ARCADIS

Homestake Mining Company of California

Decommissioning and Reclamation Plan Update 2013 SUA-1471

Homestake Grants Reclamation Project
Cibola County, New Mexico

April 2013

ARCADIS

Decommissioning and Reclamation Plan Update 2013 SUA-1471

Homestake Grants
Reclamation Project
Cibola County, New Mexico

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of California

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April 2013

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ACM	Asbestos Containing Material
ACOE	U.S. Army Corps of Engineers
AEA	Atomic Energy Act
AEC	U.S. Atomic Energy Commission
ALARA	As Low As Reasonably Achievable
ALI	Annual Limit on Intake
AOC	Area of Concern
AQB	Air Quality Bureau
ARAR	applicable or relevant and appropriate requirement
ASTM	ASTM International
bgs	below ground surface
BLM	U.S. Bureau of Land Management
CAP	Corrective Action Plan
CEDE	committed effective dose equivalent
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act of 1980
CESQG	Conditionally Exempt Small-Quantity Generator
CFR	Code of Federal Regulations
cfs	cubic feet per second
CO	carbon monoxide
COC	constituent of concern
CPT	cone penetrometer test
CQA	construction quality assurance
CQC	construction quality control
CSP	corrugated steel pipe
DOE	U.S. Department of Energy
DOT	Department of Transportation
DP	Discharge Permit
dpm	disintegrations per minute
DRP	Decommissioning and Reclamation Plan
EC	electrocoagulation
EMC	elevated measurement comparison
EP-1	Evaporation Pond No. 1

EP-2	Evaporation Pond No. 2
EP-3	Evaporation Pond No. 3
EPA	U.S. Environmental Protection Agency
EQ	Environmental Quality Management, Inc.
ER	Environmental Report
FEMA	Federal Emergency Management Agency
FIDLER	Field Instrument for the Detection of Low Energy Radiation
FSS	Final Status Survey
gpm	Gallons per Minute
GPS	global positioning system
GWPS	groundwater protection standards
GWQB	Groundwater Quality Bureau
HDPE	high-density polyethylene
HMC	Homestake Mining Company of California
HWB	Hazardous Waste Bureau
ICP-MS	inductively coupled plasma mass spectrometry
IX	ion exchange
kg	kilograms
LLD	lower limit of detection
LTP	Large Tailings Pile
LTSP	Long-term Surveillance Plan
M&E	material and equipment
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
mg/L	milligrams per liter
ML	milliliter
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
mrem/yr	millirems per year
MSL	mean sea level
NAAQS	National Ambient Air Quality Standards
NAD 83	North American Datum of 1983
NCP	National Contingency Plan

NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NHNM	Natural Heritage New Mexico
NIMCIX	National Institute of Metallurgy Column Ion Exchange
NMAC	New Mexico Administrative Code
NMDOT	New Mexico Department of Transportation
NMED	New Mexico Environment Department
NMEIB	New Mexico Environmental Improvement Board
NMEID	New Mexico Environment Improvement Division
NMOSE	New Mexico Office of the State Engineer
NMSHPO	New Mexico State Historic Preservation Officer
NPL	National Priorities List
NRC	U.S. Nuclear Regulatory Commission
NRHP	National Register of Historic Places
NUREG	Nuclear Regulatory Guide
O&M	operation and maintenance
Off-Pile	Refers to areas other than the Large and Small Tailings Piles
OSHA	Occupational Safety and Health Administration
OSL	optically stimulated luminescent dosimeter
OU	operable unit
pCi/g	picoCuries per gram
pCi/m^2s	picoCuries per square meter per second
PGA	peak ground acceleration
PM	Project Manager
PM_{10}	particulate matter less than 10 microns in diameter
$PM_{2.5}$	particulate matter less than 2.5 microns in diameter
PMF	probable maximum flood
PMP	probable maximum precipitation
POC	point of compliance
PRM	passive radon monitor
PSD	Prevention of Significant Deterioration
psi	pounds per square inch

QA	quality assurance
QAP	quality assurance program
QC	quality control
QCP	quality control program
QCT	quality control testing
QCTS	Quality Control Testing Services
RAI	Request for Additional Information
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
RG	Regulatory Guide
RI/FS	Remedial Investigation and Feasibility Study
RO	reverse osmosis
ROD	Record of Decision
RPA	Radiation Protection Administrator
RSE	Remediation System Evaluation
RSO	Radiation Safety Officer
RWP	Radiation Work Permit
S&HMS	Safety and Health Management System
S&HP	Safety and Health Policy
SDWA	Safe Drinking Water Act
SET	Senior Environmental Technician
SHPT	Senior Health Physics Technician
SO_2	sulfur dioxide
SOP	standard operating procedure
SPCC	Spill Prevention Control and Countermeasure
SSL	Soil Screening Levels
STP	Small Tailings Pile
SWB	Solid Waste Bureau
SWDA	Solid Waste Disposal Act
SWQB	Surface Water Quality Bureau
TDS	total dissolved solids
TEDE	total effective dose equivalent

TLD	thermo luminescent dosimeter
TM	Task Manager
tpd	tons per day
TSP	total suspended particulate
U_3O_8	uranium oxide
UF_6	uranium hexafluoride
UMTRCA	Uranium Mill Tailings Radiation Control Act of 1978
Updated CAP	Updated Corrective Action Plan (for groundwater)
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
UST	underground storage tank
USTB	Underground Storage Tank Bureau
WDC	waste disposal cell
WL	working level
WQA	Water Quality Act
WQCC	Water Quality Control Commission
WRAP	Water Resources Allocation Program
WTS	water treatment system
yd^3	cubic yards
µR	microRad

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1. Executive Summary

This Updated Decommissioning and Reclamation Plan (Updated DRP) for the Homestake Grants Reclamation Project is provided by Homestake Mining Company of California (HMC) in accordance with the regulatory requirements set forth in 10 Code of Federal Regulations (CFR) 40 and Appendix A to Part 40, 10 CFR 20, 10 CFR 51, and current license conditions. The purpose of this Updated DRP is to update the previous reclamation plan submitted by HMC to the U.S. Nuclear Regulatory Commission (NRC) in October, 1993, and to provide supporting documentation to amend current license conditions for the completion of final groundwater restoration activities and remaining site decommissioning and reclamation activities. An integral component of the Updated DRP for the HMC Grants Reclamation Project is the groundwater Updated Corrective Action Program (Updated CAP). Due to the complexity of the groundwater restoration program and dual jurisdiction by the NRC and New Mexico Environment Department (NMED), groundwater restoration activities at the site are being addressed in a separate Updated CAP document. This Updated CAP, which was updated as of March 2012 (HMC 2012a), is being reviewed by the NRC, U.S. Environmental Protection Agency (EPA), and NMED. The Updated CAP is only summarized in this Updated DRP. Therefore, the Updated CAP should be reviewed for details of the groundwater restoration program.

This Updated DRP was prepared using the guidance set forth in NUREG-1620, Revision 1 (Standard Review Plan for the Review of a Reclamation Plan for Mill Tailings Sites under Title II of the Uranium Mill Tailings Radiation Control Act of 1978 [UMTRCA]) and applicable portions of NUREG-1757 Volume 1, Revision 2 (Consolidated Decommissioning Guidance). The application of these two guidance documents is dependent upon the present and intended uses of radioactive material at the site, the extent and types of radioactive material contamination, previously completed and approved decommissioning activities, the manner in which the site will be decommissioned, and other factors affecting the potential for any increased risk to the public or workers from the decommissioning operations. Only applicable information has been provided. A cross-reference checklist for the two guidance documents and sections of the Updated DRP is presented in **Table 1.0-1**.

The Updated CAP was also prepared following acceptance criteria presented in NUREG-1620. The acceptance criteria are outlined in **Table 1.0-2,** which provides the location of each of the key components of the plan relative to the required checklist from the guidance document. As stated above, the Updated CAP document should be reviewed for detailed discussions of the groundwater restoration program.

