descriptions of potential pollutant sources, spill prevention and control measures, and outfall controls.

Therefore, the NRC staff concludes that impacts to surface water from potential construction activities at the Crow Butte facility are expected to be SMALL.

4.6.1.2 Operational Impacts on Surface Water

During operations, surface waters could be impacted by accidental spills or leaks from the ISR facility or by permitted discharges. Spills or leaks from the central processing plant or well fields, as well as spills during transportation, could impact surface waters by contaminating storm water runoff or by contaminating surficial aquifers that are hydraulically connected to surface waters. As described in SER Section 3.1.3.4, flow monitoring and spill response procedures are expected to limit the impact of potential spills to surficial aquifers (NRC 2014).

Storm water discharges are controlled through the SWPPP that is part of the NPDES permit issued by the NDEQ. The SWPPP describes the potential sources of storm water contamination at the facility, routes by which storm water may leave the facility, and the best management practices (BMPs) that would be used to prevent storm water contamination. For example, concrete curbing and berms are typically used to contain spills and facilitate cleanup in accordance with approved operating procedures. Although the NPDES permit for storm water discharges does not provide specific numerical water quality standards, it does include monitoring requirements and specifies that storm water discharge shall not cause pollution, contamination or degradation of waters of the state. Waters of the state include wetlands; surface water channels, whether perennial or not; and lakes and reservoirs. Thus storm water discharges compliant with the NPDES permit would not be expected to result in significant impacts to surface waters.

Potential impacts to surface water resulting from spills and leaks are most likely to impact the nearby surface streams such as Squaw Creek and English Creek, or one of the eight surface impoundments that exist within or near the commercial restricted area boundaries. Quarterly monitoring results from commercial operations between 1990 and 2010 show that radionuclide concentrations in these water bodies have remained at or below preoperational background levels. Furthermore, CBR has never had a spill that exceeded the threshold criteria for a reportable spill under the requirements of 10 CFR Part 20. However, CBR has had several leaks of lower magnitude (in terms of volume or contaminant concentration or both) that required reporting to State regulators. CBR has investigated and mitigated the impacts immediately following the release or spill as warranted (NRC 2014).

CBR maintains a list of the spills or leaks that have occurred on site and will be required to demonstrate compliance with the regulations during NRC review of decommissioning or reclamation plans. If CBR maintains compliance with their permits, impacts from any unintended discharges will be controlled. In order to minimize potential impacts from spills, CBR has implemented a Spill Prevention, Control, and Countermeasure (SPCC) Plan. The SPCC Plan includes procedures for reporting accidental discharges, spill response, and cleanup measures. As an additional measure to protect surface water, CBR has installed dikes or berms in wellfield areas to prevent spilled process solutions from entering surface water features. Process buildings have been constructed with secondary containment, and a regular program of inspections and preventive maintenance is in place.

Sediment in Squaw and English Creeks and impoundments were sampled at upstream and downstream locations at six month intervals for one year prior to any construction in the area. Following construction, samples have been taken annually from locations upstream and downstream from the CBR facility (i.e., three locations on Squaw Creek (S-1, S-2, and S-5), two locations on English Creek (E-1 and E-2 Composite, and E-5), and from three impoundments on English Creek (1-3, 1-4, and 1-5)). Samples are analyzed for natural uranium, radium-226, thorium-230, and lead-210.

Although other radioisotopes are detected in the sediment, uranium is the most important indicator parameter of potential impacts and therefore sediment concentrations of uranium between 1998 and 2010 are graphed in Figures 4-1 and 4-2. These graphs plot the concentrations of uranium at the upstream and downstream locations for English and Squaw Creeks and at the inlet to each of the impoundments. The concentration of natural uranium at the upper end of English Creek was above the regional background levels. However, CBR recorded elevated concentrations in the English Creek drainage during preoperational monitoring (1982-1986), which suggests that these levels are anomalously high natural background concentrations. Composite samples obtained from E-1 and E-2 collected as part of the preoperational sampling program from 1982 through 1986 had elevated natural uranium (3.4 picocuries per gram (pCi/g)) and lead-210 (1.4 pCi/g) when compared with the other surface water sample locations. Samples in addition to E-1 and E-2 obtained in 1998 before milling operations began in this area show similar elevated uranium concentrations. CBR believes that the elevated uranium concentrations in these samples are related to the high amount of organic carbon and subsequent precipitation of the uranium within the wetlands in the upper reach of English Creek, from where these samples were collected (CBR, 2007A). CBR has not speculated on the source of the elevated lead-210 concentrations.

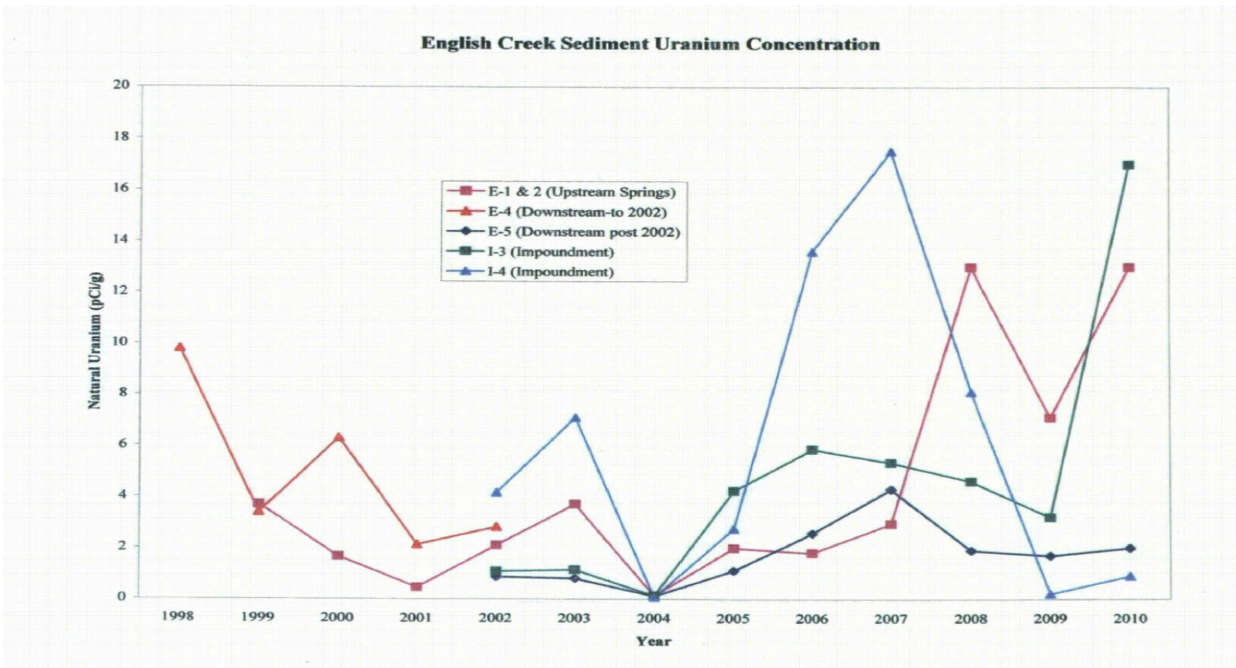


Figure 4-1. Uranium concentrations detected in English Creek sediment from 1998 through 2010

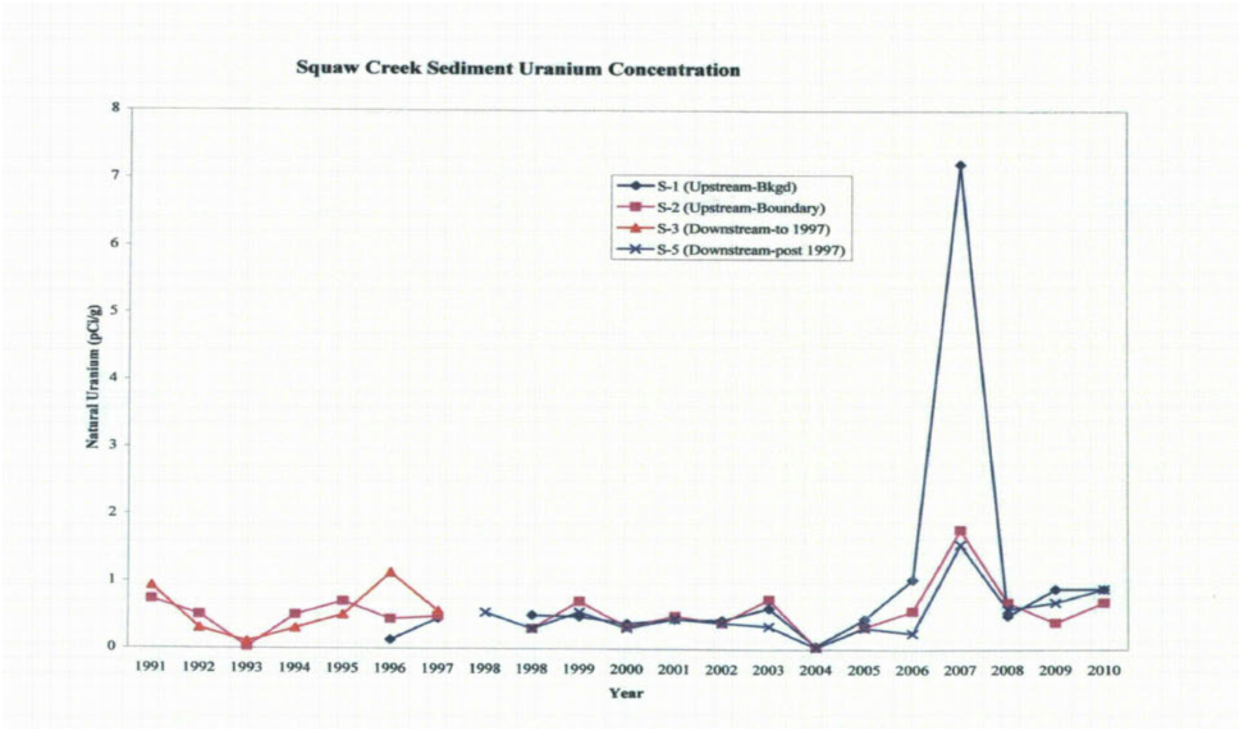


Figure 4-2. Concentrations of uranium detected in Squaw Creek sediment from 1998 through 2010

Under NDEQ NPDES Permit NER 100000, CBR is required to implement procedures that control runoff and the deposition of sediment in surface water features during operational activities.

Based upon minimal historical impacts, permitting and reporting requirements, the NRC staff concludes that potential impacts to surface water from the ongoing plant operations would be SMALL.

4.6.1.3 Aquifer Restoration Impacts on Surface Water

Activities occurring during aquifer restoration that could impact surface waters include management of process waste water, storm water runoff, spills and leaks, and management of brine concentrate from the reverse osmosis system. Storm water quality would be controlled under the SWPPP in the same manner as during operations.

Aquifer restoration activities involve the treatment of ground water using process equipment to return the ground water quality to the ground water protection standards in the affected wellfield area. A reverse osmosis (RO) unit is used to reduce the total dissolved solids and other constituents in the ground water. The RO unit produces water with reduced constituents (permeate) and brine. The licensee currently disposes of the permeate and brine by injection of the wastes into the two waste disposal ponds and then into two NDEQ-permitted non-hazardous on-site deep disposal wells. The waste disposal ponds comply with the design, installation, and operation criteria specified in the NRC Regulatory Guide 3.11 (NRC, 2008a).

In accordance with the license amendment dated November 16, 1993 (NRC, 1998), the licensee has two other options for waste water disposal. One option for the disposal of permeate is the discharge to surface water. This option requires a NPDES permit by the State of Nebraska, which would require treatment to specific water quality standards before any water is permitted to be discharged. The other option is land application, for which the licensee has a permit. The licensee has not used either of these options and has not indicated they will in the future.

Based on CBR's implementation of mitigation measures in the past and its compliance with both the NRC and NDEQ permit requirements, the NRC staff concludes that the impact on surface water during the in situ recovery (ISR) aquifer restoration phase at Crow Butte would be SMALL.

4.6.1.4 Decommissioning Impacts on Surface Water

During decommissioning of the facility, temporary impacts to surface waters are anticipated from sediment loading associated with removal of piping, linear crossings, and other facility infrastructure. Decommissioning and reclamation would be expected to return the surface water to preconstruction/operation status. Storm water runoff would also be controlled under the SWPPP during decommissioning activities.

The NRC and NDEQ require CBR to decommission areas within the site boundary once ISR extraction is completed. Part of this decommissioning involves the reclamation of a mine unit following successful completion of ground water restoration activities. Reclamation involves the proper plugging and abandonment of all wells within the mine unit boundary; removal of surface and subsurface structures, utilities, and pipelines; and removal of surface and subsurface radiological contamination.

CBR will submit a final detailed decommissioning plan for structures and equipment to the NRC for review and approval at least 12 months before the planned commencement of decommissioning of structures and equipment. This final decommissioning plan will describe structures and equipment to be decommissioned, planned decommissioning activities, methods that will be implemented to ensure protection of workers and the environment against radiation hazards, and the final radiation survey. Impacts from decommissioning are expected to be similar to, but less than, impacts from construction. Activities to clean up and to recontour and reclaim the land surface during decommissioning will mitigate potentially long-term impacts on surface waters. Therefore, the NRC staff concludes that potential impacts on surface water from decommissioning and reclamation activities would be SMALL.

4.6.2 Ground Water Impacts

4.6.2.1 Construction Impacts on Ground Water

During construction of ISR facilities, the potential for ground water impacts is primarily from introduction of drilling fluids and muds from well drilling, and spills of fuels and lubricants from construction equipment.

The Crow Butte facility currently has 11 mine units in various phases of operation (Figure 4-3). Mine Unit 1 has been restored and decommissioned; Mine Units 2 through 6 are undergoing ground water restoration; and Mine Units 7 through 11 are in the production phase (NRC, 2011).

In accordance with NDEQ Permit NEO122611, CBR cannot have more than five mine units in production and five mine units in restoration at any one time. Therefore, restoration will need to be completed on one more of the mine units before restoration begins on another. As CBR has no further wellfields planned for development, no construction is currently underway and none is planned. If any construction were to occur, it would be limited in scope (e.g. installing additional wells for improving restoration or capturing excursions).

Potential impacts to ground water during any minor construction unrelated to new wellfield development would be primarily from injection of drilling fluids and muds during well drilling, and spills of fuels and lubricants from construction equipment. The volume of drilling fluids and muds used during well installation would be limited, and BMPs would be used to prevent, identify, and correct impacts on soils and the uppermost aquifer. Drilling fluids and muds are placed into mud pits to control the spread of the fluids, to minimize soil contamination in the area, and to enhance evaporation. After the mud pit is no longer needed, all subsoil is replaced and topsoil is applied. Mud pits generally remain open a short time.

According to the site potentiometric[6] data, the depth to the water table in the uppermost Brule aquifer is less than 25 feet [7.6 m] below the ground surface. Therefore, small amounts of leakage from the mud pits or spills during drilling activities would result in a small amount of infiltration, which would have a minimal effect on the water quality of the Brule surficial aquifer. Because drilling muds are designed to seal the borehole to set the casing, the amount of drilling fluids that could be introduced into the lower aquifers during the installation of production and monitoring wells would be minor.

A small volume of fuels and lubricants would be stored in the main building facilities of the CBR facility during construction of wells. If a leak or spill were to occur, it would be primarily surficial in nature and would result in an immediate cleanup response, resulting in only a negligible impact on surface soils, vegetation, and ground water. Further, CBR is required by an NRC license condition to maintain documentation of spills of source or byproduct materials (including process solutions) and process chemicals, to maintain procedures to evaluate the consequence of a spill, and to implement reporting requirements.

Because of the limited nature of construction activities and the implementation of BMPs to protect shallow ground water, the NRC staff concludes that construction impacts on ground water would be SMALL.

4.6.2.2 Operation Impacts on Ground water

During operation of ISR facilities, impacts to ground water quantity are primarily from consumptive ground water use. Impacts to ground water quality in aquifers may occur from spills or leaks of process fluids from wellfields and wellfield infrastructure or waste storage ponds, and excursions of process fluids from the production zone to surrounding aquifers. Impacts to ground water quality in deep aquifers may occur from waste disposal in deep injection wells.

4.6.2.2.1 Ground water Quantity Impacts from Consumptive Use

Impacts to ground water quantity during ISR operations can be caused by consumptive water use. In the ISR process, a leach solution, or lixiviant, is injected through wells into the mineralized zone within the Basal Chadron Formation. The lixiviant moves through

[6] The potentiometric surface is a hypothetical surface representing the level to which ground water would rise if not trapped in a confined aquifer (an aquifer in which the water is under pressure because of an impermeable layer above it that keeps it from seeking its level). The potentiometric surface is equivalent to the water table in an unconfined aquifer.

the pores in the host rock, dissolving uranium and other metals. Production wells withdraw the resulting “pregnant” lixiviant, which now contains uranium and other dissolved metals, and pump it to the central processing plant for further uranium recovery and purification. The CBR facility is licensed to process 9,000 gallons per minute (gpm) [34,065 lpm] of leach solution. The operating flow observed at the time of an NRC inspection in 2011 was 6,760 gpm [25,586 lpm] (NRC, 2011).

Part of this operating flow is removed as bleed to create an inward gradient in the wellfields to contain process fluids to protect surrounding ground water. The remaining water is returned to the wellfields. The consumptive use of ground water from this bleed has been about 0.5 percent to 1.5 percent of the water circulated through the wellfields (CBR, 2009). Therefore, at a processing rate of 7,000 gpm [26,495 lpm], the consumptive use would be between 35 gpm [132.5 lpm] and 105 gpm [397.5 lpm].

The withdrawal of this bleed creates drawdown of the aquifer potentiometric surface which is greatest in the wellfields and decreases with distance in a region known as the zone of influence. The licensee reported that potentiometric surface in the Basal Chadron Sandstone has decreased by 40 to 60 feet [12.1 to 18.3 m] throughout the CBR facility wellfields since 1982–1983 (CBR, 2009) from consumptive use. Since distance decreases the drawdown effects of pumping, it is reasonable to assume that the drawdown in the potentiometric surface has decreased no more than 30 to 50 feet [9.1 to 15.2 m] in the vicinity of Crawford. Although the piezometric surface was lowered in the Basal Chadron aquifer over the previous license period, the aquifer remained under a significant amount of pressure. Water levels in wells penetrating the Basal Chadron aquifer continue to rise very close to the land surface or actually flow under artesian pressure. The significance of this phenomenon is that it indicates that the Basal Chadron and Brule aquifers are not in good hydraulic communication. Therefore, drawdowns associated with pumping in the Basal Chadron aquifer will not be observed in the Brule aquifer. As described in SER Section 2.4.3.2.2, this conclusion is supported by aquifer testing and a comparison of the pre- and post-operational ground water level measurements detected in the Brule aquifer (NRC 2014).

The amount of consumptive water use during operations is expected to remain the same in the renewal period, so the drawdown will be similar. Because use of water from the Basal Chadron aquifer is limited in this area due to poor water quality, and because the aquifers will remain confined (i.e., saturated thickness will not decrease), the drawdowns associated with the pumping during ISR operations will not significantly impact the ground water quantity in the Brule or Basal Chadron aquifers.

4.6.2.2.2 Ground water Quality Impacts from Spills and Leaks

Ground water quality could potentially be impacted during all phases of the ISR operations as a result of spills or leaks of process liquids from wellfield piping and infrastructure. If there are spills or leaks, potential contamination of the shallow aquifer (Brule), as well as surrounding soil, could occur. Spills and leaks can also potentially impact deeper aquifers.

In order to prevent these types of releases, all piping is either PVC, high density polyethylene with butt welded joints, or equivalent. All piping is leak tested prior to production flow and following repairs or maintenance. As described in SER Section 3.1.3.4, CBR continuously monitors wellfield and plant operations to detect any leaks or spills (NRC 2014). If a leak or spill is detected CBR is required to undertake immediate spill response actions in accordance with onsite standard operation procedures. As part of the monitoring requirements for ISR facilities, the licensee must report certain spills to the NRC within 24 hours. The licensees also must comply with applicable NDEQ requirements for spill response and reporting.