1.1 Site and Licensee Information

License Name: Homestake Mining Company of California

Material License Number: SUA-1471

Docket Number: 040-08903

Licensee Address: Homestake Mining Company of California
Grants Reclamation Project
P.O. Box 98
Grants, New Mexico 87020

The HMC Grants Reclamation Project is currently owned and operated by HMC, which is a wholly owned subsidiary of the Barrick Gold Corporation. The project is located approximately 5.5 miles north of the Village of Milan, County of Cibola, New Mexico, in Section 26, Township 12 North, Range 10 West. Other major land uses south and southwest of the project site consists of residential, commercial, and agriculture. There are large areas north, west, and east of the project site that are largely unused except for animal grazing. Much of the land that immediately surrounds the project site to the north, east, and west has been acquired over the years by HMC, and the property is used for livestock grazing except for soil borrow areas, areas of stockpiled rock cover to be used for final cover of the tailings piles, and irrigation areas and infiltration trenches used as part of the groundwater restoration program. In 2010, the area of the license boundary (approximately 900 acres) was expanded at the northwest corner of the existing license boundary with the addition of 185 acres to allow for construction of a new evaporation pond (Evaporation Pond No.3 [EP-3]). The purpose of this pond is to support the ongoing groundwater restoration program. The combined license area acreage is now 1,085 acres.

The U.S. Department of Energy (DOE) Bluewater (UMTRCA Title II) disposal site is located approximately 4.5 miles to the west-northwest of the HMC site (distance from approximate mid-points of each property site boundary).

The primary focus of the Grants Reclamation Project is currently ongoing groundwater remediation and monitoring activities. These were initially implemented in 1977. Remediation activities involve two tailings piles, groundwater extraction and injection system, a reverse osmosis (RO) water treatment system (WTS), two lined collection ponds, three lined evaporation ponds for disposal of contaminated groundwater, administrative buildings, and associated equipment and structures.

1.2 Summary of Licensed Activities

Operations at the mill site, which are discussed in detail in **Section 2.2**, originally started up operations in 1958 under a radioactive material license (SUA-708) issued by the U.S. Atomic Energy Commission (AEC). On May 1, 1974, the State of New Mexico (New Mexico Environmental Improvement Division [NMEID]) was granted licensing authority over the Grants mill project by the AEC. On June 1, 1986, the NMEID relinquished licensing authority to the NRC. The Grants mill project operated under the NRC license SUA-1471 (with amendments) until mill operations ceased. Over the life of the project, the site produced a total of 22.3 million tons of mill tailings, with 11.41 million tons generated under AEC contracts and 10.89 million tons under commercial contracts.

Mill operations at the HMC site ceased in 1990, and HMC submitted a proposed tailings reclamation and mill decommissioning plan for the Grants Mill to the NRC for review in January 1991. Revisions to the plan were submitted to the NRC in October 1993; since then, several license requirements have been modified with associated amendments made to license SUA-1471. The majority of the mill structures were decommissioned between 1993 and 1995, with some structures left in place to support the continuing groundwater restoration program. The only current structures and operational activities at the project site are related to the operation and maintenance (O&M) of the continuing groundwater restoration program. Groundwater restoration and decommissioning are scheduled to be completed in 2022.

The HMC Grants Reclamation Project is a designated UMTRCA Title II site. The site was placed on EPA's Superfund National Priorities List (NPL) in September 1983, at the request of the State of New Mexico. As a result, the site's cleanup activities are also being overseen under EPA's Superfund Program, in accordance with Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) (Meyer 2010).

As a result of overlapping regulatory authority at the HMC site, the NRC and EPA signed a memorandum of understanding (MOU) in December 1993 establishing the regulatory roles and responsibilities for each agency during decommissioning and reclamation of the site:

- NRC is designated as the lead regulatory agency for site reclamation and closure activities.

- EPA has responsibility to monitor all reclamation activities to assure that activities conducted under NRC's regulatory authority will allow attainment of applicable or relevant and appropriate requirements (ARARs) under CERCLA.
- NRC and EPA agreed that conformance with 10 CFR Part 40 Appendix A will assure conformance with CERCLA requirements.

The State of New Mexico has regulatory authority over the decommissioning activities at the HMC site through the issuance of discharge permits DP-200 and DP-725.

Once NRC (with concurrence of the EPA and NMED) approves completion of the remaining decommissioning and reclamation actions, HMC will fund the post-closure long-term monitoring program and the license will be transferred to the DOE under UMTRCA for long-term custody and care. The DOE will administer the provisions of a general license granted under Title 10 CFR Part 40.28 (General License for Custody and Long-term Care of Uranium or Thorium Byproduct Materials Disposal Sites).

1.3 Nature and Extent of Site Radiological Contamination

1.3.1 Surface Contamination

Contamination associated with the milling operation has been consolidated with the tailings or mill wastes which were disposed in the existing mill debris pits or tailings piles. Final cover has been placed over the mill yard. Interim cover exists on the tailings piles (i.e., Large Tailings Pile [LTP] and Small Tailings Pile [STP]) and debris pits to isolate the material from the environment. Remaining site features to be assessed for radiological contamination as part of the final decommissioning and reclamation activities include three buildings; the RO WTS; two water towers; water collection and evaporation ponds (**Figure 2.1-1**); and wells, pumps, piping, and processing equipment associated with the groundwater restoration program. Currently, there is negligible surface soil contamination on the site because a significant amount of soil cleanup was completed during and after mill was decommissioned in December 1995 (AKG 1996). The cleanup of windblown contamination and other contaminated off-pile soils (other than the LTP and STP) occurred from 1993 through 1995, with verification of cleanup completed on September 20, 1995 (ERG 1995). The NRC accepted the cleanup programs on March 1, 1995 (NRC 1995).

1.3.2 Groundwater Contamination

Seepage from the tailings piles over time has resulted in the contamination of groundwater at the site with radiological (e.g., uranium, thorium-230, radium-226, and

radium-228) and non-radiological (e.g., selenium, molybdenum, sulfate, and total dissolved solids [TDS]) contaminants (HMC and Hydro-Engineering 2006, ACOE 2010). Although impacts have been widespread in the alluvial aquifer, contaminants with slight to moderate concentrations have also been identified in the Upper, Middle, and Lower Chinle aquifers near their subcrops with the overlying alluvial system near the project site (HMC & Hydro-Engineering 2006). Contaminant concentrations in the alluvial aquifer are highest under and near the tailings piles and the former mill processing area.

HMC currently manages a groundwater restoration program as defined by the NRC License SUA-1471 and NMED Discharge Plans DP-200 and DP-725 (HMC and Hydro-Engineering 2010). This program is a dynamic ongoing strategy that has evolved since startup in 1977. The current Updated CAP is a result of modifications to the groundwater correction action operations based on the hydrologic and geochemical responses observed in each aquifer system.

Groundwater restoration is scheduled to be completed in 2022. The long-term goal of HMC is to restore affected groundwater aquifers to levels as close as practicable to the upgradient site background levels. At the request of the NRC, an Updated CAP was submitted in 2012. HMC's ongoing and planned future groundwater restoration program is discussed in **Sections 2.2.2.5** and **9.10**, respectively.

1.4 Decommissioning Objective

The objectives of the Updated DRP are as follows:

- Achieve cleanup standards for groundwater through the successful completion of a comprehensive groundwater corrective action plan.
- Achieve final closure of the LTP and STP.
- Achieve closure and demolition of the groundwater water treatment systems.
- Achieve closure of two collection ponds and three evaporation ponds (East and West Collection Ponds; Evaporation Pond Nos. 1, 2, and 3 [EP-1, EP-2, and EP-3, respectively]).
- Use EP-1 and/or EP-2 as a Waste Disposal Cell (WDC) for disposal of contaminated building debris generated during demolition, contaminated soils, and other contaminated material generated during closure activities. One or both evaporation pond(s) will be selected as the WDC following the completion of more detailed engineering of final demolition and reclamation actions.
- Demolish remaining site structures.

- Reclaim remaining contaminated soils.
- Complete final surface recontouring and construct structures required for the long-term protection of the tailings piles, mill area, and disposal pits from rainfall events.
- Apply topsoil and reseed reclaimed areas.
- Install remaining security features (e.g., fencing, gates, and signage).
- Complete a final radiological verification survey to demonstrate that the site meets NRC required cleanup standards for the long-term intended use.

The completion of site reclamation and decommissioning activities will provide for both restricted and unrestricted use of the property within the license boundary presented in this plan. The majority of the current license boundary (~900 acres) will be designated as restricted, which is primarily due to the long-term presence of the LTP, STP, designated WDC, and the reclaimed mill site that contains buried mill debris (**Figure 2.1-1**). An additional approximate ~185 acres of the license boundary will be designated for unrestricted use. This acreage was added for the construction and operation of an additional evaporation pond (EP-3) in 2010 for use in the groundwater restoration program. Once groundwater restoration has been completed, EP-3 will be closed with sediments, liners, piping, and any contaminated soils and equipment removed and buried in the designated WDC. Following radiological survey verification, HMC will request NRC approval for designation as unrestricted use for this area and adjustment of the license boundary.

1.5 Radiological Criteria for Unrestricted Use

Radiological criteria for unrestricted use are specific to land, building surfaces, and material and equipment (M&E).

For land and building surfaces, the unrestricted release criteria are contained in Criterion 6 of Appendix A to 10 CFR Part 40. This includes radium-226 concentrations in land not to exceed 5 picoCuries per gram (pCi/g) above background for a depth interval of 0 to 5 cm below ground surface (bgs) or 15 pCi/g above background for a depth interval of 5 to 15 cm bgs. Byproduct material containing concentrations of radionuclides (other than radium-226 in soil, and surface activity on remaining structures) must not result in a total effective dose equivalent (TEDE) that exceeds the dose from cleanup of radium-contaminated soil, as per the standard identified above, and must be at levels which are as low as reasonably achievable.

The unrestricted release criteria for M&E to be salvaged from the site are contained in NRC Regulatory Guide (RG) 1.86 "Termination of Operating Licenses for Nuclear Reactors".

1.6 As Low As Reasonably Achievable Analysis

HMC currently employs health physicist and engineering contractors to conduct annual As Low as Reasonably Achievable (ALARA) audits for the HMC Grants Reclamation project site. The audits are conducted in accordance with NRC RG 8.31. Other applicable references include HMC's NRC License SUA-1471 and NRC Regulatory Guides 8.10, 8.22, and 8.30. The latest such ALARA audit was conducted on December 4 and 5, 2012 (ERG 2012). The associated ALARA report will be included as Appendix C of the 2012 HMC annual monitoring report (HMC and Hydro-Engineering 2012). The radiation protection program was found to be effective in reducing exposures to very low levels and is as low as reasonably achievable. Results from external and internal dosimetry monitoring programs demonstrate that the doses received by the HMC staff and contractors are very low and well within the limits allowed by regulations. Additional engineering and administrative controls taken by the staff demonstrate adherence to the ALARA policy.

Soil cleanup requirements are contained in 10 CFR 40, Appendix A. The radium-226 soil cleanup criteria are based on EPA regulations contained in 40 CFR 192 and are considered health-based standards that are ALARA. The remaining soil cleanup standards contained in 10 CFR 40, Appendix A require a demonstration that the levels are ALARA. At this time, HMC is not aware of areas where byproduct material in soil or on building surfaces will require development of dose-based cleanup criteria. In the event that these areas are identified in the future, HMC will develop dose-based (radium-226 benchmark dose) cleanup criteria using appropriate methods and will demonstrate that these criteria are at levels that are ALARA.

1.7 License Termination Restricted Conditions

The decommissioning of the Grants Reclamation Project site will result in the permanent stabilization of the LTP, STP, the designated WDC, and demolished contaminated mill structures and equipment buried in cells within in the previous mill processing area. These features are located within a designated license boundary. As discussed in **Section 1.4**, a portion (185 acres) of the current license boundary (1,085 acres) added in 2010 for construction and operation of EP-3 will be removed from the current license boundary and closed as unrestricted use. The remaining area within

the license boundary (900 acres) will be designated as a restricted area once final reclamation and decommissioning has been completed to the satisfaction of the NRC.

1.8 Financial Assurance

License Condition 28 of License SUA-1471 requires that HMC maintain an NRC-approved financial surety arrangement consistent with 10 CFR 40, Appendix A, Criteria 9 and 10, which is adequate to cover estimated decommissioning and decontamination costs. The surety is required to be updated annually and submitted to the NRC for approval. The most recent surety was approved by the NRC via License Amendment No. 44 (License Condition 28) by letter dated December 20, 2011. A total amount of $41,093,194 for the project was presented for years 2012 through 2017 (NRC 2011). The total is composed of the following: total project cost of $35,022,907; the 15 percent NRC contingency fee per NUREG-1620 App. C of $5,253,436; and the NRC Long-Term Maintenance/Surveillance Fee of $816,851 (using January 2011 index basis).

A summary of the currently approved 2011 closure cost estimates (for years 2012 through 2017) is presented in **Table 18.1-1,** and a summary of the physical reclamation cost estimates is presented in **Table 18.1-2**. These cost estimates are based on 2011 dollars.

HMC submitted an updated 2012 closure cost estimate for the Grants Reclamation Project to the NRC by letter dated March 29, 2012 (HMC 2012b). The updated cost estimate reflects the adjusted timeframe for completion of groundwater remediation at the Grants site as described in the Updated CAP. The proposed cost estimate reflects a total closure cost for the project for years 2013 through 2022 of $80,797,033. The total is composed of the following: total project cost of $69,527,206; the 15 percent NRC contingency fee per NUREG-1620 App. C of $10,429,081; and the NRC Long-Term Maintenance/Surveillance Fee of $840,746 (using January 2012 index basis).

A summary of the proposed and pending 2012 closure cost estimates (for years 2013 through 2022) is presented in **Table 18.1-3,** and a summary of the physical reclamation cost estimates is presented in **Table 18.1-4**. These cost estimates are based on 2012 dollars. The basis of the 2012 proposed closure cost estimate is discussed in **Section 9**.

The cost estimate will continue to be updated annually per license condition or as dictated by changes in the decommissioning and reclamation plan as those plans and activities proceed.

1.9 Institutional Controls

In order to restrict access, the area within the license boundary is currently enclosed by a security fence approved by the NRC with warning signs. The site maintains security support services, security alarm systems, and site entry controls. Once site reclamation has been completed and site structures have been demolished and removed, and until title transfer to the DOE, HMC will continue to maintain institutional controls (security support services, site entry controls, fencing, and warning signs). Scheduled inspections, repairs, and maintenance will be carried out on the LTP, STP, diversion structure, mill area, other site grounds, and remaining groundwater compliance monitor wells. Upon title transfer from HMC to the DOE, the DOE will assume custody and responsibility of the site in perpetuity for the licensed area. HMC will establish a financial assurance arrangement to cover the cost of long-term care and monitoring according to Criterion 10 of Appendix A to CFR Part 40.

1.10 Final Decommissioning and Reclamation Schedule

The proposed schedule for final decommissioning and reclamation at the HMC Grants Reclamation Project will result in closure activities occurring between 2013 and 2022. The schedule is shown on **Figure 9.11-1**. Restoration of groundwater on and off the site is the primary reason for the extended schedule, with aquifer remediation estimated to be completed in 2020. Remaining assets (e.g., collection ponds, evaporation ponds, and the RO treatment plant) that are part of the groundwater restoration program cannot be reclaimed and decommissioned until the aquifer has been restored. More detailed discussions of the schedule are presented in **Section 9.11**.

1.11 Post-Remediation Activities

Once all required remediation has been completed, HMC will continue with post-remediation monitoring of designated long-term monitor wells. Such monitoring shall continue until HMC's license terminates as part of the license transfer to the DOE under the UMTRCA for long-term custody and care. The DOE will administer the provisions of a general license granted under Title 10 CFR Part 40.28 (General License for Custody and Long-term Care of Uranium or Thorium Byproduct Materials Disposal Sites). DOE will assume control and responsibility for continuation of long-term groundwater monitoring at the Grants Reclamation Project site.

1.12 Request for License Amendment to Incorporate Decommissioning Plan

HMC is requesting that current License SUA-1471 be amended to incorporate this Updated DRP, which serves to update the revised Reclamation Plan dated October 1993 (AKG and Jenkins 1993). HMC's License Condition No. 36 requires that HMC complete site reclamation in accordance with an approved reclamation plan. Considerable time has passed since the current reclamation plan was approved, and the site has been partially reclaimed. Therefore, the purpose of this Updated DRP is to summarize what decommissioning and reclamation activities have been completed, summarize regulatory actions that have occurred since operations ceased at the site, document any changes to the 1993 Reclamation Plan, clarify remaining decommissioning and reclamation activities required to close the site and present the revised schedule for site closure. Groundwater cleanup alternatives are still being evaluated; therefore, additional updates to this Updated DRP can be expected.