To date, CBR has never had a spill that exceeded the threshold criteria for a reportable spill under the requirements of 10 CFR Part 20. However, CBR has had several leaks of lower magnitude (in terms of volume or contaminant concentration or both) that required reporting to State regulators. CBR has investigated the impacts immediately following the release or spill as warranted (NRC, 2011) and taken corrective action. CBR maintains a list of the spills or leaks that have occurred on site and will be required to demonstrate compliance with the regulations during NRC review of decommissioning or reclamation plan. To date, no long term impact to ground water quality has been detected from a spill or leak.

To detect injection well casing failures which may lead to leaks, the NDEQ Class III injection well permit and an NRC license condition specify that mechanical integrity testing (MIT) be conducted initially, after a well is serviced, and at intervals of once every 5 years. Should a well fail an MIT, CBR is required to repair or abandon the well in accordance with the license condition. In addition, an MIT failure is considered to be a potential release of process chemicals that may have impacted the environment. CBR is required by the license to notify the NRC of all MIT failures. CBR is also required to maintain documentation on corrective actions that were implemented and to keep that documentation for the NRC staff to review during onsite inspections. Through its Underground Injection Control (UIC) Program, NDEQ also has oversight with regard to MIT of wells that are used for ISR and has more stringent reporting requirements for MIT failures.

During CBR's license history, the licensee has reported a total of 16 MIT failures for wells that have been in service (Table 4-1). For all reported MIT failures, the licensee consulted with NDEQ staff to establish the potential for a release and the need for corrective actions, and it reported the release and corrective actions to the NRC. One of the MIT failures resulted in measurable environmental impacts, which were subsequently mitigated by corrective actions. The corrective actions were deemed successful in rectifying the environmental impact (CBR, 1998).

Because of the requirement to detect and provide an immediate response to spills and leaks at ISR facilities, conduct MIT testing and undertake corrective actions for spills and leaks, the NRC staff concludes that the ground water impacts from spills and leaks would be temporary, and the overall long-term impact on ground water would be SMALL.

Table 4-2: Summary of Historic MIT Failures

Well	Mine Unit	Date Detected	Depth (ft)[m]	Monitoring wells Installed	Environmental Impact Detected/ Expected	Corrective Actions Complete	Document Accession Number
P-5338	10	8/22/13	315[96.0]	0	No	No	ML13262A502
P-3415	8	8/6/13	395[120.0]	0	No	No	ML13239A452
P-3357	8	1/18/13	20[6.1]	0	No	No	ML13135A029
P-4501	10	6/4/12	320[97.5]	0	No	No	ML1217A102
SM6-5	6	5/25/12	35[10.67]	0	No	No	ML12157A094

Well	Mine Unit	Date Detected	Depth (ft)[m]	Monitoring wells Installed	Environmental Impact Detected/ Expected	Corrective Actions Complete	Document Accession Number
I-968	5	7/18/11	20[6.0]	1	No	No	ML11214A234
P-2469		7/6/2010	60[18.3]	No	No	No	ML101960372
P-4231	9	5/10/2010	240[73.2]	No	No	No	ML102010407
P-821	5	11/19/2009	N/A	N/A	No	No	ML093380649
I-3720P	9	4/15/2009	420[128.0]	No	No	No	ML091289429
I2430-31	7	10/27/2005	38–48[11.5-14.6]	3	No	No	ML060230309
I723-14		7/4/2005	18–28[5.5-8.5]	3	No	No	ML052430386
I622-10	4	2/19/2004	180[54.8]	1	No	No	ML040960396
I567	4	9/20/1999	40[12.2]	3	No	No	ML003685594;ML991026002
I196-5	2	3/29/1996	40[12.2]	15	Yes	Yes	ML090580383
I752-14	5	11/8/1996	100[30.5]	2	No	Yes	ML090910569

Sources: NRC (2012) for data available in the Agencywide Documents Access and Management System (ADAMS) as of February 7, 2011; later documents available in ADAMS as of February 3, 2014, added to the table by NRC staff.

4.6.2.2.3 Ground water Quality Impacts from Waste Storage Ponds

Groundwater quality could potentially be impacted during all phases of the ISR operations as a result of waste storage pond leakage or failure. If there should be an undetected pond leak or failure, potential contamination of the shallow aquifer (Brule), as well as surrounding soil, could occur. Such contamination could result from a slow leak (e.g. liner tear) or a catastrophic failure (e.g., storage pond breach). In addition, contamination could occur from an overflow of the pond due to exceeding the freeboard limits from the addition of excessive rainwater or runoff.

The CBR facility is authorized to construct five waste storage ponds; however, only three ponds have been constructed. To mitigate the likelihood of pond failure, all ponds at the CBR facility are designed and built using impermeable synthetic liners. A leak detection system is installed, and all ponds are inspected on a regular basis. In addition, shallow monitoring wells are installed around the ponds. In the event that a leak is detected, the contents of the pond with the problem are transferred to another pond while repairs are made.

To date, several leaks associated with the inner pond liner have occurred (NRC 2014). In each case, these leaks were quickly discovered during routine inspections, primarily as a result of leak detectors in the under drain system. Corrective actions included lowering the pond level and locating the leak to allow repairs. Based on the ground water quality data measured in the shallow monitoring wells surrounding the ponds, none of the pond leaks impacted the shallow ground water and it is assumed the second pond liner functioned as designed and prevented a release of the pond contents. All pond leaks, their causes, and corrective actions taken are reported to the NRC and NDEQ.

With respect to potential overflow of a pond, current standard operating procedures require that pond levels be closely monitored to meet freeboard limits as part of the daily inspection. In 2010, increased facility efficiencies (e.g., addition of micron filters) also reduced the amount of process waste effluent sent to the facility ponds from approximately 95 percent of the working capacity (i.e., 36,700 gallons) [138,909 L] to approximately 55 percent of the working capacity. Therefore, since the amount of effluent has been reduced, all the ponds have sufficient capacity to handle diverted flow if necessary. In addition, dikes and berms around the ponds channel runoff away from the ponds, and sufficient freeboard is maintained on all ponds to allow for a significant addition of rainwater with no threat of overflow.

Because of the requirement to monitor for leaks at the CBR waste ponds, conduct daily inspections of ponds, conduct shallow ground water monitoring around the ponds, and undertake corrective actions if any leak is detected, the NRC staff concludes that the ground water impacts from waste storage ponds would be temporary, and the overall long-term impact on ground water will be SMALL.

4.6.2.2.4 Ground water Quality Impacts from Excursions

Ground water quality may be impacted by excursions of process fluids from the production zone into surrounding aquifers. To detect excursions, CBR has placed excursion monitoring wells in the overlying aquifer and in perimeter rings surrounding all mine units to detect excursions. The perimeter ring of monitoring wells provides early detection of any unwanted horizontal flow (horizontal excursion) of process fluids from the production zone. CBR has designated the upper part of the Brule Formation as the overlying aquifer. The monitoring wells in the overlying aquifer allow for the early detection of unwanted vertical flow of fluids (vertical excursion) from the production zone (i.e., Basal Chadron Sandstone). CBR has not installed monitoring wells in the underlying aquifer due to the presence of a thick and effective confining layer (Pierre Shale) below the ore-bearing aquifer and the naturally elevated levels of total dissolved solids (above secondary drinking water standards) in the water-bearing layers below the confining layer (CBR, 1996).

CBR is required to perform excursion monitoring, including biweekly monitoring of wells in the perimeter ring and overlying aquifer. The program consists of monitoring three indicator parameters (alkalinity, conductivity and chloride[7]) and comparing the levels to upper control limits (UCLs) established for the monitoring wells in each mine unit during baseline (pre-extraction) sampling. Should the levels monitored during the excursion monitoring program exceed the UCL thresholds,[8] then the licensee is required to notify the NRC and begin corrective actions to ensure that the production fluids do not migrate from the production aquifer.

For the prior license period, the NRC staff reviewed the excursion monitoring program of the CBR facility in accordance with NUREG-1748 (NRC, 2003a) and through onsite

[7] During the past license period, the parameters included in the excursion monitoring program were modified to the current three parameters by License Amendment 16, dated October 16, 2003. The NRC staff reviewed and approved the removal of the parameters sodium and sulfate at that time.

[8] The UCL threshold is the exceedence of UCLs for two excursion parameters, or the UCL for any one parameter by more than 20 percent. Once the exceedence is confirmed, the well is placed on excursion status. The licensee must increase the monitoring from biweekly to weekly for all wells on excursion status. The excursion status is terminated if the levels of the excursion parameters are below the UCLs for three consecutive weekly sampling events.

inspections. For this review, NRC examined the inspection reports and numerous excursion monitoring reports (NRC 2014).

From 1995 to 2010, CBR placed 13 perimeter monitoring wells on excursion status, and 12 monitoring wells in the overlying aquifer had 16 excursion status events (Table 4-2). Corrective action for the perimeter ring wells primarily consisted of adjusting flows in the nearest production units to capture any outward flow. These corrective actions proved adequate in controlling the excursions in a timely manner for nine perimeter wells. For the other four wells (PR-8, PR-15, IJ-13, and CM5-11), the corrective action proved less effective. For three wells, (PR-8, PR-15, and IJ-13), CBR attributed the cause for the excursion status to the mine unit geometries (NRC 2014). For the fourth well (CM5-11), CBR attributed the inadequacy of the corrective action to differences in completion intervals of the perimeter well and the nearest production wells (NRC 2014). None of these excursions have impacted the surrounding ground water quality.

CBR attributed the excursion events for wells in the overlying (shallow) aquifer to natural fluctuations in water quality for the following reasons: (1) CBR has stated that the wells with excursions are located in Mine Units 6 and 8, which are in close proximity to the headwaters (including ground water seeps) for English Creek, (2) CBR has stated that ground water in the overlying aquifer is under the influence of surface water, and (3) CBR has presented data that correlate a rise in ground water levels with increased excursion parameter concentrations (NRC 2014). For all excursion status events in the shallow aquifer, the events generally terminate within 90 days without corrective actions, which is consistent with the process for events not attributed to operations.

The NRC staff questioned whether the excursion events in MU6 and MU8 were a consequence of natural fluctuations in the water quality of the shallow aquifer in Section 5.7.9.4 of the SER (NRC 2014). The NRC staff agreed with the applicant that the excursion status to date for monitoring wells in the overlying (uppermost) aquifer did not appear to be a consequence of the migration of lixiviant from the production aquifer (NRC 2014). The excursions are coincidental with precipitation events, and no corrective actions by the licensee have been required to date. However, the NRC staff was concerned that spills or unintended releases of production fluids may be the source of the excursions. As a consequence of the continued number of excursions in the shallow overlying aquifer and the lack of evidence to support that all such excursions are a result of natural fluctuations, NRC has included a license condition which requires sampling for Natural Uranium and Ra 226 in addition to the indicator parameters when an overlying excursion monitoring well in Mine Unit 6 or 8 is placed on excursion status for more than 60 days (NRC 2014) to assess if there is any impact to ground water quality.

Based on the analysis of ground water quality impacts from excursions in the prior license period and the continued requirements for excursion monitoring to detect and take corrective action to eliminate the excursion, the NRC staff concludes that the long-term impacts on ground water from excursions will be SMALL.

Table 4-3: Summary of Excursions

Well	Mine Unit	Aquifer	Excursion Dates			Comments	Document Accession Number
			Initiation	Termination	Duration (days)		
Horizontal Excursion							
PR-8	1/2	P	12/23/2003	7/27/2010	2408	wellfield geometry	ML062860036; ML041140333; ML102250171
PR-15	1/2	P	9/26/2006	Present	950	wellfield geometry	ML082860036
IJ-13	1/3	P	12/27/2002	Present	2321	wellfield geometry	ML062860036
CM5-19	5	P	5/2/2005	7/26/2005	85		ML052280359
CM5-11	5	P	9/10/2002	7/3/2003	296	upper zone for production	ML031640167; ML022770128
CM6-7	6	P	4/4/2002	4/25/2002	21		ML021640176
CM6-6	6	P	7/2/1999	9/23/1999	83		ML003685594
CM8-12	8	P	7/8/2010	8/19/2010			ML102280222; ML102520624
CM8-21	8	P	1/8/2006	4/4/2006	86		ML061220279
CM9-3	9	P	5/30/2008	7/15/2008	46		ML082130050
CM9-4	9	P	6/11/2009	7/21/2009	40		ML092230727; ML092220670
CM9-5	9	P	5/15/2008	6/24/2008	40		ML082959998
CM9-16	9	P	8/4/2005	11/8/2005	96		ML053270239
Vertical Excursion							
SM4-2	4	O	4/13/1995	2/20/1996		Initial UCLs set too low	ML090910569
	4	O	1/25/1995	5/5/1995		No excursion; monitoring well not cased properly	ML090910569
SM4-7	4	O	12/29/1995	2/20/1996		Initial UCLs set too low	ML090910569
SM6-12	6	O	6/27/2005	7/26/2005		No excursion; precipitation	ML052280353
SM6-12	6	O	9/8/2000	11/2/2000		Pressure relief valve failure on nearby injection well	ML003768517
SM6-13	6	O	3/1/2001	4/12/2001		Initial UCLs set too low	ML011200146
SM6-18	6	O	3/6/2000	4/1/2001		New UCLs; attributed to natural fluctuations in aquifer	ML011200152
SM6-20	6	O	4/27/2009	8/25/2009			ML092520329
SM6-23	6	O	6/16/2010	7/29/2010		Attributed to Natural Fluctuations/Precipitation	ML101870407; ML102250173
SM6-28	6	O	6/16/2005	7/5/2005		Attributed to Natural Fluctuations/Precipitation	ML052220108
			6/16/2010	7/29/2010		Attributed to Natural Fluctuations/Precipitation	ML101870407; ML102250172
SM7-23	7	O	4/27/2000			No excursion; no mining was conducted; attributed to drilling fluid	ML023050009
SM8-6	8	O	4/12/2010	8/31/2010			ML102260025; ML102571451
SM8-28	8	O	6/16/2010	8/12/2010			ML101870407; ML102360287

Source: ADAMS as of February 4, 2011
P - Production Zone Monitoring Well
O - Overlying Aquifer Monitoring Well

4.6.2.2.5 Ground water Quality Impacts to Deep Aquifers

Ground water quality may be impacted in deep aquifers from the injection of liquid waste into the two NDEQ-permitted deep disposal wells at the CBR facility. The EPA and NDEQ UIC requirements will continue to protect ground water in aquifers used for the deep well injection of process-related liquid effluents from the CBR operating facility. To date, no impacts to deep aquifers have been detected and permitting requirements would keep these impacts negligible in continuing ISR operations

4.6.2.2.6 Ground water Quality Impacts outside of the CBR facility

In the unlikely event that a ground water excursion is not detected and corrected, ground water quality in aquifers surrounding the wellfields could potentially be impacted. To detect any such contamination, CBR is required in its license to monitor ground water quality at water supply wells located within 1 mile [1.6 k] of a wellfield as part of the environmental monitoring program. The parameters analyzed for this program are natural uranium and radium-226. The number of wells included in the environmental monitoring program increased during the preceding renewal period primarily because wellfields were added to operations, extending the area of review.

As of 2010, the program monitored ground water quality at 19 water supply wells. The NRC staff reviewed the environmental ground water monitoring program as part of the routine annual inspections performed during the past renewal period and for this renewal application. The NRC staff found that no discernible trends exist in the monitoring data that are attributable to impacts from the CBR facility, and that observed levels are consistent with background levels and below established Federal water quality standards[9] (NRC, 2011).

The NRC staff observed that the radium concentration at one well, Well #61, is higher than that reported in ground water at the other wells; however (1) the higher levels are consistent with background for this well and (2) this well differs from the other wells because it is drawing water from the Lower Chadron sand, whereas the other wells are screened in the overlying Brule Formation.

For the prior license period, the NRC staff found that there are no measureable impacts to the environment at the nearby water supply wells from operations (NRC, 2011). Given the excursion monitoring detection and corrective actions and monitoring of private wells to detect contamination, the NRC concludes that potential impacts of the ISR operation on ground water outside the CBR facility will be SMALL.

4.6.2.3 Aquifer Restoration Impacts on Ground water

The potential environmental impacts to ground water quantity and quality during aquifer restoration are the same as those for operations, except ground water consumption is increased and there may be potential impacts from the introduction of brine slurries resulting from reverse osmosis in to waste storage ponds and deep disposal wells. In addition, aquifer restoration directly affects ground water quality in the vicinity of the well field being restored.

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[9] In the second quarter of 2010, the uranium concentration in the ground water at two wells was slightly above the National Primary Drinking Water Standard (0.031 versus 0.030 milligrams per liter). For one of those wells (Well #66), the reported level is statistically indistinct from the uranium background level of 0.0292 +/- 0.0032 milligrams per liter. For the other well (Well #138), no baseline data are available nor is its use documented by CBR (NRC, 2011).

The purpose of aquifer restoration is to return the ground water quality in the production zone to compliance with the ground water protection standards in 10 CFR Part 40, Appendix A, Criterion 5B(5). These standards require that the concentration of a hazardous constituent must not exceed (1) the Commission-approved background concentration of that constituent in ground water, (2) the respective value in the table in paragraph 5C if the constituent is listed in the table and if the background level of the constituent is below the value listed, or (3) an alternate concentration limit the Commission establishes. If ground water is restored to approved restoration standards, the impact on ground water quality in surrounding aquifers is negligible.

Following operations at a mine unit, CBR initiates aquifer restoration, which uses a combination of (1) ground water transfer, (2) ground water sweep, (3) treatment, (4) permeate injection, and (5) wellfield circulation. A reductant may be added at any time to the fluids circulated during restoration to lower the oxidation potential of the production zone and thereby render uranium less mobile. Ground water transfer involves recovering pre-operational ground water from a mined unit starting production and injected into the mined unit starting restoration in order to lower the concentrations of total dissolved solids. During ground water sweep, water is pumped from the wellfield, without reinjection, resulting in an influx of baseline-quality water from the perimeter of the wellfield. This baseline-quality water effectively sweeps (cleanses) the affected portion of the aquifer. The pumped water is not returned to the wellfield but is injected into one of the two deep UIC (underground injection control) wells. Water that is pumped from the wellfield may also be treated by passing it through ion exchange (IX) and RO circuits. Following treatment this water is reinjected into the wellfield and recirculation is initiated. Recirculation consists of pumping from the wellfield and reinjecting the recovered solution to recirculate solutions and homogenize the ground water conditions. The brine that results from the IX and RO treatment is stored in the waste storage ponds and injected into one of the two deep UIC wells. Regardless of the process, hydraulic control of the former production zone must be maintained during restoration. This is accomplished by maintaining an inward hydraulic gradient through a production bleed process where more water is pumped than injected.

The consumptive use of ground water from bleed during aquifer restoration is generally greater than during ISR operations. This is particularly true during the sweep phase, when a greater amount of ground water is generally withdrawn from the production aquifer. During the sweep phase, ground water is not reinjected into the production aquifer and all withdrawals are considered consumptive.

A network of buried pipelines is used during ISR operation and restoration for transporting fluids between the pump house and the satellite or processing facility. Although the liquids carried in these pipes during restoration are less hazardous than those used during the operation phase, the failure of pipeline fittings or valves, or failures of well mechanical integrity, could result in leaks or spills of these fluids, which could impact ground water quality. Similarly, the waste storage ponds continue to operate during restoration, and any leaks would impact shallow ground water, as discussed for the operation phase in Section 4.6.2.2. The monitoring and mitigation activities for ground water aquifers during operations described in Section 4.6.2.2 would also limit the estimated impacts on ground water aquifers during aquifer restoration. Therefore, adverse impact on shallow and production aquifers during aquifer restoration would be negligible.