The major remaining activity at the site is the completion of the groundwater reclamation program. HMC is to complete groundwater cleanup in accordance with an approved Updated CAP, which is authorized by License Condition No. 35. The current Updated CAP, a separate document, has been updated as of March 2012 and was submitted under separate cover to the NRC and NMED in March 2012. HMC will seek separate approval of the Updated CAP and updates to License Condition No. 35. The NRC approval of the Updated DRP depends on the agency's approval of the Updated CAP because it is a component of the Updated DRP.

1.13 References

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AK Geoconsult, Inc. and Jenkins Environmental. Inc. (AKG and Jenkins). 1993. Homestake *Reclamation Plan Revision 10/93.* Volume I Text, Tables and Figures. ML091490367. October 1993.

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Homestake Mining Company and Hydro-Engineering, LLC (HMC and Hydro-Engineering). 2006. 2005 Annual Monitoring Report / Performance Review For Homestake's Grants Project Pursuant To NRC License Sua-1471 And Discharge Plan DP-200. ML060950167. March.

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U.S. Army Corp of Engineers. (ACOE). 2010. Focused View of Specific Remediation Issues, An Addendum to the Remediation System Evaluation for the Homestake Mining Company (Grants) Superfund Site, New Mexico. Final Report. December 23.

U.S. Nuclear Regulatory Commission. (NRC). 1995. Letter from Joseph J. Holonich, Chief, High-Level Waste and Uranium recovery Branch, Division of Waste Management, Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Commission, Washington, D.C. to F.R. Craft, Resident Manager, Homestake Mining Company, Grants, New Mexico Regarding License Amendment No. 20, approval of Soil Cleanup Verification Survey and Sampling Plan. March 1.

NRC. 2011. Letter from Bruce Watson, Acting Deputy Director, Decommissioning and Uranium Recovery Licensing Directorate, Division of Waste Management and Environmental Protection to A.D. Cox, Homestake Mining Company Regarding License Amendment No. 44 (2011 annual surety update). ML113190523. December 20.

2. Facility Operating History

This section summarizes the HMC Grants Reclamation Project historical operations, license activities, and current site conditions consistent with applicable guidance contained in Section 16.2 of NUREG-1757 and Appendix B of NUREG-1620. Previous documents/communications prepared by HMC and its contractors, NRC, EPA, and NMED, and discussions with HMC staff, were the basis for the information presented in this section. This review included the records that identified historical operations and events that have resulted in known or potential sources of residual radioactivity within the site boundary. This information was used to assess past decommissioning and reclamation activities in order to ensure that there were no other site areas potentially or known to be impacted by historical operations that had not been addressed. **Appendix A** presents the chronology of major licensing, permitting, and operational activities impacting reclamation and decommissioning tasks over the past 52 years.

There have been a large number of various decommissioning and reclamation activities completed since such activities began in 1993. This section provides a consolidated chronological summary of the major historical activities. Major actions approved by the NRC via license amendments are summarized in **Appendix B**, with the most recent radioactive material license conditions shown in **Appendix C**. This will help the NRC staff reviewing the plan to focus on those changes proposed by license amendments that have not been finalized and approved, using the appropriate sections of the standard review plans of NUREG-1757 and NUREG-1620. As stated in Appendix B of NUREG-1620, "aspects of the facility and its operation that have not changed since the last renewal or amendment should not be reexamined."

2.1 License Number, Status, and Authorized Activities

The following section describes the current HMC Grants Reclamation Project license status and summarizes activities authorized under NRC License SUA-1471 for the project site.

2.1.1 Facility Ownership

HMC began uranium milling operations in 1958 under a license (SUA-708) issued by the AEC, with original operations being conducted by two distinct partnerships – the Homestake-Sapin Partners and Homestake-New Mexico Partnership. HMC acted as the managing partner of both partnerships. The Homestake-New Mexico Partnership was dissolved in 1961, and the property was acquired by Homestake-Sapin Partners. The name of the partnership was changed in 1968 to United Nuclear-Homestake

Partners. Combining of the two milling operations resulted in a mill with a nominal throughput capacity of 3,400 tons per day (tpd). HMC purchased United Nuclear Corporation's interest in March 1981, and the name was changed to Homestake Mining Company – Grants. HMC merged with Barrick Gold Corporation on December 4, 2001, and HMC is currently a wholly owned subsidiary of the Barrick Gold Corporation.

Over the life of the project, the site produced a total of approximately 22.3 million tons of mill tailings, with 11.41 million tons generated under AEC contracts and 10.89 million tons under commercial contracts. All of the uranium processed at the Grants mill between 1958 and 1973 was mined from 1958 to June 1970 for the federal government under contracts with the AEC. Of the 22.3 million tons of mill tailings at the Grants site, 51 percent (or 11.4 million tons) are wastes associated with AEC contracts. The remaining 10.9 million tons of waste, generated from 1974 through 1990 under license by the NRC for commercial use, are the responsibility of HMC. In 1978, with the passage of UMTRCA, this act made DOE responsible for remediation of radioactive wastes left from uranium and milling operations contracted by the AEC.

2.1.2 Facility Status

The entire land base of the project site is owned in fee title by HMC. Mill operations at the HMC site ceased in 1990, and HMC submitted a Reclamation Plan (tailings reclamation and mill-decommissioning plan) for the Grants mill site to the NRC for review in January, 1991 (AKG et al. 1991). This plan was an update to the 1986 Tailings Stabilization and Site Reclamation Plan, prepared during operations and prior to the decision to terminate operations (see additional discussions in **Section 2.1.3.1**). Revisions to the 1991 plan were submitted to the NRC in October 1993, and since then, several license amendments have been added or modified to license SUA-1471 (**Appendix C**). The mill operating facilities were decommissioned and demolished between 1993 and 1995, with a few facilities remaining in place to support ongoing groundwater restoration activities (see discussions below).

Table 2.1-1 presents the HMC permit boundary coordinates according to two different projections:

- Latitude/longitude coordinates (degrees) according to Geographic Projections in North American Datum of 1983 (NAD 83); and
- Northing/easting coordinates (feet) according to the projection NAD_1983_StatePlane_New Mexico_West_FIPS_3003 (US_foot).

These data were used for the topography maps in this report.

The total acreage within the license boundary is approximately 1,085 acres. The LTP occupies an area of approximately 215 acres and is approximately 85 to 90 feet high. The LTP contains an estimated 21.1 million tons of mill tailings. The STP occupies an area of approximately 40 acres and is 20 to 25 feet high. The STP contains approximately 1.2 million tons of mill tailings. Seepage from these two tailings piles has impacted the underlying groundwater aquifers.

Current major assets at the HMC Reclamation Project site consist of:

- LTP;
- STP;
- Groundwater extraction and injection system;
- Tailings flushing and dewatering system;
- RO WTS;
- Two lined collection ponds;
- Three lined evaporation ponds;
- Associated equipment; and
- Office building and related support structures.

HMC currently manages a groundwater restoration program as defined by NRC License SUA-1471 and NMED Discharge Plans DP-200 and DP-725.

The major remaining tasks to be completed for final site closure include:

- Completion of groundwater restoration;
- Final closure of LTP;
- Final closure of STP;
- Closure of the collection and evaporation ponds;
- Demolition of remaining site facilities;
- Onsite burial of remaining contaminated byproduct waste material in a WDC(s);
- Final site grading;
- Final radiological site survey;
- Site security program; and
- Ongoing environmental monitoring.

Figure 2.1-1 shows the locations of the current assets onsite, and **Table 2.1-2** provides descriptions of the current use and status of these facility buildings and structures. The work required for decommissioning of the mill facilities is illustrated on **Figure 2.2-2**, which depicts the identification and locations of operating assets prior to decommissioning the mill. Plans are to complete the remaining site reclamation and decommissioning activities by the year 2022. See **Section 9.10** for detailed discussions of HMC's groundwater restoration plan.

A diagram of the current 1,085-acre HMC property and remaining assets included in the license boundary is shown on **Figure 2.1-1**. The site buildings and structures shown in this figure currently support the ongoing groundwater restoration program and will also support final reclamation and decommissioning activities. See detailed discussions of planned activities in **Section 9**.

2.1.3 Regulatory Authority

The AEC regulated the original radioactive materials license for the site between 1958 and 1974 under License No. SUA-708, when the State of New Mexico became an NRC Agreement State, and the AEC granted it the authority to regulate uranium milling activities. The New Mexico Environmental Improvement Board (NMEIB) and the NMEID assumed regulatory authority over the original AEC license, including its renewal. The State of New Mexico was responsible for licensing and regulating uranium milling operations at the site from 1974 to 1986, when it relinquished its authority to the NRC on June 1, 1986. The Grants mill project operated under the NRC license (SUA-1471 with amendments) until mill operations were terminated. Post-operational activities (i.e., site decommissioning and reclamation tasks) continue to be addressed under license SUA-1471.