CBR is concurrently restoring individual mine units while maintaining ISR operations within other mine units. The final approval of ground water restoration for Mine Unit 1 was granted by the NRC in 2003 (CBR, 2007). At that time, ground water restoration activities are occurring at Mine Units 2 through 6 (CBR, 2012). The restoration of these mine units(MUs) are projected to gain regulatory approval in 2015 for MUs 2 and 3, 2019 for MU 4, 2022 for MU 5, and 2021 for MU 6, respectively (CBR, 2012). However, restoration activities at Mine Units 2, 3, 4, 5, and 6 are still in progress. To accelerate ground water restoration, CBR has increased the flow capacity through the RO circuit from 200 to 1,150 gpm [757 to 4352 lpm], and the flow through the IX circuit has been increased from 200 to 1,200 gpm [757 to 4542 lpm] (CBR, 2012). In addition to the upgrades to the IX and RO circuits, CBR has installed new restoration pipelines and manifolds to allow for the increased flows and to improve wellfield isolations. In 2011, CBR began operating a second deep disposal well to help accommodate the disposal of additional waste water generated by the increased RO and IX flow.

The NRC performed a water-balance analysis in Section 5.7.9.4 of the SER and based on the restoration analogues in the most recently approved license application and representations made by CBR, restoration of a mine unit will need at least extract eleven pore volumes of ground water for restoration (NRC 2014). Given the historical flow rates, it is anticipated that CBR may need to extract more than eleven restoration pore volumes for all mine units; thus, the restoration schedule may extend beyond that proposed by CBR. The extension of the restoration periods, as well as the greater than expected consumptive use rates, could significantly increase the drawdown in the potentiometric surface of the Basal Chadron aquifer, but it should still remain saturated. Consequently, the short-term impact from consumptive ground water use during aquifer restoration may be MODERATE. However, water levels would eventually recover after aquifer restoration is complete resulting in an overall SMALL impact from consumptive ground water use.

4.6.2.4 Decommissioning Impacts on Ground water

Before decommissioning and reclamation activities can begin, CBR is required to submit a decommissioning plan to the NRC for review and approval. The environmental impacts on ground water during dismantling and decommissioning ISR facilities are primarily associated with potential spills of fuels and lubricants and well abandonment. Spills of fuels and lubricants during decommissioning activities could impact the water quality of shallow aquifers. CBR’s implementation of BMPs, such as those identified in Section 4.2.2.3 of the ER, during decommissioning would reduce the likelihood and magnitude of such spills and facilitate cleanup (CBR, 2007A). Based on the applicant’s proposed BMPs to minimize water use and spills, the estimated environmental impacts on the ground water resources in shallow aquifers from decommissioning would be SMALL.

After ISR operations are complete, improperly abandoned wells or exploratory borings could impact aquifers above the production aquifer by providing hydrologic connections between aquifers. As part of the restoration and reclamation activities, all monitoring, injection, production and exploration wells from previous activities will be plugged and abandoned in accordance with the Nebraska UIC program requirements. The wells will be filled with cement or clay or both and then cut off below plow depth to ensure that ground water does not flow through the abandoned wells. If this process is properly implemented and the abandoned wells are properly isolated from the flow domain, the estimated environmental impact would be SMALL.

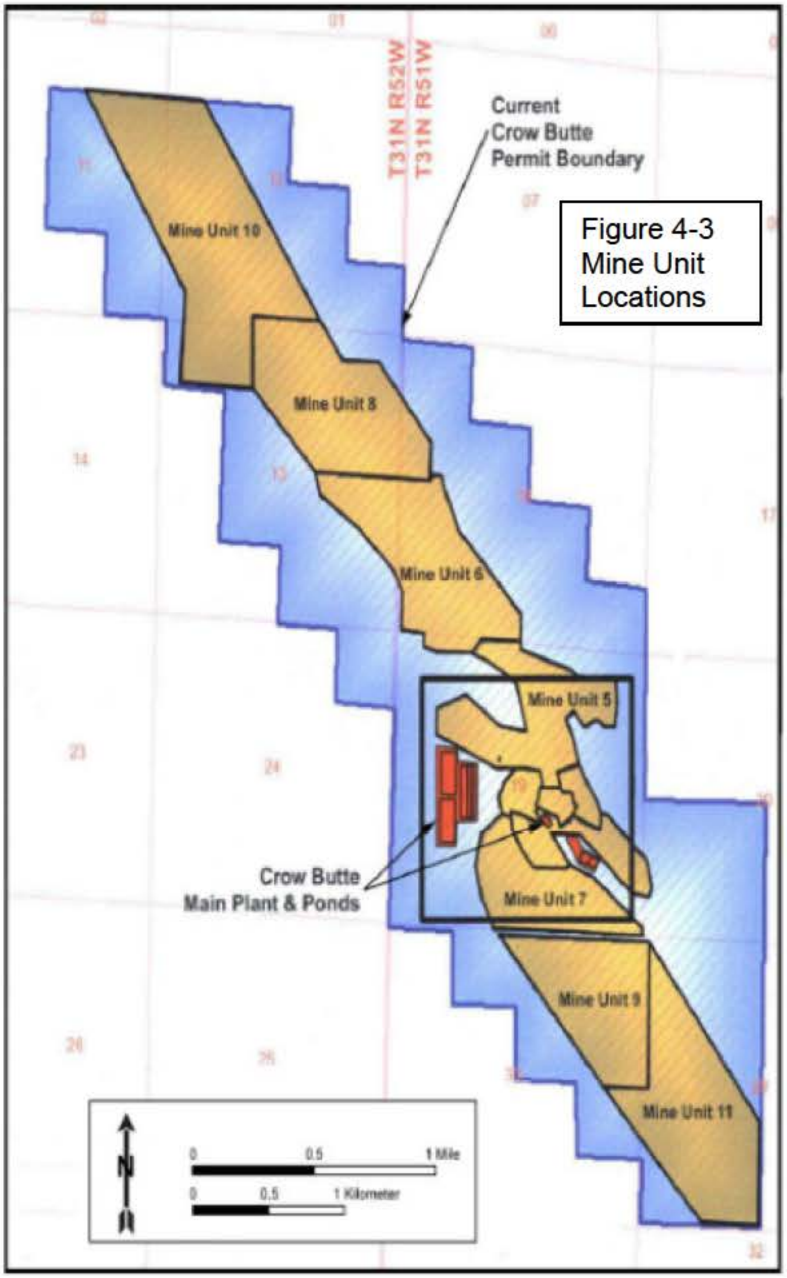

Figure 4-3. Location of the 11 Mine Units present within the CBR facility at Crow Butte.
Source: CBR, 2007A

4.6.3 No-Action Alternative

If the renewal of the license is not granted, decommissioning of the CBR facility would commence upon NRC approval of the final decommissioning plan in accordance with 10 CFR Part 40.42. NRC approval of a final decommissioning plan would constitute a federal action under NEPA and would be subject to a site-specific environmental review. Potential impacts on water resources associated with decommissioning activities on the CBR facility as discussed in Section 4.6 of this EA are expected to be SMALL.

4.7 Socioeconomic Impacts

There are positive overall socioeconomic impacts from the operation of the CBR facility in addition to potential negative impacts. The major positive impacts on socioeconomics are monetary benefits which accrue to the community. Potential negative monetary impacts may also occur, as there is a possibility for new or expanded schools and other community services.

4.7.1 Tax Revenues

Future tax revenues are dependent on uranium prices, which cannot be forecast with any accuracy; however, these taxes are also somewhat dependent on the number of pounds of uranium produced by CBR facility. The present taxes are based on a relatively consistent production rate of 800,000 pounds per year and would be on the order of $1.0 million to $1.2 million per year in combined taxes.

4.7.2 Temporary and Permanent Jobs

4.7.2.1 Projected Short-Term and Long-Term Staffing Levels

Because CBR expects that the types of positions at the CBR facility will have no significant impact on services and resources such as housing, schools, hospitals, recreational facilities, or other public facilities, the NRC staff concludes that impacts to short and long-term staffing levels will be SMALL.

4.7.3 Impact on the Local Economy

At the CBR facility, CBR actively supports the local economies through purchasing procedures that emphasize obtaining all possible supplies and services that are available in the local area. In 2006, these local purchases were estimated at $5,000,000. This level of business is expected to continue and would possibly increase somewhat with the addition of expanded production from any potential satellite facilities, although not in strict proportion to production. While there are some savings due to some fixed costs (central plant utilities for instance), there are additional expenses that are expected to be higher (well field development for the satellites is expected to be more expensive). Therefore, it can be estimated that the overall effect on local purchases will be proportional to the number of pounds produced. In addition, mineral royalty payments accrue to local landowners. Impacts on the local economy from continued operation of the CBR facility will be SMALL, with a potential positive MODERATE impact.

4.7.4 No-Action Alternative

If the renewal of the license is not granted, decommissioning of the CBR facility would commence upon NRC approval of the final decommissioning plan in accordance with 10 CFR Part 40.42. The NRC approval of a final decommissioning plan would constitute a federal action under NEPA and would be subject to a site-specific environmental review. Potential impacts on socioeconomics associated with decommissioning activities on the CBR facility are expected to be SMALL. Mitigation measures taken by CBR pertaining to socioeconomics would further reduce potential impacts.

4.8 Historical and Cultural Resources Impacts

Review and approval of the proposed action, entailing the renewal of NRC Source Materials License SUA-1534 and, accordingly, the continued operation of the CBR In Situ Uranium Recovery Facility, does not necessitate evaluation of all of the normal project phases typically addressed by an environmental review associated with a licensing action. Construction of project infrastructure (facilities and roads) was undertaken early in the initial license period. Ongoing construction during the operational phase involves construction of injection and production wells, including well houses and piping systems for delivery to the production facility. Throughout the operation phase of the project, CBR has practiced avoidance of all recorded cultural resources, an approach that would continue in the license renewal period.

Cultural resources surveys were completed in 1982 and 1987 for the entire CBR license area. A total of 21 prehistoric and historic archaeological and architectural sites was recorded, with six of these sites being evaluated at the time as “potentially eligible” for nomination and listing on the NRHP. The six “potentially eligible sites” were designated for avoidance during construction activities, both at the time and for the future. Only one site, 25DW192, is located entirely in an area of potential disturbance, and this property is protected by a fenced perimeter.

The original license contained an administrative condition calling for (1) additional cultural resources surveys should any previously unsurveyed land be used for future developmental activity, (2) cessation of work and immediate notification to the NRC should a discovery of previously unknown cultural artifacts take place during project disturbance activity, and (3) providing the NRC with documentation of its interaction with the Nebraska State Historical Society before any development activity takes place in the immediate vicinity of the six “potentially eligible” sites. Although the NRC has amended the license several times over the operating period Administrative Condition 9.9 still includes these stipulations, and this condition would continue in the license renewal period.

The practice of avoiding potential impacts for the six “potentially eligible” cultural resource sites would continue for the aquifer restoration and plant decommissioning phases of the project. Activities associated with restoration of the ground water in mine units occur at existing wells within established well fields and would result in little or no potential impacts to known cultural resource sites. While general earth-disturbing activities would be associated with decommissioning of the well fields and other facilities, the known cultural resource sites would be avoided during those activities (CBR 2004).

Section 3.9 of this EA discusses how NRC fulfilled its responsibilities under Section 106 of the NHPA for the CBR license renewal project. By letter dated July 15, 2013, the Nebraska SHPO concurred with NRC's Finding of No Historic Properties Present for the CBR In Situ Uranium Recovery License Renewal Project (ADAMS ML13266A266). Following SHPO concurrence with this finding, on September 30, 2013, the NRC posted a draft of its Section 106 documentation for the project on the NRC's public website and requested public comment. E-mails were also sent notifying the consulting parties of the website. No comments were received at the NRC.

Since the CBR Crow Butte project area has been subjected to intensive cultural resources field surveys for archaeological and historical sites (including a TCP field survey), and the six properties evaluated as "potentially eligible" for the NRHP are being actively avoided during all phases of the overall project, the NRC staff concludes that there will be no effects to the known and recorded cultural resource sites if the operating license is renewed.

At present, a class III archeological survey, a TCP survey completed by Santee Sioux Nation, a completed literature review and overall Tribal consultations have not yielded new information on TCPs that might be located within the CBR facility. It is possible that culturally important medicinal herbs may be found in the CBR facility. Comparison of the CBR ISR project area plant species list and the list of plants used as medicinal herbs in contemporary times by the Oglala Sioux (Morgan and Weedon, 1990) yields a list of 9 plant species used today by the Oglala which are identified in Table 4-4 (CBR, 2007A). Although each of the plants included in Table 4-4 may potentially occur at the CBR facility, these plants are known to be found over a wide range in the Northern Plains.

Two of the plants identified as a culturally important Oglala Sioux medicinal herb, peyote and sweet flag, are not native to the Northern Plains. The closest known location of sweet flag and peyote are along Bordeaux Creek, near Chadron in the Pine Ridge of northwestern Nebraska, about 30 miles from the CBR facility, where it is believed to have been introduced in historic times by Lakota people (Morgan and Weedon, 1990).

Table 4-4 Summary of Crow Butte Resources, Inc. In Situ Uranium Recovery Facility Plant Species that Have Been Identified as Being Used by the Oglala Sioux in Contemporary Times

Common Name	Scientific Name	Lakota Name	Lakota Use
Stickhead, Curly cup gumweed	*Grindelia squarrosa* (Pursh) Dun.	*pteiciyuha unma*	Remedy for colic, kidney problems, and other ailments
Cone flower, Purple coneflower	*Echinacea angustifolia* DC.	*icahpe hu*	A commonly used medicinal plant with a wide range of uses
Sweet clover	*Melilotus officinalis* (L.) Lam. and *Melilotus albus* Dest.	*wacanga iyececa*	Two species of sweet clover are hung in the house for its aromatic odor and burned as an aromatic for pleasure, purification, or curing

Wild sage	*Artemisia ludoviciana* Nutt.	*pejihota ape blaskaska*	Consistently used at religious ceremonies, for medicinal purposes, and for remedies associated with women's menstruation
Little wild sage	*Artemisia frigida* Willd.	*pejihota wastemna*	Same as for wild sage
Wild or Field mint	*Mentha arvensis* L.	*ceyaka*	Used to make a traditional beverage and as a remedy for colds and upset stomach
Sunflower	*Helianthus annuus* L.	*wahcazizi*	Used to make a tea and as a remedy for pulmonary troubles, upset stomach, and diarrhea
Wild rose, Rose hip	*Rosa arkansana* Porter	*unjinintka*	Roots of plant used for stomach ailments
Red false mallow	*Sphaeralcea coccinea* (Pursh) Rydb.	*heyoka tapejuta*	Used as a healing salve for sores and wounds, but may not be used any longer

Source: Morgan and Weedon (1990).

Potential preexisting TCPs, such as Crow Butte, are highly visible from the CBR project area, and the project is located within a potentially significant historic and Native American cultural landscape. However, the NRC staff concludes that there will be no adverse effects to these previously known and recorded cultural resource sites if the operating license is renewed. This assessment is based on findings that potential impacts from major construction activities have already occurred as the uranium project has been operation for more than 20 years.

Based on information obtained through Section 106 consultation, the TCP cultural Report submitted by Santee Sioux Nation (SSN, 2013), the class III archeological survey, and independent Staff reviews, overall impacts to historic and cultural resources from the relicensing of the CBR facility would be SMALL. Additionally, the NRC staff concludes that no new identified properties are eligible for listing in the National Register as TCPs.

4.8.1 No-Action Alternative

If the renewal of the license is not granted, decommissioning of the CBR facility would commence upon NRC approval of the final decommissioning plan in accordance with 10 CFR Part 40.42. NRC approval of a final decommissioning plan would constitute a federal action under NEPA and would be subject to a site-specific environmental review. Potential impacts on cultural resources associated with decommissioning activities on the CBR facility are expected to be SMALL. Mitigation measures taken by CBR pertaining to cultural resources would further reduce potential impacts.

4.9 Environmental Justice Impacts

As required by Title VI of the Civil Rights Act of 1964, federal agencies must consider whether their actions may cause disproportionately negative impacts on minority or low-income populations. Executive Order 12898 (59 FR 7629) (1994), "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," requires similar analysis.

In response to Executive Order 12898, the Commission issued a Policy Statement on the Treatment of Environmental Justice Matters in NRC Regulatory and Licensing Actions (69 FR 52040). The Policy Statement explains that "The Commission is committed to the general goals set forth in Executive Order 12898, and strives to meet those goals as part of its NEPA review process."

In 1997, the CEQ provided the following guidance relevant to determining when an agency's actions may disproportionately affect certain populations:

> Disproportionately High and Adverse Human Health Effects. Adverse health effects are measured in risks and rates that could result in latent cancer fatalities, as well as other fatal or nonfatal adverse impacts on human health. Adverse health effects may include bodily impairment, infirmity, illness, or death. Disproportionately high and adverse human health effects occur when the risk or rate of exposure to an environmental hazard for a minority or low-income population is significant (as defined by NEPA) and appreciably exceeds the risk or exposure rate for the general population or for another appropriate comparison group. (CEQ, 1997)
>
> Disproportionately High and Adverse Environmental Effects. A disproportionately high environmental impact that is significant (as defined by NEPA) refers to an impact or risk of an impact on the natural or physical environment in a low-income or minority community that appreciably exceeds the environmental impact on the larger community. Such effects may include ecological, cultural, human health, economic, or social impacts. An adverse environmental impact is an impact that is determined to be both harmful and significant (as defined by NEPA). In assessing cultural and aesthetic environmental impacts, impacts that uniquely affect geographically dislocated or dispersed minority or low-income populations or American Indian tribes are considered. (CEQ, 1997)

The following environmental justice analysis assesses whether relicensing the CBR facility might cause disproportionately high and adverse human health or environmental effects on minority and low-income populations. In assessing the effects, the following CEQ (1997) definitions of minority individuals, minority populations, and low-income populations were used:

> Minority individuals. Individuals who identify themselves as members of the following population groups: Hispanic or Latino, American Indian or Alaska Native, Asian, Black or African American, Native Hawaiian or Other Pacific Islander, or two or more races meaning individuals who identified themselves on a Census form as being a member of two or more races, for example, Hispanic and Asian.

Minority populations. Minority populations are identified when (i) the minority population of an affected area exceeds 50 percent or (ii) the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis.

Low-income population. Low-income populations in an affected area are identified with the annual statistical poverty thresholds from the Census Bureau's Current Population Reports, Series PB60, on Income and Poverty.

The NRC addresses environmental justice matters for license reviews through (i) identifying minority and low-income populations that may be affected by the proposed relicensing of the CBR facility and (ii) examining any potential human health or environmental effects on these populations to determine whether these effects may be disproportionately high and adverse.

The CBR facility is located in Dawes County, Nebraska, approximately 4 miles southeast of the city of Crawford. Table 4-5 shows 2010 Census data on poverty (low-income) and minority populations for the entire United States, the state of Nebraska, Dawes County, and the city of Crawford. The minority population percentages for Nebraska and Dawes County are approximately one third of the percentage across the United States. The minority population percentage in the city of Crawford is approximately one ninth that of the entire United States. The percentages of low-income populations are about the same for all four areas (slightly larger for Dawes County).

Table 4-5: Census data for Poverty and Minority Percentages

Geographic Unit	Percent Living in Poverty	Percent Minority
United States	13.8	36.3
Nebraska	14.0	13.9
Dawes County	17.5	10.61
Crawford	14.8	4.41

Source: USCB, 2010

Table 4-6 and 4-7 show the percentages of minority populations by race for Dawes County and the city of Crawford, respectively. Both Dawes County and the city of Crawford have significantly lower minority populations and percentages than the overall averages across the United States.

Table 4-6 Census data for Minority Type Populations of Dawes County, Nebraska

Population by Race	Counts	Percentages
American Indian and Alaskan native alone	362	3.94
Asian alone	95	1.03
Black or African American alone	134	1.46
Native Hawaiian or Other	46	0.50

Pacific alone		
Some other race alone	104	1.13
Two or more races	233	2.54
Hispanic or Latino Origin alone	306	3.33
White alone	8,208	89.39

Source: USCB, 2010

Table 4-7 Census data for Minority Type Populations of the City of Crawford, Nebraska

Population by Race	Counts	Percentages
American Indian and Alaskan native alone	9	0.90
Asian alone	2	0.20
Black or African American alone	1	0.10
Native Hawaiian or Other Pacific alone	7	0.70
Some other race alone	2	0.20
Two or more races	23	2.31
Hispanic or Latino Origin alone	10	1.0
White alone	953	95.59

Source: USCB, 2010

Because the CBR facility is located in a rural area outside city limits, the area of assessment (review area) used for the environmental justice analysis is a 4-mile radius (NRC, 2003a, Appendix C). The city of Crawford is the major population center within that area. No concentrations of minority populations were identified as residing near the CBR facility, as residents nearest to the CBR facility are rural populations, and most of the minority population lives in Crawford. In 2010, the total population for the city of Crawford was 997 people (USCB, 2010). As shown in Table 4-7, minority populations accounted for less than 5 percent of this total population.

The population characteristics of the review area are compared with Nebraska and Dawes County population characteristics to determine whether there are significant concentrations of minority or low-income populations in the review area relative to the state and county.

The NRC staff considers environmental justice in greater detail when the percentage of minority or low-income population in the impacted area exceeds the corresponding populations in the county or state by more than 20 percentage points, or when the minority or low-income population in the impacted area exceeds 50 percent (NRC, 2003a, Appendix C). According to the census data presented above, the percentages of minority and low-income populations of 4.4 and 14.8 percent, respectively, in the vicinity of the CBR facility (as represented by the city of Crawford) do not significantly exceed the corresponding percentages in either Dawes County (10.61 and 17.5 percent, respectively) or the state of Nebraska (13.9 and 14.0 percent, respectively). Also, the low-income or minority populations within the affected area do not exceed 50 percent. Therefore, the NRC staff concludes that there would be no disproportionately high or adverse impacts to minority or low-income populations from the renewal of the CBR facility license.

As noted in Section 3.6.2, Shannon County, South Dakota, the location of the Pine Ridge Indian Reservation is located approximately 50 miles (80 km) from the CBR facility. About 54 percent of the Shannon County population is below the poverty level, compared with about 14 percent for the State of South Dakota (USCB, 2011). Also, Shannon County’s population is approximately 96 percent minority (Native American). However, because of the distance between the Pine Ridge Indian Reservation and the CBR facility, the NRC staff concludes that there would not be disproportionately high or adverse impacts on minority or low-income residents on the Pine Ridge reservation from the relicensing of the CBR facility.

If the application were to receive approval, there would be potential positive impacts to environmental justice from the relicensing of the CBR facility. Positive economic impact on minority groups is possible, since the project could generate additional employment opportunities with compensation that compares favorably with other employment opportunities in the area.

Due to the significantly lower percentages of minority populations in the area surrounding the CBR facility, and the distance of the facility from the Pine Ridge reservation, the NRC staff concludes that there would not be disproportionately high or adverse impacts on minority and low-income populations if the CBR facility is relicensed. Therefore, overall impacts to environmental justice from the relicensing of the CBR facility would be SMALL.

4.9.1 No-Action Alternative

If the renewal of the license is not granted, decommissioning of the CBR facility would commence upon NRC approval of the final decommissioning plan in accordance with 10 CFR Part 40.42. The NRC approval of a final decommissioning plan would constitute a federal action under NEPA and would be subject to a site-specific environmental review. Potential impacts on environmental justice associated with decommissioning activities on the CBR facility are expected to be SMALL. Mitigation measures taken by CBR pertaining to environmental justice would further reduce potential impacts.

4.10 Ecological Impacts

4.10.1 Vegetation Impacts

Impacts to vegetation from the CBR facility include primarily short-term vegetation loss due to the modification of structure, species composition, and areal extent of cover types from soil disturbance and grading.

Potential indirect impacts include the short-term and long-term increased potential for non-native species invasion, establishment, and expansion; exposure of soils to accelerated erosion; shifts in species composition or changes in vegetative density; reduction of wildlife habitat; and changes in visual aesthetics. Vegetation removal and soil handling associated with the construction and installation of wellfields and pipelines, and the maintenance of access roads, would affect vegetation resources both directly and indirectly. If the mixed-grass prairie vegetation community were to be developed, direct impacts would include the short-term loss of vegetation (modification of structure, species composition, and areal extent of cover types). Indirect impacts would include the short-term and long-term increased potential for non-native species invasion, establishment, and expansion; exposure of soils to accelerated erosion; shifts in species composition or changes in vegetative density; reduction of wildlife habitat; reduction in livestock forage; and changes in visual aesthetics.

An estimated 1,041.7 acres of cultivated agricultural fields would be affected by surface-disturbing production facilities, although much of this has already been completed as part of the original application.

Construction activities, increased soil disturbance, and higher traffic volumes could stimulate the introduction and spread of undesirable and invasive, non-native species on the CBR facility. Establishment of invasive species has become a reason for impacts to vegetation in the United States. These species often out-compete desirable species, including special-status species, rendering an area less productive as a source of forage for wildlife. Additionally, sites dominated by invasive, non-native species often have a different visual character that may negatively contrast with surrounding undisturbed vegetation.

In general, the duration of effects on cultivated agricultural land and mixed-grass prairie vegetation are significantly different. Cropland areas can be readily returned to production through fertilizer treatments and compaction relief. However, disturbed native prairie tracts require reclamation treatments and natural succession to return to predisturbance conditions of diversity (both species and structural). Reestablishment of mixed-grass prairie to predisturbance conditions would be influenced by climate (growing season, temperature, and precipitation patterns) and edaphic (physical, chemical, and biological) conditions in the soil.

During reclamation, previously agricultural lands would return to approximate precontours and be ripped to depths of 12 to 18 inches to relieve compaction. If mixed-grass prairie tracts were disturbed by surface activities, these areas would be completely reclaimed. Mitigation measures agreed to in the application would reduce potential impacts. These include reclamation of mixed-grass prairie. Specifically, the reductions would generally include: (1) completing cleanup of the disturbed areas (wellfields and access roads); (2) restoring the disturbed areas to the approximate ground contour that existed before construction; (3) replacing topsoil, if removed, over all disturbed areas; (4) ripping disturbed areas to a depth of 12 to 18 inches; and (5) seeding recontoured areas with a locally adapted, certified weed-free seed mixture.

Impacts to vegetation from the relicensing of the CBR facility would be SMALL, with the potential for temporary MODERATE impacts. Mitigation measures outlined above would reduce any potential MODERATE impacts during reclamation to SMALL; therefore the overall impact from vegetation would be SMALL.

4.10.2 Wetlands Impacts

Sediment yields have the potential to impact wetlands in the United States. Although normal construction activities within the wellfields, processing plant, and along pipeline courses and roads may slightly increase the sediment yield of the areas disturbed, the relative size of such disturbances is minor compared to the size of the permitted areas and to the size of the watersheds. As wellfield decommissioning and reclamation activities will be on going throughout the life of the project, the area to be reclaimed at the conclusion of operations will be reduced, although a slight increase in sediment yields and total runoff can still be expected.

The results of stream sediment sampling for Squaw and English Creeks indicate that measured concentrations of radiological parameters (e.g., uranium) between 1998 and 2207 are consistent with preoperational monitoring, which indicates that these levels are anomalous natural background concentrations. (CBR 2007A)

Surface disturbances associated with the CBR facility would not affect either Spring Creek or the White River, which is where the wetlands in the vicinity of the CBR facility are located. Wetlands and/or waterbodies (i.e., wet meadow, mixed prairie- riparian, wet meadow- riparian, deep marsh-riparian, riverine, and impoundment) make up only 3.17 percent (273.92 acres) of the habitat at the CBR facility.

Overall impacts to wetlands from the relicensing of the CBR facility would be SMALL.

4.10.3 Small Mammals and Birds

The direct disturbance of wildlife habitat in the project area likely would reduce the availability and effectiveness of habitat for a variety of common small mammals, birds, and their predators. The initial phases of surface disturbance and increased noise would result in some direct mortality to small mammals and would displace some bird species from disturbed areas. In addition, a slight increase in mortality from increased vehicle use of roads in the project area would be expected.

The temporary disturbances that occur during the construction period would tend to favor generalist wildlife species such as ground squirrels and homed larks, and would have more impact on specialist species such as western meadowlarks, lark buntings, and grasshopper sparrows. Overall, the long-term disturbance of 1,310 acres would have negligible impacts on common wildlife species. Songbirds that may be affected by the reduction in cultivated fields would be homed larks, sage sparrows, sage thrashers, and vesper sparrows. Although there is no way to accurately quantify these changes, the impact is likely to be small in the short term and be reduced over time as reclaimed areas begin to provide suitable habitats.

Because of the high reproductive potential of these species, they would rapidly repopulate reclaimed areas as habitats become suitable. Birds are highly mobile and would disperse into surrounding areas and utilize suitable habitats to the extent that they are available. The primary small mammals found on the project area include, but are not limited to, eastern cottontail, deer mice, thirteen-lined ground squirrel, white-footed mouse, meadow jumping mouse, and northern pocket mouse. The initial phases of surface disturbance would result in some direct mortality and displacement of small mammals from construction sites. Quantifying these changes is not possible because population data are lacking. However, the impact is likely to be small, and the high reproductive potential of these small mammals would enable populations to quickly repopulate the area once reclamation efforts are initiated.

Overall impacts to small mammals and birds from the relicensing of the CBR facility would be SMALL.

4.10.4 Big Game Mammals

The principal wildlife impacts likely to be associated within the project area include: (1) a direct loss of certain wildlife habitat; (2) the displacement of some wildlife species; (3) an increase in the potential for collisions between wildlife and motor vehicles; and, (4) an increase in the potential for the illegal killing and harassment of wildlife.

In general, direct removal of habitat used by big game mammals is expected to be minimal, as the project area is predominantly used for agricultural production. Because a substantial proportion of the project area is used for seasonal crop production, only a small proportion of the available wildlife habitat in the project area would be affected. The capacity of the project area to support big game populations should remain essentially unchanged from current conditions.

In addition to the direct removal of habitat because of the development of wells and associated satellite facilities, disturbances from drilling activities and traffic would affect utilization of the habitat immediately adjacent to these areas; however, big game mammals are adaptable and may adjust to non-threatening, predictable human activity. It is envisioned that most big game mammal responses will consist of avoidance of areas proximal to the operational facilities, with most individuals carrying out normal activities of feeding and bedding within adjacent suitable habitats. In addition, the magnitude of displacement would decrease over time as: (1) the animals have more time to adjust to the operational circumstances; and, (2) the extent of the most intense activities such as drilling and road building diminishes and the wellfields are put into production. By the time the wellfields are under full production, construction will have ceased, and traffic and human activities in general would be greatly reduced. As a result, this impact would be minimal and it is unlikely that big game mammals would be significantly displaced under full field development. The level of big game mammal use of the project area is more likely to be determined by the quantity and quality of forage available.

The potential for vehicle collisions with big game mammals would increase as a result of increased vehicular traffic associated with the presence of construction crews and would continue (although at a reduced rate) throughout all phases of the wellfield operations. Development of new roads would allow greater access to more areas and may lead to an increased potential for poaching of big game animals; however; because of the proximity to Crawford and locations of farm residences in the project area, the incidence of vehicle collision impacts to big game mammals is anticipated to occur infrequently and no long- term adverse effects are expected.

Based on the foregoing, long-term adverse effects are not expected for any local big game mammal populations.

Overall impacts to big game mammals from the relicensing of the CBR facility would be SMALL.

4.10.5 Upland Birds

The potential effects of the operation and maintenance of project facilities on upland game birds may include nest abandonment and reproductive failure caused by project- related disturbance and increased noise. Other potential effects involve increased public access and subsequent human disturbance that could result from new construction and production activities.

No sharp-tailed grouse leks are known to occur within the project area. However, noise related to drilling and production activities may affect sharp-tailed grouse utilization of leks or reproductive success. Mitigation in the form of reduction of noise levels in areas near leks would minimize this potential impact. If leks are found, surface disturbance will be avoided within 0.25 miles of leks, as committed to by CBR in the ER (CBR, 2007A). If disturbance within the buffer areas is avoided, no impacts are expected.

Areas with large tracts of mixed-grass prairie would provide the best quality nesting habitat. Additional mitigation measures include protecting sharp-tailed grouse nesting habitats; construction would be limited within a 1-mile radius of an active lek between March 1 and June 30, as committed to by CBR in the ER (CBR, 2007A). Significant impacts to leks and subsequent reproductive success are not expected if these guidelines are implemented.

Impacts to upland birds from the relicensing of the CBR facility is SMALL to MODERATE. Mitigation outlined above that CBR has committed to would reduce any MODERATE impacts to SMALL. Therefore, overall impacts to upland birds from the relicensing of the CBR facility would be SMALL.

4.10.6 Raptors

Potential impacts to raptors within the project area include: (1) nest desertions or reproductive failure as a result of project activities and increased public access; (2) temporary reductions in prey populations; and (3) mortality associated with roads.

The primary potential impact to raptors from project activities is disturbance during nesting that might result in reproductive failure. To minimize this potential, CBR agreed in the ER not to allow construction during the critical nesting season (February 1 - July 31, depending on species) within 0.5 mile of an active nest of listed or sensitive raptor species, and 0.25 mile (depending on species or line of sight) of an active nest of other raptor species (CBR, 2007A). The nature of the restrictions, exclusion dates, and the protection radii would vary, depending on activity status of nests, species involved, and natural topographic barriers, and line-of- sight distances would be developed in coordination within the Nebraska Game and Parks Commission (NGPC) or the U.S. Fish and Wildlife Service (USFWS).

Nests not used in one year may potentially be used in subsequent years. Subsequent development within close proximity to these nests may preclude use of the nest in following years. Mitigation measures in the protection of nests that may potentially be used in the future may require limiting construction within 300 meters (depending on species or line of sight) to minimize impacts. If "take" of an inactive nest were unavoidable, development of artificial nesting structures would mitigate for the loss of the nest. In some instances, during the production phase when human activity is reduced, raptors may actually nest on artificial above-ground structures. Based on the foregoing, significant impacts to raptor nesting activities are not expected.

The development of proposed wellfield would disturb an estimated 1,310 acres of potential habitat for several species of small mammals that serve as prey for raptors. This short-term impact would affect approximately 62 percent of the CBR facility, although this is not likely to limit raptor use within the project area. The small amount of short-term change in prey base populations created by construction is minimal in comparison to the overall status of the rodent and lagomorph populations. While prey populations on the project area would likely sustain some impact during the initial phase of the project, prey numbers would be expected to soon rebound to pre-disturbance levels following reclamation or active agricultural uses. Once reclaimed or in active agricultural uses, these areas would likely promote an increased density and biomass of small mammals that is comparable to those of undisturbed areas. For these reasons, implementation of the project is not expected to produce any appreciable long-term negative changes to the raptor prey base within the project area.

As use of the project area increases, the potential for encounters between raptors and humans would increase and could result in increased disturbance to nests and foraging areas. Closure of roads located near active raptor nests to public vehicle use would offset this potential impact. Some raptor species feed on road-killed carrion on and along the roads, while others (owls) may attempt to capture small rodents and insects that are illuminated in headlights. These raptor behaviors put them in the path of oncoming vehicles where they are in danger of being struck and killed. The potential for such collisions can be reduced by requiring drivers to follow all posted speed limits.

Impacts to raptors from the relicensing of the CBR facility would be SMALL to MODERATE. If CBR implements the mitigation outlined above it would reduce any MODERATE impacts to SMALL. Therefore, overall impacts to raptors from the relicensing of the CBR facility would be SMALL.

4.10.7 Fish, Macroinvertebrates, Reptiles and Amphibians

There are habitats for fish, macroinvertebrates, reptiles and amphibians within portions of Spring Creek and the White River. It is expected that surface disturbances associated with the continued operation of the CBR facility will not affect either Spring Creek or the White River. Therefore impacts to fish, macroinvertebrates, reptiles and amphibians from the relicensing of the CBR facility would be SMALL.

4.10.8 Threatened and Endangered Species

The USFWS and NGPC have identified the following threatened, endangered and candidate species with the potential to occur in Dawes County: swift fox (state endangered), the bald eagle (state endangered), black-footed ferret (state/federal endangered), and whooping crane (state/federal endangered). The only species with a reasonable possibility of occurring on or near the project site are the bald eagle and swift fox. The whooping crane, black-footed ferret and black-tailed prairie dog have not been observed at the CBR facility.

Swift Fox (State Endangered)

The swift fox is closely associated with lagomorph populations, prairie dog colonies, ground squirrels, and other small mammals, which exist in varying densities and abundance throughout the CBR facility. High quality swift fox habitat is present in a grassland area immediately northwest of the project area, which would be expected to be a preferred habitat area over the existing CBR facility. Based on the NRC’s analysis, the implementation of the project may affect the swift fox due to disturbance to habitats that may support preferred swift fox prey species. This minor indirect effect is not expected to affect the individual health of the swift fox or the status of the local swift fox population because of the availability and suitability of other undisturbed habitats in the CBR facility and adjacent areas.

Bald Eagle (State Threatened)

Based on its analysis of the effects of project implementation and the current and potential status of this species in northwestern Nebraska, the NRC concludes that the relicensing of the CBR facility will have no adverse effect on the bald eagle. This analysis is based on lack of observed bald eagle nests in the project area, no documentation of winter concentration areas or winter nighttime roosts (Fritz 2004), and lack of open water in which most bald eagle populations tend to maintain a close association

Black-footed Ferret (Federal and State Endangered)

There have been no observations or reports of the black-footed ferret in the project area, nor have there been any confirmed populations of the ferret observed in the state of Nebraska since 1959 (USFWS 1978). Black-footed ferret populations coincide closely with colonies of prairie dogs, on which the ferret depends for food and habitat. Prairie dog colonies required for a successful ferret population are not found within the CBR facility. Based on its analysis of the effects of project implementation and the current and potential status of this species in northwestern Nebraska, the NRC concludes that the relicensing of the CBR facility will have no adverse effect on the black-footed ferret.

Whooping Crane (Federal and State Endangered)

There is a limited availability of highly suitable whooping crane habitat within the CBR facility, with the majority of sightings within Nebraska occurring in the Platte Valley that is located a considerable distance away in central Nebraska. Therefore, any presence of whooping cranes within the CBR facility and surrounding area would be expected to be infrequent and transient. Based on its analysis of the effects of project implementation and the current and potential status of this species in northwestern Nebraska, the NRC concludes that the relicensing of the CBR facility will have no adverse effect on the whooping crane.

Therefore, overall impacts to threatened and endangered species from the relicensing of the CBR facility would be SMALL.

4.10.9 No-Action Alternative

If the renewal of the license is not granted, decommissioning of the CBR facility would commence upon NRC approval of the final decommissioning plan in accordance with 10 CFR Part 40.42. The NRC approval of a final decommissioning plan would constitute a federal action under NEPA and would be subject to a site-specific environmental review. Potential impacts on ecology associated with decommissioning activities on the CBR facility are expected to be SMALL. Mitigation measures taken by CBR pertaining to ecology would further reduce potential impacts.

4.11 Scenic and Visual Resources Impacts

The visible surface structures constructed in the CBR facility include the processing plant building, the office buildings, the small boxes that make up the wellhead covers, the shed structures that hold the wellhouses, and the electrical distribution lines. The main processing plant building is 100 by 130 feet in size, and makes up the largest structure on the CBR facility. There are also electric distribution lines that connect wellhouses to existing electric distribution lines. These electric lines are distributed with the use of 20 foot high wooden poles.

4.11.1 Short-term Impacts

Temporary and short-term impacts to the rural character of the landscape occurred from well construction, well drilling, and associated construction of ancillary facilities such as access roads and electric distribution lines. Once installation of facilities was complete, temporary disturbance areas were reclaimed to pre-construction conditions. Only permanent disturbances such as the building and plant structures associated with operations and maintenance of the facilities have remained following post-construction restoration. Beyond what is already constructed and in place, there will be no additional impacts.

Overall short-term impacts of scenic and visual resources from the relicensing of the CBR facility would be SMALL.