Major regulatory responsibilities for the HMC Grants Reclamation Project are currently shared by the NRC, EPA, NMED, and the New Mexico Office of State Engineer (NMOSE). These agencies have the same overall goal to restore the site and groundwater to protect public health and safety, but each agency has specific regulatory requirements that must be met during decommissioning and reclamation. **Tables 2.1-3** and **2.1-4** list the primary federal and state statutes and authorities that potentially apply to the site depending on regulatory authority and future reclamation and decommissioning activities.

The current federal and state licenses, permits, and approvals and major compliance requirements held by HMC for the site are listed in **Table 2.1-5**. Agency responsibilities are discussed in more detail later in this section.

This Updated DRP provides updates to the existing HMC Grants Reclamation Plan (October 1993) and provides additional detail regarding past site reclamation and decommissioning actions, current reclamation and decommissioning efforts, and a description of final closure activities that remain to be performed. As titled, its purpose is to serve as an update to site reclamation and decommissioning activities. Some details of final reclamation and decommissioning actions cannot be presented until final groundwater restoration measures are better defined (completion of ongoing studies and research) and more detailed engineering of final reclamation, demolition, and decommissioning actions have been completed. Once these steps have been taken, HMC will submit final closure plans for specific tasks to the NRC and other appropriate agencies for approval.

The Grants Reclamation Project Updated CAP is a fundamental component of the Updated DRP for the site, and future updates of the Updated CAP will continue to address progress in groundwater restoration. As such, established groundwater site cleanup standards must be achieved prior to final reclamation and decommissioning of surface assets and environmental media. During decommissioning and demolition of surface facilities in the mid-1990s, some surface assets were left in place to support the source control and groundwater restoration efforts. Groundwater restoration activities began during the active life of the mill; therefore, groundwater restoration plans were developed and implemented in separate but related documentation to final site decommissioning and reclamation activities. The Updated CAP was submitted to the NRC by letter dated March 15, 2012 (HMC 2012a, HMC 2012b). The Updated CAP is currently undergoing regulatory review by the NRC, EPA, and NMED, as well as review by the public.

The NRC has regulated activities at the site since June 1, 1986 under a source and byproduct material license issued in accordance with Title 10 CFR Part 40. Prior to June 1986, the HMC site activities were regulated (1973 – June 1986) under a license issued by the State of New Mexico as per its status as an NRC Agreement State (Meyer 2010). The NMED does currently retain some regulatory oversight responsibility at the site through regulation of water management via Discharge Permits DP-200 and DP-725. Discharge Permit DP-200 regulates several aspects of the ongoing groundwater cleanup program and related RO WTS within the NRC-licensed boundary. Discharge Permit DP-725 regulates the discharge to the evaporation ponds and two existing collection ponds. The NMED also has a consulting role with the EPA in enforcing CERCLA responsibilities.

The HMC Grants Reclamation Project is a designated UMTRCA Title II site. The HMC site was placed on EPA's Superfund NPL in September 1983 at the request of the State of New Mexico. As a result, the site's cleanup activities are also being overseen under EPA's Superfund Program, in accordance with CERCLA (Meyer 2010).

The HMC site is complex because the reclamation must meet UMTRCA and CERCLA requirements. Due to the regulatory overlaps in the requirements of the NRC and EPA (Region VI), the two agencies signed an MOU in December 1993 which defines the regulatory roles and responsibilities for each agency during reclamation of the HMC site (**Appendix D**). As per the MOU, the NRC is the designated lead agency for the byproduct material disposal area reclamation and closure activities. EPA's responsibilities are as an oversight agency, monitoring all reclamation activities carried out under the NRC's regulatory authority in order to ensure their actions will allow attainment of ARARs under CERCLA (Meyer 2010).

Under the EPA/NRC MOU, the agencies agreed that requirements of 10 CFR Part 40, Appendix A are the federal environmental and public health ARARA requirements for the HMC site, and conformance with these regulations will generally assure conformance with CERCLA requirements. The MOU clarifies that, after closure of the disposal area and completion of other remedial measures undertaken in full compliance with NRC's 10 CFR Part 40, Appendix A, the EPA, pursuant to 40 CFR Parts 425(e) and 505(c)(3) and in consultation the NMED, shall jointly determine whether all required response actions with respect to the site have been implemented (Meyer 2010). Once such a determination has been made, the site may then be considered for deletion from the NPL.

The NRC, EPA, and NMED continue to explore ways to resolve regulatory and policy issues in order to achieve multi-agency consensus on such issues affecting reclamation and decommissioning activities at the site. A Homestake Executive Steering Committee is composed of senior managers from the NRC, EPA, and NMED. The purpose of this committee is to resolve differences of opinion between the regulatory agencies. Recent meetings occurred on 8/08/2011, 10/11/2011, and 6/12/2012. Roles of the NRC, EPA, and NMED are discussed further in **Sections 2.1.3.1** through **2.1.3.5**.

2.1.3.1 NRC

As previously stated, the NRC is the lead agency responsible for regulating and directing all site closure and remedial activities at the Grants site per the terms of Radioactive Materials License SUA-1471.

The principal statutory authorities that govern the NRC's activities at the site are:

- Atomic Energy Act (AEA), as amended
- UMTRCA, as amended

NRC regulations are issued under the CFR Title 10, Chapter 1. The principal NRC regulatory authorities applicable to the Grants site are:

- 10 CFR 40 (domestic licensing of source material), including:

  Appendix A to 10 CFR 40 – Criteria Relating to the Operation of Uranium Mills and the Disposition of tailings or wastes Produced by the Extraction or Concentration of Source Material from Ores Processed Primarily for their Source Material Content
- 10 CFR 20 (standards for protection against radiation)
- 10 CFR 51 (implements the National Environmental Policy Act [NEPA]: environmental protection regulations for domestic licensing and related regulatory functions)

Source and Byproduct Material

Under the AEA, the NRC has the responsibility of regulating source material and byproduct material generated from conventional uranium milling operations such as the Grants site. NRC regulations for source material facility licensing are also established in 10 CFR 40.

Source material means:

(a) "Uranium or thorium, or any combination thereof, in any physical or chemical form; or

(b) Ores which contain by weight one-twentieth of 1 percent (0.05 percent) or more of uranium, thorium or any combination of uranium and thorium. Source material does not include special nuclear material."

Byproduct material means:

> "The tailings or wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content."

The NRC regulates byproduct material located at a site where milling operations are no longer active if such site is not covered by the remedial action program of Title I of

UMTRCA. As previously stated, the HMC Grants site is designated as a Title II site (see discussions of Title I and II sites below).

Residual Uranium

Radioactive Material License SUA-1471 authorizes only the possession of residual uranium and byproduct material in the form of uranium waste tailings and other byproduct waste generated by the licensee's past milling operations.

Under 10 CFR 20, "regulations in this part establish standards for protection against ionizing radiation resulting from activities conducted under licenses issued by the NRC. These regulations are issued under the AEA, as amended, and the Energy Reorganization Act of 1974, as amended".

It is the purpose of the regulations under 10 CFR 20 "to control the receipt, possession, use, transfer, and disposal of licensed material by any licensee in such a manner that the total dose to an individual (including doses resulting from licensed and unlicensed radioactive material and from radiation sources other than background radiation) does not exceed the standards for protection against radiation prescribed in the regulations in this part. However, nothing in this part shall be construed as limiting actions that may be necessary to protect health and safety."

Environmental Protection

Regulations in 10 CFR Part 51 provide for environmental protection regulations for domestic licensing and related regulatory functions (implements NEPA), while regulations in 10 CFR 20 cover radiation protection standards.

UMTRCA amended the AEA, and established two programs to protect the public health, safety, and environment from uranium mill tailing. One program deals with the federal government assuming responsibility for cleanup at abandoned, inactive uranium milling sites (Title I sites) and the second program (Title II sites) places the responsibility for cleanup of commercially owned sites with the NRC licensees that were operating in 1978, or licensed by the NRC, or licensed by an Agreement State after 1978. Title I sites are where tailings resulted largely from production of uranium for the U.S. weapons program.