4.11.2 Long-term Impacts

Long-term impacts for the project have resulted from the addition of structures to the landscape, such as the main facility plant, the shed wellhouses, the cement wellhead covers, the associated access roads, and the electric distribution lines. Project development and construction of buildings and roads have altered the setting and visual quality of some portions of the CBR facility landscape. Although the existing rural and agricultural landscape has been largely maintained, the industrial component associated with the buildings has created an overall modification. Line and textural contrasts of the well houses, the plant, administration buildings, and associated access roads and distribution lines are not visible from any of the identified sensitive viewing areas. This is due to the CBR facility being isolated from locations where there are viewers with a concern for scenic landscapes, including recreation areas, major transportation routes, and residential areas. There have been several offsite residential areas that have impacted the overall visual resources that are not associated with the CBR facility.

Overall long-term impacts to scenic and visual resources from the relicensing of the CBR facility would be SMALL.

4.11.3 No-Action Alternative

If the renewal of the license is not granted, decommissioning of the CBR facility would commence upon NRC approval of the final decommissioning plan in accordance with 10 CFR Part 40.42. NRC approval of a final decommissioning plan would constitute a federal action under NEPA and would be subject to a site-specific environmental review. Potential impacts on scenic and visual resources associated with decommissioning activities on the CBR facility are expected to be SMALL. Mitigation measures taken by CBR pertaining to scenic and visual resources would further reduce potential impacts.

4.12 Public and Occupational Health Impact

4.12.1 Non-radiological Impacts

The potential non-radiological impacts from construction include disturbance of the land during construction of wellfields, fugitive dust, vehicle and construction equipment emissions, and waste (such as trash and hazardous and nonhazardous chemicals). There are no additional construction activities anticipated for the CBR facility; therefore, impacts from construction activities are anticipated to be SMALL.

The potential non-radiological impacts from operation and aquifer restoration include fugitive dust and emissions from vehicles, leaks and spills from hazardous and non-hazardous chemicals, evaporation pond leakage, potential lixiviant excursions, and waste. As indicated in Section 4.4, all airborne emissions are expected to have a minimal impact on the environment. At no time during the life of the project is it anticipated that the ambient air quality standard of the State of Nebraska will be exceeded. During operation, the only significant source of TSP is dust emissions from unpaved roads. If increased dust is determined to be a concern during environmental monitoring, emissions would be reduced through appropriate control procedures, such as the use of dust control chemicals on the road surface (CBR 2007A).

As described in Section 3.11.1, the current operations at the central plant involve the use of chemicals that could present a hazard to workers and the environment. The typical chemicals, hazardous and nonhazardous, that are used at ISR facilities have been identified in the GEIS, Section 4.2.11.2.4. The design of storage and handling facilities at the CBR facility is in accordance with applicable codes and standards. As a result, there has not been a serious incident involving hazardous chemicals at the CBR facility. Operation of the CBR facility is by design a self-contained uranium recovery circuit, which limits spills and leaks during operation. If spills and leaks occur, the applicant would be required to comply with Federal regulations to limit the potential impacts to workers and the public, which include:

- 40 CFR Part 68, Chemical Accident Prevention Provisions. This regulation lists regulated toxic substances and threshold quantities for accidental release prevention.

- 29 CFR 1910.119, OSHA Standards (which include Process Safety Management). This regulation lists highly hazardous chemicals, including toxic and reactive materials that have the potential for a catastrophic event at or above the threshold quantity.

- 40 CFR Part 355, Emergency Planning and Notification. This regulation lists extremely hazardous substances and their threshold planning quantities for the development and implementation of emergency response procedures. A list of reportable quantity values is also provided for reporting releases.

- 40 CFR Part 302.4, Designation, Reportable Quantities, and Notification–Designation of Hazardous Substances. This regulation lists hazardous substances under the Comprehensive Environmental Response, Compensation, and Liability Act, compiled from the Clean Water Act and Clean Air Act.

CBR would also comply with these regulations in the event of evaporation pond leakage, and efficient and effective corrective action would be taken to minimize impacts. The potential for leakage and/or overflow from the lined ponds affecting water resources is mitigated by Federal and State statutes that regulate the discharge of stormwater runoff and process-related water through the permitting process (e.g., NPDES, SWPPP). Compliance with these statutes, required mitigation measures, and use of best management practices would minimize potential non-radiological impacts.

Section 3.11.1 describes the potential for lixiviant excursion at the CBR facility, which is considered to be a potential release of process chemicals that may impact the environment. To date there have been several horizontal excursions in the Chadron sandstone in the current CBR facility, which were recovered through overproduction in the immediate vicinity (CBR, 2007A). In no case did the excursions threaten the water quality of an underground source of drinking water, since the monitoring wells are located well within the aquifer exemption area approved by the EPA and NDEQ. As described in Section 4.6, the applicant is required to conduct mechanical integrity testing during operation to detect and minimize impacts from lixiviant excursion. CBR is required by the license to notify the NRC of an excursion and maintain documentation on corrective actions for the NRC staff to review during onsite inspections. CBR also retains a NDEQ UIC permit which sets the values to which ground water quality must be restored.

Waste generated by the facility is contained and eventually removed to offsite disposal facilities that are operated under State and Federal oversight. At the CBR facility, CBR is required to comply with NRC standards in NUREG/CR-6733 and OSHA requirements in 29 CFR Part 1910.119 to prevent and minimize impacts associated with storage and handling of hazardous and nonhazardous chemicals (CBR 2007A). Compliance with these regulations and requirements minimizes the potential for non-radiological impacts due to waste.

The potential non-radiological impacts from decommissioning are similar to those identified for construction. During decommissioning, non-radiological impacts would be temporary as the site is returned to unrestricted use. Appropriate dust suppression practices would be employed to minimize impacts from vehicle and construction equipment. Decommissioning activities at the CBR facility are completed under NRC and NDEQ permitting regulations and any potential impacts would be localized and mitigated through compliance with these requirements. While spills of fuels and lubricants during decommissioning activities could potentially result in non-radiological impacts, CBR's implementation of best management practices, such as those identified in Section 4.2.2.3 of the ER, would reduce the likelihood and magnitude of such spills and facilitate corrective action (CBR, 2007A). Impacts from decommissioning would be further minimized as CBR restores ground water to the appropriate restoration values set by NDEQ and Criterion 5B (5) of 10 CFR Part 40, Appendix A, thereby reducing the potential for non-radiological releases into ground water.

In conclusion, the NRC staff expects that non-radiological impacts to public and occupational health from the relicensing of the CBR facility would be SMALL.

4.12.2 Radiological Impacts

Potential radiological impacts from the CBR facility on public and occupational health and safety are determined by analyzing the types of emissions from the CBR facility, the potential emission pathways present, and an overall evaluation of the potential radiological hazards associated with the associated emission and pathways. Since the project is an ISR facility, most of the particulate emission sources normally associated with a conventional mill will not be present. The only source of radioactive emissions from the current operation is radon released into the atmosphere through plant ventilation systems or from the well fields. This radon release could result in radiation exposure through inhalation and ingestion.

4.12.2.1 Radiological impacts associated with exposure from water pathways

The solutions in the extraction zone are controlled and adequately monitored to ensure that migration does not occur. The overlying aquifers are also monitored. Three commercial evaporation ponds located approximately 2,000 feet from the plant building have been constructed for commercial operation. There are also two R&D evaporation ponds located approximately 1,000 feet from the plant building. The R&D ponds have a 34-mil Hypalon liner and a leak detection system. The commercial evaporation ponds are lined with double impermeable synthetic liners. There is a leak detection system installed to provide a warning if the liner develops a leak. The ponds, therefore, are not considered a source of liquid radioactive effluents.

The CBR facility is located on a curbed concrete pad to prevent any liquids from entering the environment. Solutions used to wash down equipment drain to a sump and are pumped to the ponds. The pad is of sufficient size to contain the contents of the largest tank in the event of its rupture.

The primary method of waste disposal at the CBR facility is deep disposal well injection. The deep disposal well is 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). The well has been constructed under a Class I Underground Injection Control (UIC) Permit issued by the NDEQ and meets all requirements of the NDEQ UIC program. Since there are no routine liquid discharges of process water from the CBR facility, there are no definable water related pathways.

For the above reasons, impacts to public and occupational health from water pathways on the CBR facility and the surrounding environment if the relicensing of the CBR facility occurs would be SMALL.

4.12.2.2 Radiological impacts associated with exposure from air pathways

Exposures from air pathways to the environment come in the form of radon gas, which has the potential to be released via a vent from the main plant or the wellfields during operation. Radiation exposure occurs through one of three pathways: inhalation, ingestion, or external exposure. The total effective dose equivalent (TEDE) is calculated to employees at the CBR facility and the residents of Crawford NE and surrounding area residents. CBR compiled the joint frequency data, which was used to define the atmospheric conditions in the project area with a site-specific meteorological station.

After the data was compiled by CBR, it was found that no TEDE limits were exceeded. The NRC's evaluation of the TEDE (from the SER) follows:

- The maximum TEDE was 31.7 mREM/yr at Receptor #15, which is located approximately 0.25 mile northeast of the CBR facility site.

- The estimated TEDE at Receptor #6, located on the east side of the town of Crawford, was 1.65 mREM/yr.

- Since radon-222 is the only radionuclide emitted, public dose limits in 40 CFR 190 and the 10 mREM/yr constraint rule in 10 CFR 20.1101 are not applicable to the CBR facility.

(NRC 2014)

For the above reasons, impacts to exposure from air pathways on the CBR facility and surrounding environment if the relicensing of the CBR facility occurs would be SMALL.

4.12.2.3 Radiological impacts associated with population dose

Table 4.8 shows a comparison of the following:

1. The annual population dose commitment to the population in the region within 80km of the CBR facility. The dose to the population within 80km of the facility due to natural background radiation.
2. The release of radon results in a dose to the population on the North American continent.
3. The continental dose is calculated by comparison with a previous calculation based on a 1-kilocurie release near Casper, Wyoming in 1978.

The results of these calculations were combined with dose to the region within 80km of the facility to arrive at the total radiological effects of one year of operation at the CBR facility. The maximum radiological effect of the combined operation of the facility would be to increase the dose to the bronchial epithelium of the continental population by 0.0023 percent.

Table 4-8: Dose to the Population Bronchial Epithelium and Increased Continental Doe from One Year's Operation at the CBR Facility

Criteria	**Dose (Person Rem/Yr)**
Dose received by population within 80km of the facility	171
Natural background by population within 80km of the facility	24025
Dose received by population beyond 80km of the facility	224
Total continental dose	394
Natural background for the continental population	1.73×10^8
Fraction increase in continental dose	2.27×10^{-6}

Source: CBR, 2007A

Therefore, impacts to population dose from the relicensing of the CBR facility would be SMALL.

For the above reasons, overall impacts to public and occupational health from the relicensing of the CBR facility would be SMALL.

4.12.3 No-Action Alternative

If the renewal of the license is not granted, decommissioning of the CBR facility would commence upon NRC approval of the final decommissioning plan in accordance with 10 CFR 40.42. NRC approval of a final decommissioning plan would constitute a federal action under NEPA and would be subject to a site-specific environmental review. Potential impacts on public and occupational health associated with decommissioning activities on the CBR facility are expected to be SMALL. Mitigation measures taken by CBR pertaining to public and occupational health would further reduce potential impacts.

4.13 Cumulative Impacts

CEQ regulations implementing NEPA define cumulative effects as “the impact on the environment which results from the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions” (40 CFR 1508.7). Unless otherwise indicated for a specific resource, the NRC staff has chosen a geographical range for this cumulative impacts analysis to be a 50 mile (80 km) radius from the CBR facility as this geographical range encompasses the proposed action, all reasonably foreseeable actions in the area, and a reasonable buffer surrounding these areas. The staff has chosen the timeframe for cumulative impacts to be 35 years, starting in 2007 when the application for license renewal was received, which will cover the renewed operation and restoration for the existing facility as well as construction, operation, and restoration of proposed Crow Butte ISR expansion areas.

For the purposes of this analysis, past actions are those related to the resources between the time of original licensing of the CBR facility and submittal of the license renewal application. Present actions are those that have occurred since submittal of the renewal application. No nuclear materials facilities other than the present CBR operation are located in Nebraska (CBR 2012). Other facilities exist within the region but are all more than 50 miles (80 km) from these CBR projects (CBR 2012). The NRC staff obtained information from the Dawes County Department of Roads on current local and regional projects or actions that could potentially contribute to the cumulative impacts in this area. County staff stated that only minor road repair and maintenance projects are ongoing in the county. The NRC staff also reviewed Table 5.3-4 of NUREG-1910, “Generic Environmental Impact Statement for In Situ Leach Uranium Milling Facilities (NRC, 2009) (GEIS) for current actions that might contribute to cumulative impacts for the proposed action and has determined, through the GEIS and its own independent analysis, that present actions in the geographic range include the everyday operations of the CBR facility as well as a cell phone tower that has been constructed on the Pine Ridge escarpment between the CBR facility and the proposed Marsland Expansion Area (MEA). Impacts from the continued operation of the CBR facility are discussed in Sections 4.1 – 4.12. The cell phone tower is not likely to have a significant cumulative impact to the resources areas in this geographic range as the tower has been erected on previously disturbed land and occupies a relatively small footprint as compared to the overall geographic range of this assessment.

Presently, the NRC has received two license amendment applications from CBR for the North Trend ISR Expansion Area (NTEA) and MEA. In addition, CBR has indicated that it plans to submit an application for the Three Crow ISR Expansion Area (TCEA) by the end of 2014. CBR possesses a NDEQ mineral exploration permit for the entire pan-handle region of Nebraska[10] that allows it to perform exploratory drilling at the CBR facility and the proposed expansion areas. Since the last license renewal, CBR has drilled approximately 250 exploratory holes at the CBR facility, all of which have been plugged and abandoned in accordance with their NDEQ permit. CBR has also drilled approximately 1000 exploratory holes at the NTEA and 2000 holes at the MEA that have also been plugged and abandoned. There are approximately 1500 exploratory holes at the TCEA which have been plugged and abandoned as required by the NDEQ permit. NDEQ specifies the time frame and conditions for properly plugging and abandoning the exploratory holes, which would eliminate the potential for impacts. For this reason, exploratory drill holes are not expected to contribute to cumulative impacts within any resource area.

For purposes of this analysis, future actions are considered to be those that are reasonably foreseeable through the 35-year timeframe for cumulative impacts. The Dawes County Department of Roads has stated that no major projects are planned for the foreseeable future (SC&A, 2013a). The NRC staff's review of the GEIS did not identify future actions in the geographic range that might contribute to cumulative impacts. As mentioned above, the NRC has received license amendment applications for NTEA and MEA and has information pertaining to the future submittal of the TCEA application. Construction and operation of these expansion areas would enable CBR to extract uranium from wellfields through an ISR process, conduct the ion-exchange (IX) portion of the ISR processing circuit at a satellite facility structure at each expansion area, and ship loaded resin from the IX process off site to CBR's current central processing facility.

The locations of these foreseeable future actions are shown in Figure 4-5. The NTEA is approximately 2 miles northwest of the CBR facility (nearest boundary to nearest boundary) and encompasses approximately 2,110 acres. The TCEA is approximately 4 miles west of the CBR facility (nearest boundary to nearest boundary) and encompasses approximately 1,643 acres. The MEA is approximately 6 miles southeast from the CBR facility (nearest boundary to nearest boundary) and encompasses 4,622.3 acres. The proposed Dewey-Burdock facility near Edgemont, SD, in Custer and Fall River Counties, SD (more than 65 miles (105 km) north-northwest from Crawford, NE), would be the nearest ISR facility other than the CBR expansion areas (NRC, 2013a).

Based on the above information, the staff has analyzed whether cumulative impacts could result from the incremental impact of the proposed action (license renewal) when added to the impacts from the proposed CBR ISR expansion areas. The potential cumulative impacts from these expansion areas are discussed in Sections 4.13.1 – 4.13.12.

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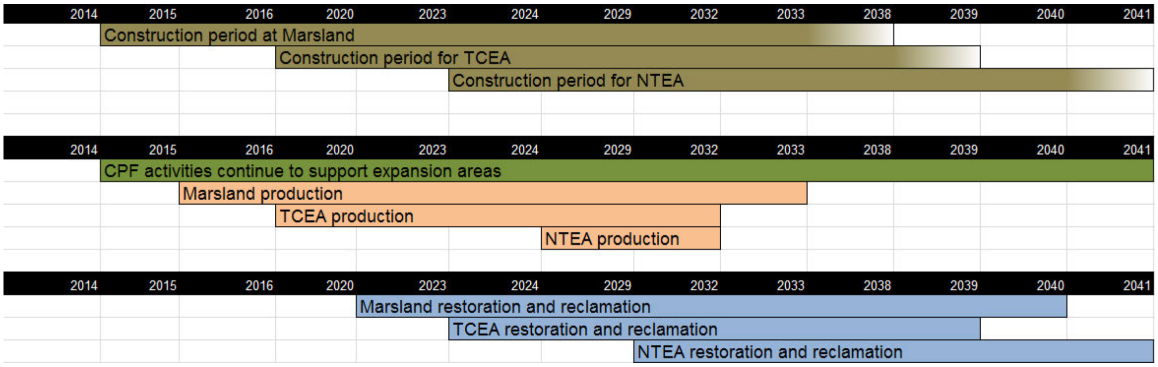
[10] CBR initially possessed three individual mineral exploration permits, which were administratively condensed into one permit in 2009. The original exploration permit for the Crawford extraction area remains valid to date until NDEQ confirms that reclamation of the land is complete. Well plugging and abandonment has been completed for all exploratory holes under CBR's permits.

CBR plans to continue extraction in the current license area until the end of 2014. There are no additional planned construction activities associated with the operation of the CBR facility under the renewed license, although the license does include the approval for certain, small-scale construction activities. Figure 4-4 shows the timeframes for the proposed CBR ISR expansion areas construction, production, and aquifer restoration and reclamation phases. Initial construction activities at each expansion facility would include construction of an ion exchange building and the first wellfield. Subsequent construction activities would include additional wellfields over the operational lifetime of each project. In the MEA application, CBR estimated that initial construction at the MEA would begin in 2014, with commercial production starting in 2015 and ending in 2033. Aquifer restoration and reclamation at the MEA would begin in 2020, concurrent with operations, with final decommissioning activities and surface reclamation completed in 2040 (CBR 2014b). CBR plans initial construction of the NTEA project in 2023, with production from 2024 to 2032, and ground water restoration activities from 2029 through 2039. Final site decommissioning and reclamation would be completed in 2041 (CBR, 2014b). Initial construction at TCEA is planned to be completed in 2016, with production from 2016 to 2032, restoration from 2023 to 2038, and final site decommissioning and reclamation completed in 2039 (CBR, 2014b). Additionally, due to the constant variations in market price of uranium, it is likely that CBR will not operate more than one of the three ISR expansion areas, should they all be granted a license, at any given time. Despite this likelihood, the NRC staff has analyzed the cumulative impacts for the expansions areas should they be constructed, operated, and decommissioned as proposed by CBR.

As described in Sections 2.3 through 2.6, the activities involved in decommissioning of all proposed CBR ISR expansion areas will include well plugging and abandonment, determination of appropriate cleanup criteria for structures and soils, radiological surveying and sampling of all facilities and process-related equipment and materials, removal of all contaminated equipment and materials to an approved licensed facility for disposal or reuse, decontamination of items to be released for unrestricted use, radiological surveying of excavated areas and the removal of any contaminated materials to a licensed disposal facility, and performance of final site soil radiation surveys. In addition, all disturbed areas will be backfilled and recontoured, and permanent revegetation will be established on all disturbed areas.

Figure 4-4 Proposed Timeline of Construction, Production, Restoration and Reclamation at Proposed CBR ISR Expansion Areas



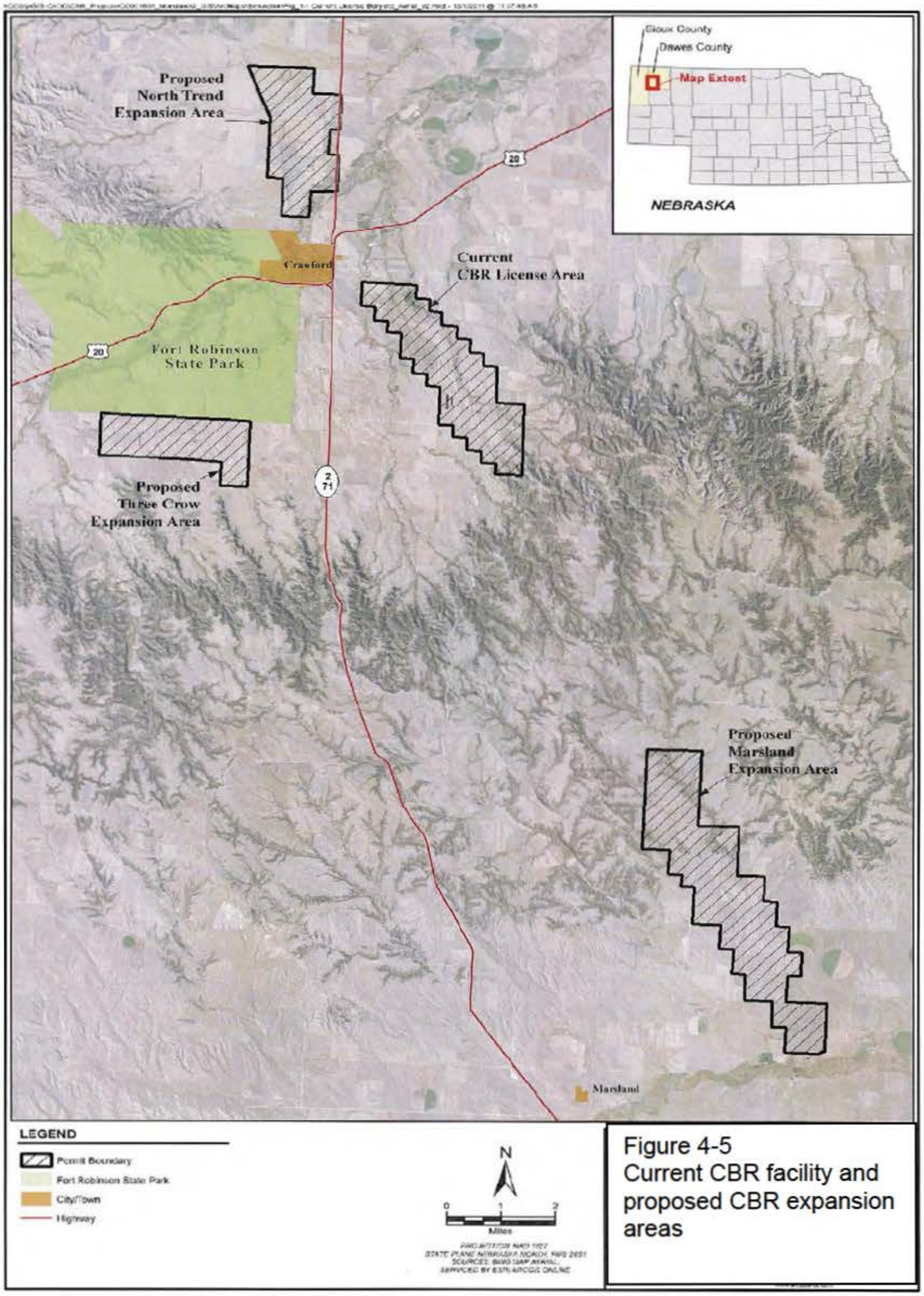


Figure 4-5
Current CBR facility and proposed CBR expansion areas

Source: CBR, 2012

4.13.1 Cumulative Impacts for Land Use

The NRC staff assessed cumulative impacts on land use within a 32-km [20-mi] radius from the CBR facility. At distances beyond 32-km [20 mi], impacts on land use from the CBR facility and proposed CBR expansion areas will be minimal.

Pasturelands are the predominant land use within the geographical range assessed in this cumulative impacts analysis. As discussed in section 3.1 of this EA, the CBR facility is comprised of 43 percent pastureland, which is consistent with the surrounding area. Fort Robinson State Park is located just west of Crawford. The rest of the cumulative impact geographic range is made up primarily of cropland. Forest lands are present, but below 20 percent of the overall total land use. Some habitat lands, residential areas, and water are within the geographic range, but these make up a very small percentage. No significant changes in land use have occurred since the original licensing of the CBR facility.

The CBR facility comprises about 3000 acres, of which 2100 acres are disturbed. If the proposed CBR expansion areas are licensed, approximately 8300 additional acres of pastureland and cropland would be used for ISR activities. The amount of land used by the CBR facility and proposed CBR expansion areas comprises a small percentage of the total pastureland and cropland in the region. After decommissioning, the land will be released for unrestricted use and can be returned to its original uses, which are primarily pasturelands and croplands. Therefore, when the incremental impacts from relicensing the CBR facility are added to other past, present, and reasonably foreseeable future actions, cumulative impacts to land use would not be significant.

4.13.2 Cumulative Impacts for Transportation

Construction of the expansion areas will not require construction of new public roads or improvements to existing roads. Impacts on transportation from construction activities at the CBR ISR expansion areas would occur from an increase in traffic from construction vehicles and delivery of construction equipment and supplies. No significant construction activities are expected at the CBR facility. Initial construction of the expansion areas will not occur simultaneously, and subsequent construction of additional wellfields during the operational lifetimes of the expansion areas is unlikely to occur simultaneously. Also, increases in traffic due to construction would be temporary, and the CBR facility and the CBR ISR expansion areas are in a rural area of Nebraska with low traffic. The small increase in traffic resulting from construction would not affect the capacity of local roads. Therefore, construction activities are not expected to have a significant cumulative impact on transportation.

At present, existing roads are used for yellowcake shipments from the CBR facility. During operation of the CBR ISR expansion areas, impacts on transportation would occur from increased truck traffic to transport extracted uranium from these expansion areas to the central processing plant, and to transport yellowcake from the central processing plant. Existing roads would be used for these activities. Because the CBR facility and the proposed CBR ISR expansion areas are in a rural area of Nebraska with low traffic, the small increase in traffic resulting from transportation of extracted uranium and yellowcake are not expected to have a significant cumulative impact on transportation.

Impacts to transportation from decommissioning would occur from increased traffic during the removal of contaminated materials and equipment, the performance of additional site surveys, and revegetation. Transportation associated with decommissioning activities would occur after operations cease at a particular site; therefore, any increase to transportation due to decommissioning would be partially offset by the absence of vehicles needed for operation activities. The increases in traffic from removal activities and survey work will not likely have a cumulative impact on transportation because these activities would be temporary and will not occur at the proposed CBR expansion areas simultaneously, thereby localizing the impacts. Also, the small increase in traffic would not have a significant impact on capacity of local roads.

As indicated in Section 4.2, the BNSF railroad operations will not be impacted by the continued operation of the CBR facility. The proposed expansions areas will not impact the railroad operations since the railroad does not cross into the boundary of any of the proposed expansion areas.

In conclusion, when the incremental impacts from relicensing the CBR facility are added to other past, present, and reasonably foreseeable future actions, cumulative impacts to transportation would not be significant.

4.13.3 Cumulative Impacts for Geology and Soils

The only potential cumulative impacts to geology would be associated with underground aquifers, which are discussed in section 4.13.6.

No further construction is anticipated at the CBR facility. As discussed in section 4.3, impacts to soils for the CBR facility are greatest during construction and lowest during operation, since greatest soil disturbance occurs when clearing vegetation, excavating, leveling, stockpiling compacting and redistributing soils. The magnitude of these impacts is expected to be similar for the proposed CBR ISR expansion areas. Construction activities associated with the proposed CBR ISR expansion areas that may have potential impacts to soils include the construction of a small-scale building to perform ion exchange, an area for trucks to transport materials to the central processing plant, and digging wells and installing piping for wellfields. There is a potential for erosion from disturbance of existing soils during these construction activities. However, the disturbance of soils will be less at the proposed CBR expansion areas because a central processing plant will not be constructed at those sites. As discussed in Section 4.3.2, various measures will be implemented to reduce erosion during construction and to keep erosion effects localized and within the immediate vicinity of each proposed expansion area. Initial construction activities at each expansion area will not occur simultaneously, and it is unlikely that subsequent construction will occur simultaneously. Therefore, construction activities are not expected to have a significant cumulative impact on soils.

Impacts to soils from operations would primarily occur from spills. There are controls in place at the CBR facility to account for accidental discharge reporting procedures, spill response, and cleanup measures, and similar controls would be in place at the proposed CBR expansion areas to minimize the potential for and impact of spills. Further, such spills would be localized and contained within the immediate vicinity of each proposed expansion area. Therefore, operations are not expected to have a significant cumulative impact on soils.

Impacts to soils from decommissioning would occur from activities such as well abandonment, determination of appropriate cleanup criteria for structures and soils and permanent revegetation. These activities would be temporary and would not further disturb the soil. Revegetation will reduce erosion potential and may have an associated positive impact to soils. Therefore, decommissioning is not expected to have a significant cumulative impact on soils.

In conclusion, when the incremental impacts from relicensing the CBR facility are added to other past, present, and reasonably foreseeable future actions, cumulative impacts to geology and soils would not be significant.

4.13.4 Cumulative Impacts for Air Quality

As stated in Section 4.4, all counties within a 50-mile (80-km) radius of the CBR facility are in attainment of NAAQS. Initial construction of the proposed CBR ISR expansion areas would potentially have impacts to air quality from increased dust and emissions from construction vehicles and an incremental increase in traffic. Subsequent wellfield construction would have similar types of impacts but to a lesser extent. No additional construction is anticipated at the CBR facility, initial construction activities at the proposed expansion areas would be staggered, and subsequent construction of additional wellfields during the operational lifetimes of the expansion areas is unlikely to occur simultaneously. Also, construction impacts to air quality would be temporary, and appropriate dust suppression practices would be employed. Finally, dust created due to vehicle traffic on unpaved roads would dissipate quickly and would remain localized. Therefore, construction is not expected to have a significant cumulative impact to air quality.

Other than wellfield construction during operations, which is discussed in the previous paragraph, operations of the CBR facility and proposed expansion areas do not produce measurable particulate emissions. The most significant sources of dust or emissions would be a small number of trucks transporting IX resin or yellowcake. Whatever dust or emissions are produced would be controlled by dust suppression practices and would dissipate quickly. Therefore, operations are not expected to have a significant cumulative impact on air quality.

Decommissioning activities will require vehicles and other equipment as well as some soil disturbance, resulting in the release of dust and emissions. These impacts are expected to be of smaller magnitude than those from construction and are not likely to occur simultaneously. Additionally, dust suppression practices will be employed and any dust produced would dissipate quickly. Therefore, decommissioning is not expected to have a significant cumulative impact on air quality.

In conclusion, when the incremental impacts from relicensing the CBR facility are added to other past, present, and reasonably foreseeable future actions, cumulative impacts to air quality would not be significant.

4.13.5 Cumulative Impacts for Noise

Cumulative impacts from noise were assessed within a 20-mi (32-km) radius of the CBR facility. During operation and decommissioning of the CBR facility, and construction, operation, and decommissioning of the proposed CBR expansion areas, noise impacts would occur from operation of vehicles and equipment. As indicated in Section 4.5, there are no other significant point sources of noise within the geographic range. Because noise from vehicles and equipment dissipates quickly with distance, impacts at each expansion area will be localized, and the distance between the proposed expansion areas and the main facility will provide a noise buffer. Therefore, no significant cumulative impacts from noise are expected.

In conclusion, when the incremental impacts from relicensing the CBR facility are added to other past, present, and reasonably foreseeable future actions, cumulative impacts to noise would not be significant.

4.13.6 Cumulative Impacts for Water Resources

In addition to impacts on water resources from the CBR facility and the proposed expansion areas, there are impacts on water resources within the 80-km [50-mi] geographic range for analysis due to irrigation, particularly in Box Butte County, which is adjacent to Dawes County to the south. A detailed hydrogeologic investigation conducted over Box Butte and southern Dawes counties indicates that although there has been significant ground water drawdown in Box Butte County due to irrigation, the water table in southern Dawes County has not changed appreciably since 1938 (Ayers, 2007). This appears to be because the Arikaree aquifer, which is the major aquifer over most of Box Butte County, is absent along the southern boundary of Dawes County. In place of the Arikaree aquifer is the White River Group, which includes the Chadron and the Brule formations. Ayers concludes that since the Chadron and Brule formations are nearly impermeable through this area, a hydrologic barrier is formed that prevents the northward expansion of the cone of depression (Ayers, 2007). A more recent modeling investigation has been conducted over roughly the same area but was focused primarily on estimating baseflow of the Niobrara River and is inconclusive with respect to ground water flow directions and volumes (NDNR 2014). Since the irrigation impacts in Box Butte County are separated from the CBR facility by both surface water and ground water divides, which would ensure that any cumulative impacts would not be significant, they are not considered further in the cumulative impact analysis.

4.13.6.1 Cumulative Impacts on Surface Water

To minimize localized impacts during all phases of the uranium recovery lifecycle, NDEQ issues a Class III Underground Injection Control (UIC) permit that stipulates that no more than 5 mine units are allowed at any one time in the extraction stage; no more than 5 mine units in the restoration stage; and no more than three mine units constructed in advance of active extraction.

Other than agriculture, the major activities that are conducted within a 50-mile (80-km) radius of the CBR license area are related to the continuing operations of the CBR facility and the proposed construction and operations of the NTEA, TCEA and MEA. As described in Section 3.5.1, the CBR facility and the proposed NTEA and TCEA areas are all located within the White River watershed. Three tributaries of the White River drain the CBR license area: White Clay Creek, Squaw Creek, and English Creek. Squaw Creek is the closest tributary to the current milling areas. Eight different surface water impoundments, seven of which are on these creeks, are located within or near the current permit area. These impoundments usually consist of earthen dams constructed across the creeks, with the impounded water used for livestock watering.

The MEA is situated south of the Pine Ridge escarpment, which forms a surface-water divide between the White River and Niobrara watersheds. Since the surface water of the Niobrara River does not comingle with that of Hat Creek or the White River within the geographic range, this hydrologic separation makes it highly unlikely that activities at the MEA would contribute to cumulative surface-water impacts. Therefore, the cumulative impacts analysis for surface water is based on continued operation of the main CBR facility along with potential impacts from the NTEA and TCEA.

Impacts to surface waters may result from road construction and crossings; surface erosion and runoff; spills or leaks of fuels, lubricants, and process-related fluids; and storm-water discharges.

4.13.6.1.1 Cumulative Construction Impacts on Surface Water

Impacts to surface water during the initial construction of ISR facilities and subsequent wellfield development may result from construction of road crossings, filling channels, surface erosion, and surface water runoff. Temporary changes to spring and stream flows due to grading and changes in topography and natural drainage patterns are other potential impacts. U.S. Army Corps of Engineers (USACE) permits under Section 404 of the Clean Water Act are required for placing fill, excavating, or using earthmoving equipment to clear land in jurisdictional wetlands or waters of the United States. As a result of the USACE permitting process, impacts are expected to be mitigated through various mitigation options, such as banking and riparian/wetland enhancement.

Potential impacts to surface waters also include accidental spills or leaks of fuels and lubricants from construction equipment and runoff from limited impervious areas including buildings, roads, and parking areas. These potential impacts will be temporary and mitigated through proper planning and design, the use of proper construction methods, and the implementation of BMPs, or restoration after the construction phase. In addition, all construction activities at the proposed CBR ISR expansion areas will be conducted under NDEQ permitting regulations and will be designed to keep any potential impacts localized and would be mitigated through procedures outlined in the required industrial and construction NDEQ permits.

No further construction is ongoing or anticipated at the CBR facility. As shown in Figure 4-4, initial construction activities at MEA, TCEA and NTEA will be staggered, which would minimize potential cumulative impacts from initial construction activities.

Construction activities related to the CBR facility have had no discernable impact on the local surface-water quality. Administrative and engineering controls are routinely implemented, including NPDES and General Construction Stormwater permits that are required to control runoff and the deposition of sediment in surface water during construction activities. Each year, CBR must submit a construction plan for the coming year and must obtain authorization from the NDEQ. Spills of petroleum products or hazardous chemicals into surface waters or related habitats must be reported to NDEQ. CBR also has in place a Storm Water Pollution Prevention Plan (SWPPP) that provides a detailed description of the sediment and erosion controls, in addition to descriptions of potential pollutant sources, spill prevention and control measures, and outfall controls.

For construction at the proposed expansion areas, CBR will implement the same administrative and engineering controls, and construction activities will be performed under NDEQ permitting regulations to control runoff and sedimentation.

Based on the staggered sequencing of construction, compliance with applicable federal and state regulations and permit conditions, and the implementation of administrative and engineering controls and other mitigation measures, the staff concludes that cumulative impacts to surface water during construction would not be significant.

4.13.6.1.2 Cumulative Operational Impacts on Surface Water

Impacts to surface water during operation activities at the CBR facility and proposed expansion areas may result from accidental spills or leaks of process-related water and the discharge of storm-water runoff. The impact from spills or leaks on surface waters will be dependent on the size of the spill, proximity of the spill to surface water, and the corrective actions taken, such at the SPCC discussed in Section 4.6.1.2.

Extraction activities involve the treatment and discharge of ground water bleed from wellfields into lined evaporation ponds and deep disposal wells. The potential for leakage and/or overflow from the lined ponds to affect surface water is mitigated by Federal and State statues that regulate the discharge of stormwater runoff and process-related water through the permitting process (e.g. NPDES, SWPPP). Monitoring of the leak detection systems of the lined ponds is also required as part of the Class III UIC permit granted by the NDEQ. A comparison of pre-operational surface-water quality data against operational surface water quality data at the CBR facility indicates that the ISR operations have had no discernable impact on the local surface water quality.

Extraction operations at the proposed expansion areas will also involve lined ponds and deep disposal wells. CBR will be required to implement the same monitoring requirements and engineering controls and extraction activities will also be conducted under NDEQ permitting regulations to control runoff and sedimentation (such as the SWPPP).

Based on compliance with applicable federal and state regulations and permit conditions and the implementation of administrative controls, best management practices, and other mitigation measures, the NRC staff concludes that cumulative impacts to surface water during operations would not be significant.

4.13.6.1.3 Cumulative Aquifer Restoration Impacts on Surface Water

The impacts from restoration activities will be similar to the impacts from operations, because the infrastructure will be in place and similar activities will be conducted (e.g., wellfield operation, transfer of fluids, water treatment, stormwater runoff). Restoration activities at the proposed expansion areas will also involve lined ponds and deep disposal wells. CBR will be required to implement the same monitoring requirements and engineering controls, and extraction activities will also be conducted under NDEQ permitting regulations to control runoff and sedimentation (such as the SWPPP). Restoration activities are anticipated to occur at the NTEA and TCEA during decommissioning of the CBR facility and therefore cumulative restoration impacts will be reduced.

Based on compliance with applicable federal and state regulations and permit conditions and the implementation of administrative controls, best management practices, and other mitigation measures, the NRC staff concludes that cumulative impacts to surface water during aquifer restoration would not be significant.

4.13.6.1.4 Cumulative Decommissioning Impacts on Surface Water

Surface water impacts from decommissioning will be similar to the impacts from construction. The NRC and NDEQ require CBR to decommission areas within the site boundary following the completion of active extraction and restoration. Part of this decommissioning involves the reclamation of a mine unit following successful completion of ground water restoration activities. Reclamation involves the proper plugging and abandonment of all wells within the mine unit boundary (specified in the Class III UIC permit); removal of surface and subsurface structures, utilities, and pipelines; and removal of surface and subsurface radiological contamination. CBR will submit a final detailed decommissioning plan for structures and equipment to the NRC for review and approval at least 12 months before the planned commencement of decommissioning of structures and equipment. This final decommissioning plan will describe structures and equipment to be decommissioned, planned decommissioning activities, methods that will be implemented to ensure protection of workers and the environment against radiation hazards, and the final radiation survey.

The CBR facility and proposed expansion areas would be subject to the same permits (NPDES, SWPPP) during decommissioning as during construction. Activities to clean up and to recontour and reclaim the land surface during decommissioning will mitigate impacts on surface waters by minimizing soil erosion and surface-water runoff.