The Grants Reclamation Project is a Title II site. Title II amended the definition of byproduct material to include mill tailings and added specific authority for the NRC to regulate this new category of byproduct material at licensed sites. Under UMTRCA,

the NRC has authority to ensure that the site meets applicable standards for protecting human health and the environment, including control of radiological and non-radiological hazards. The EPA has authority to set generally applicable standards for both radiological and non-radiological hazards. Eventually, ownership of the site will be conveyed to the DOE under a general license to the NRC.

As previously stated, the Grants Reclamation Project Updated CAP for groundwater is a fundamental component of the Updated DRP for the site, and future updates of the Updated CAP will continue to address progress in groundwater restoration. The Updated CAP was submitted to the NRC by letter dated March 15, 2012 (HMC 2012a) and is currently undergoing review by the NRC, EPA, and NMED. This Updated CAP is an update to the previous version submitted to the NRC on December 12, 2006 and documents the history of past groundwater restoration activities, the current status of the restoration effort, optimization options for the current restoration activities, and potential alternative treatment technologies to supplement the existing strategy. In addition, this update to the Updated CAP provides a revised schedule and project end date based on our current understanding of source control and groundwater restoration progress.

HMC's NRC License SUA-1471 authorizes HMC (Licensee) to possess residual uranium and byproduct material generated by the past milling operations in accordance with approved license conditions (**Appendix C**). Compliance with 10 CFR 20 is also addressed. The license only authorizes HMC to possess residual uranium and byproduct material generated by the licensee's past milling operations in accordance with approved license conditions. The license is maintained and based on the NRC requirements of Title 10 CFR Part 40 (10 CFR Part 40), Domestic Licensing of Source Material. The site reclamation plan documents how the proposed activities demonstrate compliance with the criteria set forth in Appendix A of 10 CFR Part B (Criteria relating to the Operation of Uranium Mills and the Disposition of Tailings or Wastes Produced by the Extraction or Concentration of Source Material from Ores Processed Primarily for Their Source Material Content). The license only authorizes the licensee to possess residual uranium and byproduct material generated by the licensee's past milling operations in accordance with approved license conditions.

Prior to a final decision by HMC to terminate milling operations at the Grants site, the NRC required HMC to submit a Tailings Stabilization and Site Reclamation Plan. This plan was submitted to the NRC on December 1, 1986 (HMC 1986, Kuhn and Jenkins 1986). On May 5, 1990, HMC advised the NRC that the plan would require major revisions due to changes at the site (e.g., cessation of milling operations in February

1990) and new NRC guidelines (HMC 1990). HMC submitted an Updated DRP in January 1991 (HMC 1991, AKG et al. 1991), followed by a revised plan in 1993 (HMC 1993a, AKG and Jenkins 1993a, 1993b). The current 2013 updated plan provides updates to the 1993 plan in order to address the following:

- Inclusion of license amendments/license conditions, technical reports, and data that have occurred since the 1993 reclamation plan submittal
- Changes in final reclamation and decommissioning proposed actions
- More current NRC licensing requirements and guidance
- Consideration of any improved best management practices that were not valid at the time of the earlier submittal (e.g., technology improvements)
- Current concerns of HMC's neighbors and public members with final closure

Currently, the principal licensed activities are the implementation of the groundwater Updated CAP and decommissioning of the remaining assets at the site. Once NRC approves completion of the reclamation and decommissioning and approves HMC's full funding mechanism for post-closure long-term monitoring and ongoing routine maintenance, the license will be transferred to the DOE under the UMTRCA for long-term custody and care. The DOE will administer the provisions of a general license granted under Title 10 CFR Part 40.28, General License for Custody and Long-term Care of Uranium or Thorium Byproduct Materials Disposal Sites.

All current license conditions for groundwater restoration, site decommissioning, and reclamation are presented in the HMC License located in **Appendices B and C**. **Appendix A** presents a chronology of the major licensing, permitting, and operational activities. Closure activities described in this DRP and associated documents are intended to provide the basis for completing work activities in support of license termination and subsequent release of the site to the DOE for restricted use pursuant to Appendix A of 10 CFR Part 40.

The HMC site was placed on the NPL in September 1983 under CERCLA (EPA 2010), primarily because of alleged selenium contamination of groundwater in residential wells. As stated above, the NRC is the lead agency responsible for surface reclamation and source control at the licensed site, with the EPA to monitor all such activities and provide review and comment directly to the NRC. EPA's CERLCA activities are discussed in more detail in **Section 2.1.3.5**.

HMC followed guidance from NUREG-1620 for this DRP update. NURGE-1620 provides guidance for NRC staff reviews of reclamation plans for uranium mill tailings

sites covered by Title II of UMTRCA (NRC 2003). Applicable portions of NUREG-1757 were also used for guidance (NRC 2006). Other NRC guidelines used in the preparation of this document are referenced as appropriate in the following sections.

2.1.3.2 EPA

As detailed in **Section 2.1.3.5**, the EPA's primary responsibility is oversight, monitoring all restoration activities, and providing reviews and comments directly to the NRC; this oversight role is associated with the EPA retaining responsibility for the site under CERCLA.

The principal statutory authorities that govern the EPA's current regulatory activities at the site are:

- UMTRCA, as amended
- CERCLA

UMTRCA

Although the EPA does not license uranium mills, it does establish environmental standards under UMTRCA that must be adopted by the NRC and Agreement States. The current regulations that apply to remediation of both inactive uranium mill tailings and uranium extraction facilities, including active uranium mills, have been issued by the EPA under UMTRCA, as amended. Under both the AEA and UMTRCA, the generally applicable standards that EPA promulgates for non-radiological hazards under UMTRCA are to be consistent with standards that EPA promulgates under the Solid Waste Disposal Act (SWDA) and Resource Conservation and Recovery Act (RCRA) for such hazards. The EPA does so by referencing 40 CFR Part 261 regulations. The NRC adopts these requirements into their requirements of 10 CFR Part 40, Appendix A. EPA groundwater protection standards issued under the authority of UMTRCA are required to be followed at the site.

CERCLA

CERCLA, as amended, provides broad federal authority to respond directly to releases or threatened releases of hazardous substances that may endanger public health or the environment. The National Contingency Plan (NCP; 40 CFR Part 300) is the EPA's implementing regulation for CERCLA. Under the NCP, the site was added to the NPL in 1983. As a result, the EPA continues to have regulatory authority at the site under CERCLA (see discussion in **Section 2.1.3.5** of the shared regulatory responsibilities with the NRC).

2.1.3.3 DOE

For license transfer or termination, HMC must conduct NRC-approved reclamation of any onsite radioactive waste remaining from uranium-processing operations. HMC is also required to ensure full funding for inspections, and if necessary, ongoing maintenance. The DOE will then accept title to the site for long-term custody and care. The DOE will administer the site under the provisions of a general NRC license granted under 10 CFR Part 40.28, "General License for Custody and Long-Term Care of Uranium or Thorium Byproduct Materials Disposal Sites."

2.1.3.4 State of New Mexico

The State of New Mexico has regulatory authority through a number of environmental statutes and regulations. The NMED provided the NRC with a listing of state statutory and regulatory authorities that may be applicable to the site (NMED 2011a; **Table 2.1-4**). The major state regulatory agencies involved are the NMED and NMOSE. The NMED consists of a number of bureaus, including the Ground Water Quality Bureau (GWQB), Surface Water Quality Bureau (SWQB), Solid Waste Bureau (SWB), Hazardous Waste Bureau (HWB), and the Air Quality Bureau (AQB). The NMOSE offices that are the primary agency regulatory authorities at the HMC site are the Water Rights Division (water appropriations) and the Dam Safety Bureau (permitting of dams associated with surface ponds). These two agencies are part of the New Mexico Water Resources Allocation Program (WRAP).

NMED regulatory activities on the Updated CAP are being carried out primarily by the GWQB. The GWQB of the NMED has responsibility for issuance of groundwater discharge permits, other than those related to production and refinement of oil or natural gas, under the authority of the New Mexico Water Quality Act (WQA). The GWQB has issued two groundwater discharge permits to the HMC site (DP-200 and DP-725). These permits are issued pursuant to the New Mexico WQA, NMSA 1978 74-6-1 through 74-6-17 and the New Mexico Water Quality Control Commission (WQCC) Regulations 20.6.2 New Mexico Administrative Code (NMAC). These discharge permits relate to the construction and operations of associated surface ponds (e.g., evaporation ponds) and operation of properly constructed injection/collection/monitor wells.