Based on compliance with permit conditions and associated mitigation measures, the staff concludes that cumulative impacts to surface water during decommissioning would not be significant.

4.13.6.2 Cumulative Impacts on Ground water

Within the CBR facility area, the Basal Chadron sandstone is locally separated from the overlying Arikaree Group by a thick confining layer that consists of 35–75 m (120–250 ft)-thick middle and upper Chadron units and 150–200m (500–650 ft)-thick Brule Formation. As described in Section 4.2.2 of the ER, ISR methods are being used to extract uranium from the sandstone-hosted uranium ore bodies in the Basal Chadron aquifer at the CBR facility (CBR, 2007A). The Basal Chadron Sandstone is the only water-bearing strata in the Chadron Formation that can be considered an aquifer (Section 3.1.2). The Basal Chadron aquifer is artesian, and locally, some free-flowing wells are present. However, in the mineralized zones present at the CBR facility and proposed expansion areas, the water quality in the Basal Chadron aquifer is generally poor and has high radionuclide content, limiting its use as a drinking water source. The overlying Brule Formation is an important aquifer, regionally and locally, producing sufficient quantities of water with low total dissolved solids (TDS), which is suitable for domestic and agricultural purposes. Locally, the direction of flow in the Basal Chadron and Brule aquifers is to the north-northwest. All of the existing evidence (the lack of water level response in the Brule aquifer during aquifer testing, physical separation by a thick aquitard of low hydraulic conductivity, and different geochemical signatures) indicates that the Basal Chadron and Brule aquifers are not hydraulically connected.

Potential environmental impacts to ground water quality could occur during all phases of an ISR facility's lifecycle, although impacts are more likely to occur during operations and aquifer restoration. Impacts on ground water quality can result from spills and leaks, horizontal and vertical excursions of lixiviant from production aquifers, degradation of water quality within the production zone aquifer from changes in aquifer chemistry, and waste management practices, including waste storage ponds and deep well injection.

Consumptive water use during extraction and restoration will have the greatest impact on ground water quantity. The principal activity contributing to potential impacts on ground water quantity is consumptive ground water use during operations and aquifer restoration at the CBR facility and proposed expansion areas.

To minimize localized impacts during all phases of the uranium recovery lifecycle, NDEQ issued a Class III Underground Injection Control (UIC) permit for the CBR facility that stipulates that no more than 5 mine units are allowed at any one time in the extraction stage; no more than 5 mine units are allowed at any one time in the restoration stage; and no more than three mine units are allowed at any one time in the development stage in advance of active extraction. The NRC staff expects that permits for the proposed expansion areas will contain similar limitations.

4.13.6.2.1 Cumulative Construction Impacts on Ground water

Potential impacts to ground water during construction of an ISR facility result from injection of drilling fluids and mud during well drilling, and spills of fuels and lubricants from construction equipment. Surface activities that can introduce contaminants into soils are more likely to affect near-surface and shallow aquifers during construction.

As discussed in Section 4.6.2.1, construction activities at the CBR facility to date have had a negligible impact on ground water quality. Because the same administrative and engineering controls will be implemented during construction of the proposed CBR expansion areas, the NRC staff expects that those activities would also have minimal impacts on ground water quality. One of the administrative controls is the required NDEQ Class III UIC permit to control injection of drilling fluids and muds during well drilling and spills of fuels and lubricants from construction equipment. Ground water quality of near surface aquifers during construction is protected by best management practices such as implementation of the SPCC plan, as described in Section 4.6.1.2, to minimize soil contamination. Additionally, the amount of drilling fluids and muds introduced into aquifers during well construction would be limited. No further construction is anticipated at the CBR facility. Initial construction activities at the expansion areas would be staggered, and subsequent wellfield construction is unlikely to occur simultaneously.

Based on the staggered timing of the construction activities, the distances between the proposed expansion areas and the CBR facility, and protection of ground water quality through engineering and administrative controls (e.g., permits, BMPs), cumulative impacts from construction on ground water quality would not be significant.

Consumptive use of ground water during construction at each expansion area would be limited to water used for well drilling and dust suppression. Therefore, impacts on ground water quantity would be negligible and would not contribute to cumulative impacts.

4.13.6.2.2 Cumulative Operation Impacts on Ground water

During operations, water quality in shallow aquifers could potentially be affected by spills and leaks, and by waste management practices such as the use of waste storage ponds. Potential environmental impacts to ground water resources in the production zone and surrounding aquifers also include consumptive water use and changes to water quality that could result from operations and from possible horizontal and vertical lixiviant excursions beyond the production zone. Disposal of processing wastes by deep well injection could also impact ground water in deep aquifers.

Potential cumulative impacts on ground water quantity during operation at the CBR facility and proposed expansion areas will be based on whether the volume of water extracted from multiple ISR operations would result in a significant decrease in the potentiometric surface of the Basal Chadron aquifer. A potentiometric surface is different from a water level in that it represents the height to which the water would rise in a well that penetrates the aquifer. If an aquifer is confined, as in the case of the Basal Chadron aquifer, the water will rise above the top of the aquifer and a decrease in the potentiometric surface means that some of the pressure has been released but that the aquifer will remain fully saturated.

During operations at the CBR facility, consumptive use of ground water ranges between 35 gpm [132.5 lpm] and 105 gpm [397.5 lpm]. The consumptive use of ground water is anticipated to be similar at the proposed CBR expansion areas. At the CBR facility, CBR estimates that the potentiometric surface of the Basal Chadron aquifer in the vicinity of Crawford could potentially be decreased by approximately 25 to 30 feet [7.6 to 9.1 m] by the consumptive withdrawal of water (25 gpm) [95 lpm] from the Basal Chadron aquifer during extraction operations over a 20-year operational period. The drawdown would extend over a zone of influence in which the drawdown decreases with distance from the site. Consumptive water use volumes within similar ranges at the proposed expansion areas would be expected to result in comparable drawdowns at the expansion areas, which would also decrease with distance from the sites. Drawdowns within overlapping zones of influence would be additive and therefore cumulative drawdowns within intersecting zones of influence could result.

Based on the locations of the CBR facility and proposed expansion areas, the primary potential for intersecting zones of influence would occur for the CBR facility and the proposed NTEA. Potential cumulative impacts from these two sites could result in drawdowns of the potentiometric surface of the Basal Chadron aquifer on the order of 60 feet in the vicinity of Crawford. However, the Basal Chadron aquifer is under a significant amount of pressure and water in wells penetrating the Basal Chadron aquifer will rise very close to the land surface or actually flow under artesian pressure. This indicates that the Basal Chadron and Brule aquifers are not in good hydraulic communication and that the drawdowns associated with pumping in the Basal Chadron aquifer will not be observed in the Brule aquifer. This conclusion is further supported by aquifer testing and a comparison of the pre- and post-operational ground water level measurements detected in the Brule aquifer, as discussed in Section 2.4.3.2.2 of the SER (NRC 2014). Because use of water from the Basal Chadron aquifer is limited in this area due to poor water quality, and because the aquifers will remain confined (i.e., saturated thickness will not decrease), the drawdowns associated with the pumping during operations will not significantly impact the ground water quantity in the Brule or Basal Chadron aquifers.

Potential impacts to ground water quality during operations will be mitigated and reduced through implementation of leak detection and cleanup programs, mechanical integrity testing of wells, and adherence to NDEQ UIC permit requirements. Furthermore, CBR's excursion monitoring and corrective action program (described in Section *4.6.2.2.4*) will continue to ensure the protection of water quality in the aquifers surrounding the production zone. EPA and NDEQ requirements will protect ground water in aquifers used for the deep well injection of process-related liquid effluents from the CBR operating facility.

An additional consideration in the cumulative impact analysis for ground water quality is that the CBR facility and all of the expansion areas are separated by distances of at least two miles. Therefore, the ground water present at one site could take decades to reach another site. Furthermore, natural attenuation (i.e., sorption, degradation and dilution) would remove the contaminants along the ground water flow paths.

With respect to the proposed MEA, the Pine Ridge escarpment acts as a ground water divide for the Brule and overlying aquifers, but it does not create a hydraulic divide for ground water flow within the Basal Chadron aquifer (Gjelsteen and Collings, 1988). The ground water flow velocity in the Basal Chadron aquifer, however, is estimated to be less than 20 feet per year (6 meters per year) (Gjelsteen and Collings, 1988). At that rate, ground water at MEA would take more than 1,000 years to reach the CBR facility and dilution effects over this transport distance would result in negligible concentrations for any constituents released from the MEA.

According to Figure 4-4, the operational lifetimes of the proposed expansion areas are staggered. Also, the NDEQ UIC permits for each facility will limit the number of wellfields in production at any one time. These factors would further limit potential cumulative impacts during operations.

For the reasons discussed above, the staff concludes that cumulative impacts from operations on ground water would not be significant.

4.13.6.2.3 Cumulative Aquifer Restoration Impacts on Ground Water

Impacts on ground water quantity during aquifer restoration are related to ground water consumptive use. Water quality in shallow aquifers could potentially be affected by spills and leaks, and by waste management practices such as the use of waste storage ponds. Other potential impacts to ground water quality during restoration include possible horizontal and vertical lixiviant excursions beyond the production zone. Disposal of processing wastes and brine from reverse osmosis by deep well injection could also impact ground water in deep aquifers. Ultimately, ground water quality in the production zone will be improved, because the goal of aquifer restoration is to return the ground water quality to approved ground water protection standards, pursuant to 10 CFR Part 40, Appendix A, Criterion 5.B(5).

Restoration is ongoing in five wellfields at the CBR facility and will be required for the remaining wellfields. Restoration will also occur after operations cease at the proposed expansion areas. Potential cumulative impacts to ground water quantity during aquifer restoration activities will be primarily a function of whether the volume of water extracted from multiple wellfields results in a significant additive decrease in the potentiometric surface of the aquifers. As discussed in the previous section for operations, given the distance between the proposed expansion areas, the primary potential for overlapping zones of influence exists between the CBR facility and the NTEA.

A comparison of recent water levels to the limited 1982-1983 Basal Chadron aquifer water level data depicting static (pre-operational) potentiometric surface was performed in Section 3.1.3.5.6 of the SER and drawdown within the mine units over this time period is estimated to be approximately 14.3 m (47 feet) (NRC 2014). Although the potentiometric surface of the Basal Chadron Aquifer has decreased approximately 14.3 m (47 feet), water levels measured in wells screened within the Basal Chadron aquifer would still rise to about the land surface. Therefore, the Basal Chadron aquifer would remain saturated. Furthermore, according to Section 2.4.3.2.2 of the SER, there is no evidence that water levels in the overlying Brule aquifer have been impacted (NRC 2014). Because the NTEA is about the same distance to the city of Crawford as the CBR facility, intersecting zones of influence could result in additive reduction in the potentiometric surface of the Basal Chadron aquifer over this area. Under the most conservative estimates of drawdown in this area, the Brule and Basal Chadron aquifers would remain saturated, and for the same reasons discussed under cumulative operational impacts, ground water levels and flow volumes in the Brule would not be significantly impacted. After uranium production and aquifer restoration are completed and ground water withdrawals are terminated, the ground water levels will recover with time. Furthermore, recovery rates of confined aquifers, such as the Basal Chadron aquifer, are generally far more rapid than those observed in water table aquifers.

Potential impacts to ground water quality during restoration will be mitigated and reduced through implementation of leak detection and corrective action programs, mechanical integrity testing of wells, and adherence to NDEQ UIC permit requirements. Furthermore, CBR's excursion monitoring and corrective action program (described in Section *4.6.2.2.4*) will continue to ensure the protection of water quality in the aquifers surrounding the production zone. EPA and NDEQ requirements will continue to protect ground water in aquifers used for the deep well injection of process-related liquid effluents from the CBR operating facility.

According to Figure 4-4, the restoration periods for the proposed expansion areas are staggered. Also, the NDEQ UIC permits for each facility will limit the number of wellfields in restoration at any one time. These factors would further limit potential cumulative impacts on ground water quality and quantity during restoration.

For the reasons discussed above, the staff concludes that cumulative impacts from aquifer restoration on ground water would not be significant.

4.13.6.2.4 Cumulative Decommissioning Impacts on Ground Water

The environmental impacts on ground water during decommissioning at the CBR facility and the proposed expansion areas would be primarily associated with potential spills of fuels and lubricants and well abandonment. The potential environmental impacts during the decommissioning phase would be similar to the impacts from the construction phase. Spills of fuels and lubricants during decommissioning activities could, however, impact the water quality of shallow aquifers.

The same administrative and engineering controls used during construction would be implemented during decommissioning of the CBR facility and the proposed expansion areas. As discussed in Section 4.13.6.2.1, these controls include the required NDEQ Class III UIC permit which would minimize impacts to underground drinking water sources. During decommissioning, ground water quality of near surface aquifers would be protected by best management practices such as implementation of a spill prevention and cleanup plan to minimize soil contamination.

Based on the distances between the proposed expansion areas and the CBR facility, and protection of ground water quality through engineering and administrative controls (e.g., permits, BMPs), cumulative impacts from decommissioning on ground water quality would not be significant.

4.13.7 Cumulative Impacts for Socioeconomics

As discussed in Section 4.7, the CBR facility provides a positive socioeconomic impact in the form of tax revenues and continued employment. The current CBR facility has approximately 50 full time staff and brings in approximately 1 million dollars in tax revenue. Construction, operation, and decommissioning of the proposed CBR expansion areas would provide a small positive socioeconomic impact due to additional jobs. However, the impact to jobs would not be significant because the staff does not anticipate that the proposed CBR expansion areas would require the same level of staffing (the activities will be limited to uranium extraction and ion exchange). Construction, operation, and decommissioning of the proposed CBR expansion areas would provide a measurable positive socioeconomic impact due to additional tax revenue paid by CBR. The NRC staff contacted the Dawes County Treasury office, who indicated that the county received approximately nine million dollars in certified taxes in 2013. Of this amount, approximately 7.5 percent came from CBR. As stated in Section 4.14, it is unlikely that CBR will operate more than one of the three ISR expansion areas simultaneously given the constant variations in market price of uranium; however if the facilities were to operate as projected in Figure 4-4, the tax revenue received by the county from CBR is estimated to increase from 7.5 percent to approximately 23 percent of its revenue. The NRC staff has determined this increase to be a significant positive cumulative impact to socioeconomics.

If the renewal of the license is not granted (no-action alternative), then the CBR facility would enter decommissioning and none of the proposed expansion areas would be constructed, potentially causing a negative cumulative impact to the local economy within the geographic range.

In conclusion, when the incremental impacts from relicensing the CBR facility are added to other past, present, and reasonably foreseeable future actions, cumulative impacts to socioeconomics would produce a positive significant impact.

4.13.8 Cumulative Impacts for Historic and Cultural Resources

With respect to historic and cultural resources, the NRC staff included an assessment of cumulative impacts to these resources during consultation for Section 106 of NHPA (ML13260A566). Though the density of sites found is very low within this geographic setting, and therefore is unlikely to result in significant cumulative impacts to historic and cultural resources, the detailed cumulative impacts assessment developed during consultation with the public and Native American Tribes is discussed within this section. Additional supporting information has also been documented on the following website:

http://www.nrc.gov/info-finder/materials/uranium/licensed-facilities/crow-butte/section-106-license-renewal-docs.html.

According to cultural resources specialists at the Fort Robinson Museum (Nebraska Game and Parks Commission – Fort Robinson State Park and Ponderosa Wildlife Management Area), as well as representatives from the U.S. Department of Agriculture, the U.S. Forest Service, the Nebraska National Forests and Grasslands (Pine Ridge Ranger District and Pine Ridge National Recreation Area), there are no significant public lands within a reasonable distance of the CBR Project where comparable historic and cultural resources data have been reported for use in evaluating potential cumulative impacts (SC&A, 2012).

Additional data are available from other proposed CBR projects that are currently under NRC review. CBR applications for license amendments for the proposed NTEA and the proposed MEA are currently under environmental review. The proposed NTEA is located 4 miles northwest of the town of Crawford. The proposed MEA site is located south of the Pine Ridge elevation about 11 miles south-southeast of the CBR ISR project area. CBR has indicated that it intends to provide the NRC a license amendment application for the TCEA in November of 2014 (ML14125A181). For the purpose of the present comparative analysis, archaeological and historic inventories of resources as well as a TCP survey by the Santee Sioux Nation have been completed at the CBR facility, the MEA, and the TCEA (SSN 2013).

The proposed NTEA license area includes a total of 2,680 acres, although only 1,190 acres are included in the potential development area over the life of the project. In 2004, ARCADIS U.S., Inc. (ARCADIS) conducted an intensive pedestrian cultural resources inventory of the 1,190-acre proposed development area (Späth, 2007a).

The field inventory recorded three historical sites (25DW296–298) and three isolated artifacts (25DW299–301). The historic sites include an abandoned farm complex, an occupied farm complex with a nearby schoolhouse foundation, and a small historic refuse disposal area. The isolated artifacts include an early historic period metal trade point and two prehistoric period chert artifacts (a core and a projectile point fragment). Based on the field survey findings, none of the resource sites was recommended as potentially eligible for listing on the NRHP, although one historic property, 45DW297, was recommend for further archival work should the site actually be disturbed by future mining development. The NE SHPO accepted the cultural resources report and concurred with the NRHP eligibility recommendations in 2006 (Crow Butte Resources, 2007b, Appendix C).

For the proposed MEA, ARCADIS completed an intensive pedestrian cultural resources inventory of 4,500 acres between November 2010 and February 2011 (Graves et al., 2011), followed by intensive cultural resource coverage of another contiguous 160 acres in February 2011 (Graves et al., 2012). ARCADIS recorded 15 newly discovered historic sites and five historic isolated finds in the MEA survey areas. No prehistoric sites or isolated finds were encountered during the field inventory.

Newly recorded historic sites include six home/farmsteads (25DW359, 25DW360, 25DW361, 25DW365, 25DW366, 25DW370) three debris scatters (25DW357, 25DW363, and 25DW369), two cisterns (25DW358, 25DW364), one corral (25DW367), one bridge (25DW362), one dugout (25DW368), and one quarry (25DW371). ARCADIS updated two previously recorded historic sites within the project area: two home/farmsteads (25DW00-242, 25DW00-243). ARCADIS recommended that all sites in the MEA be considered not eligible for listing on the NRHP, although they recommended avoiding historic homestead sites 25DW00-242 and 25DW00- 243, one of which is presently occupied and the other requires a level of effort beyond the procedures of the pedestrian cultural resources inventory. Further research and evaluation might be needed at these two historic sites, if avoidance is not possible during the construction and operational phases of the project. The NE SHPO concurred with these recommendations on May 19, 2011, and March 27, 2012 (CBR, 2012).

ARCADIS conducted an historic and cultural resources field inventory at TCEA in January 2006 (Späth, 2007b). The TCEA historic and cultural resources inventory included 100-percent pedestrian coverage of a 2,100-acre tract, although only 1,643 acres of this total area is included in the proposed TCEA license amendment boundary.

The field inventory recorded 11 historic period sites, along with two isolated prehistoric period artifacts and one historic period artifact, within the proposed TCEA project area. These 11 historic sites included three artifact scatters, two farm complexes, two rural residences, two collapsed buildings, a windmill and water tank, and an isolated piece of farm machinery. Isolated artifacts included an historic fraternal medallion and two prehistoric chert flakes. The sites and isolated artifacts were fully recorded and given designations 45DW302–45DW315 in the Nebraska statewide inventory system. None of the recorded sites and isolated artifacts was associated with important historical events or persons or is likely to contribute useful information about historic lifeways, beyond the data collected during the field recording. Consequently, CBR recommended that none of the recorded properties within the TCEA was potentially eligible for the NRHP. The NE SHPO concurred with this recommendation on December 17, 2007 Spath 2007b).

Figure 4-4 provides summary figures for the total number of acres that have been surveyed for historic and cultural resources in the three CBR project areas, along with the numbers of historic and prehistoric sites and isolated finds that have been recorded. In all, some 9,050 acres (14.14 square miles) have received intensive Class III pedestrian cultural resources inventories.