Other environmental media subject to regulatory control by the NMED include media such as non-radioactive air emissions (e.g., dust; NMED AQB) and solid and hazardous waste handling and disposal (NMED HWB; delegated authority from the EPA).

The current state permits and approvals held by HMC for site are listed in **Table 2.1-5.** As groundwater alternative reclamation steps are identified in more detail, additional state and federal regulatory approvals may be required.

2.1.4 Interactions of Regulatory Authorities and Grants

As discussed above, decommissioning and reclamation activities at the site are currently subject to the regulatory authority of at least two federal agencies (NRC and EPA) and two state agencies (NMED and NMOSE). Each agency's goal is to protect public health and safety during and after completion of the decommissioning and reclamation tasks, but they have different, specific regulatory roles and requirements. The agencies are committed to resolving regulatory and policy issues to achieve multi-agency consensus on groundwater restoration and site reclamation activities at the site. An overview of interactions between the NRC, EPA, NMED, and NMOSE in the completion of tasks for the DRP is described on **Figure 2.1-3**. **Table 2.1-6** provides a timeline of decommissioning and reclamation regulatory licensing history at the Grants site. Additional information and relevant documents are provided in **Appendix A**; histories of operations and restoration activities are discussed in **Section 2.2**.

The EPA conducts Five-Year Reviews under CERCLA for the Homestake Grants site in order to evaluate the implementation and performance of the remedy to determine whether the remedy is protective of human health and the environment and functions as intended based on the decision documents (EPA 2011a). The 5-year review also assesses whether the remedy will continue to be protective in the future. The latest 5-year review for the HMC site was conducted from November 2010 through June 2011 and was reported in the Third Five-Year Review Report (EPA 2011a). The review is currently based onsite remediation activities that have been divided into three distinct phases or operable units (OUs).

Under CERCLA, the EPA has divided the site remediation activities into three distinct OUs.

- OU1: restoration of groundwater contaminated by tailings seepage
- OU2: long-term stabilization of the tailings, surface reclamation, and decommissioning and closure of the mill
- OU3: addresses indoor and outdoor radon concentrations in residual areas adjacent to the mill site

HMC responses to EPA's recommendations in the Third Five-Year Review (EPA 2011a) are presented in **Section 2.1.4.4**.

The remainder of this section discusses the respective roles of each of the agencies as they currently apply to these OUs.

2.1.4.1 OU1

OU1 work is being conducted through the groundwater restoration program being carried out under NRC License SUA-1471, the Updated CAP, and NMED groundwater discharge plans DP-200 and DP-725. In 1977, the HMC implemented OU1 remedial activities by installing an NRC and state-approved groundwater collection and injection system at the site. The groundwater site cleanup standards are established by the NRC under License SUA-1471 and NMED under DP-200. In addition, HMC uses a secondary groundwater collection and land treatment system for remediating portions of the contaminant plumes that have migrated beyond the facility's licensed boundary. Although this secondary groundwater system is not required as part of the existing Updated CAP or DP-200, HMC incorporated this system into the Updated CAP as well as into DP-200 as part of a renewal process currently ongoing with NMED.

2.1.4.2 OU2

Remedial activities under OU2 are being addressed by the NRC under 10 CFR 40, Appendix A. HMC submitted a revised reclamation plan for the site in 1993, and this document serves as an additional update to address activities on the final decommissioning and reclamation activities for NRC approval. The final DRP will be implemented to meet the technical requirements of 10 CFR 40, Appendix A and conform to EPA standards in 40 CFR 192.

Issues associated with removal of the HMC site from the NPL are discussed in **Section 2.1.4.5**.

2.1.4.3 OU3

A Record of Decision (ROD) for OU3 was signed by the EPA on September 27, 1989, with the final selected remedial action being that no further action was required. However, the decision presented in the ROD did not constitute a finding by the EPA that adequate protection had been achieved within the neighboring subdivisions. Based on sampling of the soils and air in the neighboring subdivisions, the EPA continues to review outdoor air monitoring and particulate data collected at the site boundary. Under CERCLA, EPA may reopen the administrative record to include new information. The EPA has been collecting air and soil sampling data in support of the development of a Human Health Risk Assessment, which includes both indoor and outdoor radon samples. A final Human Health Risk Assessment was expected to be

issued by the EPA in the spring of 2012 (EPA 2011a). The current understanding is that the report will be issued in early 2013. Therefore, determination of the protectiveness of the OU3 remedy will be deferred until the risk assessment report is completed.

2.1.4.4 HMC Responses to Recommendations in EPA Third Five-Year Review

Table 2 of the EPA Third Five-Year Review report presented recommendations and follow-up actions for the Grants Reclamation site. This table presents milestones for addressing the recommendation/follow-up action of the different issues.

HMC provided a status update on responses or investigation/evaluations that HMC has undertaken to date (as of September 2012) with respect to Table 2 of the Five-Year Review (HMC 2012c). These responses specifically addressed Issue No. 2 under OU1 and Issue Nos. 1 and 2 under OU2 based on the milestone date of September 2012 for reporting the status or investigation/resolution of the issues described (HMC 2012c). HMC responses to Issue No. 2 of OU1 and Issue Nos. 1 and 2 of OU2 are presented below.

Issue No. 1 under OU1

Recommendations/Follow-up Action: ..."*Minimize use of clean water and develop alternate source such as treatment of extracted groundwater for use in injection into the alluvial and Chinle Formation aquifers remedy.*"

Current Status/Response: This issue points out EPA's concern of potential downward migration of contaminants associated with the extraction of large quantities of water from the San Andres Formation and subsequent injection, primarily into the alluvial aquifer. HMC will address Issue No. 1 of OU1 with respect to meeting the milestone date of September 2014. HMC's response is currently pending.

Issue No. 2 under OU1

Recommendations/Follow-up Action: ..."*Conduct a pilot study in a portion of the large tailings pile to demonstrate that rebound will not occur once the flushing program has ended. The earthquake stability analysis should be reevaluated to account for the increased fluid-filled pore space resulting from the tailings flushing program. The protectiveness is dependent on a revised earthquake-risk analysis.*"

Current Status/Response: A tailings pile rebound study was initiated in late 2011 for the purposes of characterizing the geochemical environment under post-flushing

conditions in the LTP, specifically with regard to potential for rebound in constituents of concern (COC) concentrations. A 6-acre area of the LTP was shut down in 2010 in terms of the ongoing tailing pile flushing program; this area was targeted for the first rebound study site. A dissolved gas tracer (SF6) study was initiated in the area, and monitoring was conducted to understand the flow and transport dynamics of the study area. Monitoring of the test area continues to date to observe long-term trends in concentrations for uranium, molybdenum, selenium, total dissolved solids (TDS), and other geochemical parameters. This monitoring at the test site will likely continue into 2013.

Additionally, a cone penetrometer test (CPT) was conducted on the tailing pile in mid-2012 to further refine and characterize the tailings and physical properties/grain size with depth in the current rebound monitoring area and surrounding areas.

A second, and possibly third, tracer test is under consideration at present in the LTP to focus on area(s) where the tailings matrix is more defined by lower permeability slimes. Additional monitoring wells in the LTP will likely be installed for these additional test areas to assure appropriate monitoring of the test area for potential rebound effects.

As all of the above test work is focused on geochemical rebound potential, monitoring will be required well into 2013 to understand longer-term response effects.

The following discussion considers revisiting the LTP earthquake stability analysis for purposes of accounting for an increase in fluid-filled pore space (rise in phreatic surface) due to the flushing program.

The potential effect of the flushing program on stability was recognized by HMC as part of its annual stability assessment in 2009. Homestake commissioned a stability analysis that examined the impact of the increased phreatic surface, which had reached its maximum level in 2009 (Kuhn 2010). The report entitled "Stability Analysis of the Large Tailing Impoundment, Homestake Grants Project, Grants, New Mexico" File No. 16977.07.2-ALB10RP001, dated January 21, 2010, is available for examination. The stability analysis was conducted under the direction of Dr. Alan Kuhn, PE who has been the Responsible Engineer for tailings pile stability at the site since 1980.