This combined acreage amounts to approximately 58 percent of the total acreage included in the original license application and the total numbers of acres in the license amendment applications for the NTEA, MEA, and TCEA. Because of these surveys, a total of 66 cultural resource sites and isolated finds have been recorded, for an overall density of 4.53 resources per square mile. Considering just the recorded historic and archaeological sites, the overall density drops to 3.61 per square mile. Of the total 50 cultural resources sites recorded, 42 (84 percent) are associated with historic-period Euro-American rural settlement of the CBR project areas.

Of the total number of cultural resource sites recorded, five (10 percent) have been recommended as potentially eligible for listing on the NRHP. Isolated finds, by their designation, are not eligible for potential listing in the NRHP. All of the potentially eligible sites are located at the original license area comprising the ISL facility and associated mine units. One historic site at the NTEA and two historic sites at the MEA were not recommended as potentially eligible for the NRHP based on the field inventories, but it was suggested by CBR that additional evaluation should be undertaken if the sites become directly impacted by future project construction activities (CBR, 2007A). As noted elsewhere, the CBR management approach to cultural resources involves avoidance of all sites during construction, operation, decommissioning, and reclamation activities, regardless of their NRHP significance evaluations.

At previous tribal consultations including the June 7–9, 2011 information-gathering meeting, NRC staff was informed of several potential TCPs located in proximity to both the existing CBR facility and the other close by proposed CBR expansion areas (NRC, 2011). Contacts with the nearby Fort Robinson State Park, State of Nebraska Ponderosa Wildlife Management Unit, and the Pine Ridge District of the Nebraska National Forest did not yield specific information for any additional nearby potential places of religious and cultural significance (SC&A, 2012).

On October 31, 2012, the NRC invited all the consulting Tribes to complete a TCP field Survey of the CBR facility, the MEA, and the TCEA. In November and December of 2012, a TCP field survey was completed by the Santee Sioux Nation and the Crow Nation. A TCP report (ML13064A481) was submitted to the NRC by the Santee Sioux Nation on behalf of both Tribes (SSN 2013). The report concluded that none of the 13 places identified was potentially eligible for listing on the National Register of Historic Places, but offered recommendations for a buffer zone around places to avoid impacts during future project activities. Several other consulting Tribes responded to this report disagreeing with the findings (From Cheyenne River Sioux – ML13123A089 (NRC response- ML13157A297); From Yankton Sioux – ML13126A309 (NRC response, ML13157A221); From Standing Rock Sioux – ML13126A327 (NRC response, ML13157A263).

The MEA is separated from known historical events associated with Fort Robinson and the Red Cloud Agency both by distance and by the Pine Ridge. None of the buttes near Crawford, NE, are visible from the MEA. Two studies for places of religious and cultural significance have been completed for the NPS Agate Fossil Beds National Monument which is situated about 20 miles west of the MEA (LeBeau, 2002; NPS, 2010).

Based on available information, the NRC staff concludes that the cumulative impacts of renewing the CBR facility on cultural resources including TCPs would be SMALL during all phases of the proposed action, given the low density of sites found within this geographic setting and their lack of eligibility for nomination and potential listing on the NRHP. Additionally, NRC is responsible for satisfying the requirements of Section 106 of the NHPA for this proposed undertaking as well as the proposed NTEA, MEA and the TCEA projects. If, in review of NTEA, MEA, and the TCEA, the NRC staff find TCPs eligible for listing on the National Registry, NRC will comply with Section 106 of the NHPA, 16 U.S.C. §§ 470, and its implementing regulations (36 CFR § 800 (2004)) through consultation with Tribes.

Table 4-9 Comparative Summary of Crow Butte Resources Historic and Cultural Resources Information

Data Category	Crow Butte Facility	NTEA	TCEA	MEA	Totals
Total License Area (acres)	3,300	2,680	1,643	4,621	12,244
Cultural Resource Inventory (acres)	1,100[a] (1.72 sq.	1,190 (1.86 sq.	2,100 (3.28 sq.	4,660 (7.28 sq.	9,050 (14.14 sq.

	mi.)	mi.)	mi.)	mi.)	mi.)
Number of Resource Sites and Isolated Finds Recorded	21[b]	6	14	23	64
Historic Resource Sites	12	3	10	17	42
Prehistoric Resource Sites	8	0	0	0	8
Historic Isolated Finds	0	1	2	6	9
Prehistoric Isolated Finds	0	2	2	0	4
Site Density (per sq. mi.)	12.21	1.61	3.05	2.06	3.61
Isolated Find Density (per sq. mi,)	0	1.61	1.22	0.69	1.57
Total Cultural Resources Density (per sq. mi.)	12.21	3.23	4.27	2.75	4.53

[a] This acreage is estimated based on the surface area developed as stated in the CBR license renewal application (Crow Butte Resources, 2007b).
[b] One of the recorded cultural sites at the ISR facility area is of unknown age and cultural affiliation.
Sources: Bozell and Pepperl (1987); Späth (2007a, 2007b); Graves et al. (2011, 2012).

Based on available historic and cultural resources information from the CBR application for the project area under the original license and the data related to the proposed license amendments for the NTEA, MEA, and TCEA, overall cumulative impacts to historic and cultural archaeological resources are not expected to be significant.

4.13.9 Cumulative Impacts for Environmental Justice

As discussed in Section 4.9, the NRC staff considers environmental justice (EJ) in greater detail when the percentage of minority or low-income population in the impacted area exceeds the corresponding populations in the county or state by more than 20 percentage points, or when the minority or low-income population in the impacted area exceeds 50 percent (NRC, 2003a, Appendix C). As discussed in section 4.9, the EJ analysis for the proposed action found that minority populations comprise 4.4 percent of the demographic in the area of assessment for EJ, and low-income populations are 14.8 percent within that area. These percentages fall below the 20 percent and 50 percent thresholds identified above that would prompt the NRC to more heavily scrutinize impacts disproportionately affecting minority and low-income populations. Therefore, the NRC staff concluded that there would be no disproportionately high or adverse impacts to minority or low-income populations from the renewal of the CBR facility license.

As shown in Table 4-5, Dawes County and the State of Nebraska do not, as a whole, contain populations at or above the 20 percent threshold for either minorities or low-income populations. The proposed CBR ISR expansion areas are all within 10 miles of the existing facility and are all situated in rural areas of Dawes County. Therefore, the staff expects that EJ analyses for those facilities will also find that the thresholds for further analysis are not met. Because none of the actions within the scope of the cumulative impacts analysis falls within a geographic range meeting the threshold, it is not anticipated that these expansion areas will have disproportionately high or adverse impacts to minority or low-income populations. Also, because the proposed CBR ISR expansion areas are all at least 50 miles from the Pine Ridge Indian Reservation in Shannon County, South Dakota, the staff does not expect EJ impacts to the Reservation from those future activities for the same reasons discussed in Section 4.9.

In conclusion, when the incremental impacts from relicensing the CBR facility are added to other past, present, and reasonably foreseeable future actions, cumulative impacts to environmental justice would not be significant.

4.13.10 Cumulative Impacts for Ecological Resources

As discussed in Section 4.10, ecological resources include vegetation, wetlands, and wildlife. Impacts on ecological resources during construction would include disturbance of wildlife and loss of habitat. No additional construction is expected at the CBR facility. At the proposed expansion areas, some disturbance and loss of habitat is expected, but the NRC staff does not expect significant cumulative impacts to ecological resources. Initial construction of the expansion areas will be staggered, and subsequent wellfield construction is unlikely to occur simultaneously. Within each proposed expansion area, the vegetation and habitat are relatively homogeneous; therefore, displaced wildlife will be able to find new habitat without leaving the vicinity. The loss of vegetation from construction would not be significant compared with available habitat in the geographic range. Also, the distance between the proposed expansion areas is such that wildlife displacement at one site will not affect wildlife at the others. For the proposed expansion areas, the NRC will consult with State and Federal agencies to determine appropriate mitigation to minimize impacts to ecological resources during construction, thereby reducing the potential for significant cumulative impacts. Therefore, construction activities are not expected to have a significant cumulative impact on ecological resources.

At both the CBR facility and proposed expansion areas, impacts to ecological resources during operations would be limited to vehicle noise and potential vehicle collision with wildlife. Wildlife disturbance from vehicle noise would be temporary and transient, and the noise would dissipate quickly as vehicles move away. No significant cumulative impacts would be expected due to the distance between the CBR facility and the proposed expansion areas. As discussed in Section 4.10.5, vehicle collisions with big game mammals are expected to be infrequent at the CBR facility, and the NRC staff expects that the frequency of collisions at the proposed expansion areas would be similar. Therefore, operations are not expected to have significant cumulative impacts on ecological resources.

The impacts to ecological resources from the decommissioning of the CBR facility and proposed CBR ISR expansion areas would be similar to the impacts from construction activities. For the reasons discussed above for construction, the staff does not expect significant cumulative impacts on ecological resources from decommissioning. Also, any impacts associated with decommissioning would be temporary as the land would be returned to original use.

A list of threatened and endangered species within the geographic range is provided in section 4.10.8. As discussed in Section 4.10.8, the species either have not been observed at the CBR facility, or suitable habitat is not available. With respect to the proposed expansion areas, the staff expects similar findings; furthermore, the NRC will consult with State and Federal agencies under Section 7 of the Endangered Species Act to determine appropriate mitigation activities in the event that threatened or endangered species are observed at those sites.

In conclusion, when the incremental impacts from relicensing the CBR facility are added to other past, present, and reasonably foreseeable future actions, cumulative impacts to ecological resources would not be significant.

4.13.11 Cumulative Impacts for Scenic and Visual Resources

Cumulative impacts for scenic and visual resources were assessed within a 2-mi (3.2-km) radius of the CBR facility. Beyond this distance any changes to the landscape would be in the background distance zone for the purposes of visual resource management defined by BLM, and would be either unobtrusive or imperceptible to viewers. (BLM, 1986 and BLM, 1984)

The impacts on scenic and visual resources due to the CBR facility are described in Section 4.11 and were found to be SMALL. No other past, present, or reasonably foreseeable actions are found within the 2-mi geographic range for analysis. Therefore, when the incremental impacts from relicensing the CBR facility are added to other past, present, and reasonably foreseeable future actions, cumulative impacts to scenic and visual resources would not be significant.

4.13.12 Cumulative Impacts for Public and Occupational Health

As discussed in Section 4.12, there is a potential for non-radiological and radiological impacts to public and occupational health during the life of an ISR facility.

4.13.12.1 Non-radiological impacts

As discussed in Section 4.12.1, there is no additional construction expected at the CBR facility. Non-radiological impacts from initial construction and subsequent wellfield development at the CBR expansion areas may result from land disturbance during construction of wellfields, fugitive dust, vehicle and construction equipment emissions, and waste (such as trash and hazardous and nonhazardous chemicals). The proposed CBR expansion areas will be constructed in similar fashion to the CBR facility, in accordance with State and Federal permits to minimize the potential for non-radiological impacts to public and occupational health. During construction, appropriate dust suppression practices would be employed to minimize impacts from vehicle and construction equipment to ensure that ambient air quality standard of the State of Nebraska are not exceeded. Construction activities at the proposed expansion areas would be conducted under NDEQ permitting regulations and any potential impacts would be localized and mitigated through procedures outlined in the required permits. For these reasons, cumulative non-radiological impacts to public and occupational health from construction are not expected to be significant.

During operation and aquifer restoration, potential cumulative non-radiological impacts to public and occupational health could result from fugitive dust and emissions from vehicles, leaks and spills of hazardous and non-hazardous chemicals, evaporation pond leakage, potential lixiviant excursions, and waste. As discussed in Section 4.12.1, non-radiological impacts from operation and aquifer restoration at the CBR facility are small due to CBR's compliance with appropriate State and Federal regulations. The proposed expansion areas would employ the same controls to minimize vehicle emissions at the CBR facility. The proposed CBR expansion areas would be required to adhere to the same standards for processing and storing hazardous and nonhazardous chemicals as required at the CBR facility, as discussed in Section 4.12.1. Furthermore, the proposed CBR expansion areas would follow the same environmental monitoring procedures to detect and mitigate evaporation pond leakage and would adhere to Federal and State statutes that regulate the discharge of stormwater runoff and process-related water. Migration integrity testing would be conducted at each of the proposed expansion areas to detect and minimize non-radiological impacts from lixiviant excursion as is currently required at the CBR facility. For these reasons, cumulative non-radiological impacts to public and occupational health from operation and aquifer restoration are not expected to be significant.

The potential non-radiological impacts from decommissioning are similar to those identified for construction. During decommissioning of the facilities, non-radiological impacts would be temporary as the site is returned to unrestricted use. As described in Section 4.12.1, the NRC staff expects that non-radiological impacts to public and occupational health from decommissioning activities would be small at the CBR facility. During decommissioning of the proposed CBR expansion areas, CBR would employ the same controls to limit dust and minimize impacts from vehicle and construction equipment. Decommissioning of the expansion areas would be completed under NRC and NDEQ regulations, and any potential impacts would be localized and mitigated through compliance with these requirements. CBR's implementation of best management practices, such as those identified in Section 4.2.2.3 of the ER would reduce the likelihood and magnitude of potential leaks and spills and facilitate corrective action (CBR, 2007A). Non-radiological impacts from decommissioning at the proposed CBR expansion areas would be further minimized as CBR restores ground water to the appropriate restoration values set by NDEQ and Criterion 5B(5) of 10 CFR Part 40, Appendix A, thereby reducing the potential for non-radiological releases into ground water. For these reasons, cumulative non-radiological impacts to public and occupational health from decommissioning are not expected to be significant.

Based on compliance with applicable federal and state regulations and permit conditions and the implementation of administrative controls, best management practices, and other mitigation measures, the NRC staff concludes that cumulative non-radiological impacts to public and operational health would not be significant.

4.13.12.2 Radiological Impacts

There is no additional construction anticipated at the CBR facility. Initial construction and subsequent wellfield development from the proposed expansion areas may result in radon exposure from air or water pathways, as well as population dose. Radiological impacts associated with wellfield development from the expansion areas would be expected to be similar to impacts from the CBR facility discussed in section 4.12.2, which were found to be SMALL. These exposures would come mostly from leaks and spills which are primarily non-radiological because the wells have not started operation and are not yet pumping water with radiological properties. Construction will be staggered at the CBR expansion facilities; therefore, spills and leaks will not occur simultaneously reducing the cumulative impact. Further, at each expansion facility, radiological doses to members of the public will be required to fall below the 10 CFR Part 20 annual limits for dose to the public. CBR will perform total effective dose equivalent (TEDE) studies and analysis during wellfield development of the proposed CBR expansion areas to monitor doses and will comply with federal regulations to stay under the limits. Therefore, cumulative radiological impacts to public and occupational health from construction are not expected to be significant.

Operation and restoration of the proposed expansion areas may result in radon exposure from air or water pathways, as well as population dose. At the proposed expansion areas, there would be no radiological impacts associated with yellowcake production because the expansion areas will not have a central processing plant. However, even assuming that release doses at the expansion areas will be similar to those discussed in 4.12.2.1 – 4.12.2.3, the cumulative dose assuming all four areas are in operation would still fall below dose limits set by the limits in 10 CFR Part 20. Additionally, cumulative impacts would be further reduced because it is unlikely that all expansion areas would be in operation simultaneously and the pathways of air and water are such that doses would not all carry to the same location. Also, as discussed above, CBR will perform TEDE studies and analysis during operation to monitor dose limits and comply with federal regulations to stay under those limits. Therefore, cumulative radiological impacts to public and occupational health from operation are not expected to be significant.

The potential radiological impacts from decommissioning are similar to those identified for construction. During decommissioning of the facilities, radiological impacts would result from leaks or spills associated with decommissioning activities as the site is returned to unrestricted use. For similar reasons to those discussed above, cumulative radiological impacts to public and occupational health from decommissioning are not expected to be significant.

In conclusion, when the incremental impacts from relicensing the CBR facility are added to other past, present, and reasonably foreseeable future actions, cumulative radiological impacts to public and occupational health are not expected to be significant.

5 AGENCIES AND PERSONS CONSULTED

The NRC staff consulted with other agencies regarding the proposed action in accordance with NUREG–1748 (NRC, 2003a). These consultations were intended to (i) ensure that the requirements of Section 7 of the Endangered Species Act and Section 106 of the NHPA were met and (ii) provide the designated state liaison agencies the opportunity to comment on the proposed action.

The NRC staff contacted USFWS by letter dated May 15, 2008, requesting USFWS assistance in identifying the presence of endangered or threatened species or critical habitat at the NFS site and in the vicinity (ML081270752). USFWS replied by letter dated June 20, 2008 with technical assistance to assist in the planning process to avoid or minimize adverse impacts to federal trust fish and wildlife resource caused by the proposed project. USFWS indicated that all federally listed species are also State-listed under the Nebraska Nongame and Endangered Species Conservation Act. Further, there may be State-listed species affected by the proposed project that are not federally listed. To determine if the proposed project may affect State-listed species, the Service recommended that the project proponent contact Kristal Stoner, Nebraska Game and Parks Commission (ML081850454).

By letter dated May 15, 2008, the NRC initiated National Historic Preservation Act (NHPA), Section 106 consultation with the Nebraska State Historical Society (NE SHPO) (ML081930749). On June 25, 2008, NE SHPO replied with recommendations for conducting consultation, which took place over the course of several years. On June 20, 2013, the NRC concluded consultation with NE SHPO by letter, requesting concurrence with NRC's finding of "no effect" (ML13105A359). NE SHPO concurred with the NRC's findings by letter dated July 15, 2013 (ML13266A266). The NRC also invited Native American Tribes to be consulting parties under NHPA, Section 106 (ML110130174l ML110130120; ML110130202; ML110130190; ML110130237; ML110130063; ML110130042; ML110130264; ML110130108; ML110130164; ML110130093; ML110130110; ML110130183; ML110130100; ML110130038; ML110130081; ML110130039; ML110130681; ML110130091; ML110130269). The consultation process with the Tribes is captured in Section 3.9.7 and Section 4.8 of this EA.

A copy of the draft EA was sent to the State of Nebraska, Department of Environmental Quality (NDEQ) on March 21, 2014 (ML14080A024). On April 24, 2014, NDEQ provided comments by email, which were incorporated into the final EA. Subsequently, additional changes were made to the EA, requiring the NRC staff to provide another draft EA to NDEQ on September 23, 2014. NDEQ also provided comments by e-mail, which were also incorporated into the final EA.

6 CONCLUSION

The NRC staff has assessed the environmental impacts associated with the request from CBR to renew its Source Materials License No. SUA-1534 for CBR's in situ leach (ISL) uranium milling facility (Crow Butte) located in Crawford, Nebraska, and has documented the results in this EA. The NRC staff performed the assessment in accordance with the requirements in 10 CFR Part 51. In conducting the assessment, the NRC staff considered information in the LRA, information in the responses to the NRC staff's RAIs, communications with CBR, SHPO, and the NDEQ, information from theNRC staff site visits and inspections, consultation with Native American Tribes and the public, and NRC staff's independent analysis.

Approval of the proposed action would not alter the current land use at the CBR facility. No new construction, including roads, at the CBR facility is anticipated. Traffic is also not expected to increase from current conditions. Water resources, discussed in detail in sections 4.6 and 4.13.6, would not be significantly impacted from the relicensing of the CBR facility. Section 106 of the NHPA was complied with and the proposed action would not significantly impact cultural resources or minority populations. Relicensing of the CBR facility would have a positive impact on socioeconomics. There would be no significant impacts to the public pertaining to radiological and non-radiological health associated with relicensing the CBR facility.

Based on its review of the proposed action, in accordance with the requirements in 10 CFR Part 51, the NRC staff has concluded that the proposed action, renewal of NRC Source Materials License No. SUA-1534 for CBR's in situ leach (ISL) uranium milling facility (Crow Butte) located in Crawford, Nebraska, will not have a significant impact on the resource areas summarized in the above paragraph and discussed in Chapters 3 and 4 of this EA and will not significantly affect the quality of the human environment. Therefore, the NRC staff has determined that pursuant to 10 CFR 51.31, preparation of an EIS is not required for the proposed action and a FONSI is appropriate.

7 LIST OF PREPARERS

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