The stability analysis examined the two most critical sections of the pile, where the phreatic levels were highest and closest to the slopes. These sections are in the middle of the north and south pile slopes. Both static and pseudostatic (earthquake)

load conditions were modeled using the computer code SLIDE™. Global failure surfaces involving both the entire slope and shallower failure surfaces within the slope were analyzed. Pseudostatic analyses used a peak ground acceleration, or seismic coefficient, of 0.1g, a conservative value compared to the current (2008) U.S. Geological Survey (USGS) seismic risk hazard assessment (Petersen et al. 2008, which assigns values of 0.04 to 0.08 to the Grants, NM area).

The stability analysis showed that the lowest factors of safety were 2.3 and 2.0 for static and pseudostatic loading, respectively, in the north slope and 2.1 and 1.8, respectively, for the south slope. No universally recognized minimum factors of safety apply to tailings piles that don't impound water, but most dam management or regulatory agencies accept minimum factors of safety of 1.5 and 1.0 for water-impounding dams. By this standard, the HMC LTP stability is substantially above the minimum factor of safety, even with the maximal phreatic levels observed in the pile in 2009.

Issue No. 1 under Operable Unit 2 (OU-2)

Recommendations/Follow-up Action: *..."Determine whether a remnant of the large tailings pile contaminant plume is continuing to impact groundwater. Investigate the backfilled irrigation ditch that ran through the HMC property to determine whether it serves as a preferential pathway for the migration of leached contaminants to groundwater."*

Current Status/Response: This recommendation/follow-up action speculates that elevated uranium or other COCs in groundwater south of the former mill site may be attributable to, or connected to, an old pre-mill irrigation ditch. A regional geological map (Gordon 1961) is apparently the only source of information used by EPA for the location of this ditch. No information was provided on the width or depth of the ditch, but based on its termination in the field south of the old mill and the typical size of similar ditches elsewhere in New Mexico, the ditch was only a few feet wide and deep. During the construction of the mill in the 1950s, the ground along this ditch would have been significantly disturbed, backfilled where necessary, and graded, leaving no surface expression of the ditch. Later, during reclamation of the mill site in 1993 through 1995, surface soils were extensively removed, again erasing surface features that were not part of the grading plan. No observable remnants of the ditch were observed during reclamation.

Based on the Gordon 1961 map and the known locations of the mills and tailings piles (Gordon 1961), we have concluded that the route of the ditch lay east of the

tailings piles and probably passed through the areas where the mills were located. When the mills were demolished, the mill areas were decontaminated, including excavation of soil containing excessive levels of uranium and radium followed by confirmation gamma surveys and soil sample tests. Because of the small dimensions of the original ditch and the modifications and restoration of the ground surface, any remnants of the ditch are not expected to be distinguishable from the rest of the ground in the mill area.

In summary, the historical record of the mill contains no information, coupled with subsequent mill site area reclamation and post-reclamation gamma surveys of the reclaimed area that indicated no radiological anomalies, to support the speculation that the old irrigation ditch plays any part in the movement of contaminated groundwater on the HMC site. The existing sources are separated laterally from the route of the old ditch by substantial distances of unsaturated soil; therefore, horizontal movement of contaminants to and along the ditch location is not a reasonable scenario. The movement of uranium or other COCs in groundwater has been investigated and well documented for 35 years, and remediation activities being conducted by HMC are making progress. Thus, a study of the old ditch would add nothing of value to the characterization of the site contamination, nor would it change the groundwater restoration plan.

Issue No. 2 under OU2

Recommendations/Follow-up Action: *..."Provide some type of native vegetative cover or erosion-protection cover to the east side slope of the small tailings pile/Evaporation Pond 1 and the west side of the westernmost collection pond to prevent erosion."*

Current Status/Response: With respect to the side slopes of the STP, these areas are composed of interim radon barrier soil cover until final reclamation and site closure of the facility is completed at the end of the current ongoing groundwater remediation program for the site. To date, periodic maintenance of the side slopes has been accomplished by mechanically re-placing and/or augmenting the interim cover as needed to address rill or gully erosion effects; no attempt has been made to establish vegetative cover or other physical erosion protection measures.

Physical erosion control barriers, such as jute netting, erosion blankets, silt fencing, straw bales, wattles and coir logs, or other similar approaches have not been employed to date at the site, recognizing that physical maintenance of the

slopes will be required from time to time. Periodic maintenance of the slopes with such barriers in place would result in intensive maintenance of the erosion measures and significant labor when soil replacement or re-covering work is required.

Vegetative cover could be established; however, experience has shown that establishing permanent vegetative grass cover is difficult due to site slope conditions and the erosive nature of the cover soil. The evaporation and collection ponds, including outer side slopes, are considered "dams" from a State Engineer regulatory perspective, and therefore brush or tree-type vegetation on the outer slopes requires removal. To date, intensive efforts at establishing permanent grass cover on the slopes in question has not been attempted.

In response to evaluating what options might improve the current situation, HMC recently initiated a number of test plot studies to evaluate various soil stabilizer products intended to control wind- and precipitation-induced soil erosion. Two test plot areas were commissioned in early August 2012; one test site consisting of 10 plots was placed on the LTP top and the other site consists of nine plots placed on the eastern out slope of the STP adjacent to Evaporation Pond #1. Each test site is intended to evaluate five different polymer and/or lignin-based soil stabilizer products with different strength formulations of the applied material. Visual monitoring is underway at present by the vendor/consultant at each test site and will continue through the winter 2012/13 season. Depending upon the effectiveness of the soil stabilizer trial plots, consideration may be given to applying one of these products to the out slope areas of the STP and the collection ponds areas.

2.1.4.5 Removal from NPL

Upon completion of groundwater restoration and site decommissioning and reclamation in compliance with 10 CFR Part 40, per 40 CFR Parts 300.425 (e) and 300.515(c)(3), and in consultation with the State of New Mexico, EPA will determine whether required response actions have been implemented to meet CERCLA requirements. The site may then be considered for deletion from the NPL (Meyer 2010).

In order to delete the site from the NPL, the EPA must determine, based on the deletion docket, that one of the following criteria have been met (EPA 2011c):

- The responsible party under CERCLA or other designated party(s) has implemented all appropriate response actions required.

- All appropriate fund-financed response under CERCLA has been implemented, and no further response action by the responsible party is appropriate.
- The Remedial Investigation (RI) has shown that the release poses no significant threat to public health or the environment; therefore, taking of remedial measures is not appropriate.

In a letter from the EPA to the NRC dated December 13, 2011, the EPA advised the NRC that the agency believed a ROD was necessary to deliver the agency's determination that appropriate response actions have been implemented for OU1 and OU 2 (EPA 2011b). At a June 7, 2012 public meeting on HMC's groundwater Updated CAP activities, the NRC reported that the EPA was reexamining the need to prepare RODs for OU1 and OU2 (Camper 2012). By letter dated August 7, 2012, the EPA advised the NRC that the agency will require one or more RODs for OU1 and OU2 to document findings pre-requisite to site deletion from the NPL in the future (EPA 2012a). The EPA is of the opinion that the RODs will ensure that CERCLA responses have been adequately followed to arrive at the current remedy in place and that substantive CERCLA standards have been met. The EPA issued revised requirements for the December 13, 2011 site deletion requirements at the HMC Grants superfund site on October 30, 2012 (EPA 2012b).

The agency does not believe that the decision to issue one or more RODs for OU1 and OU2 will hinder NRC's Corrective Action Plan process at the HMC site. The EPA does not believe this action falls within the framework of the existing MOU between the NRC and EPA, and modification of the MOU is not necessary at this time. However, the NRC has indicated that, in an effort to update the MOU, NRC will be proposing administrative changes to the MOU in the near future (NRC 2012a).

In producing one or more RODs, the EPA will consider the use of CERCLA-equivalent documents (or information and analysis contained in such documents) for remedial investigation/feasibility study (RI/FS) and remedial design (RD) that HMC may have already generated pursuant to NRC closure requirements (EPA 2011b). If equivalent documents do not exist, the EPA will be required to compile this information to satisfy CERCLA criteria. The EPA has furnished the NRC with their requirements for HMC site deletion (EPA 2011b). It is anticipated that the EPA will delete the site from the NPL when the groundwater Updated CAP and DRP have been completed and approved by the NRC and the agency agrees that CERCLA requirements have been achieved. As groundwater restoration and reclamation and decommissioning plans evolve, efforts have been made to ensure that information available to the EPA is

consistent with the sections of the recommended remedial action report contents and the recommended final close-out report outline identified in the EPA's guidance document for close-out procedures for NPL sites (EPA 2011c). HMC will also use any additional information provided by the NRC and EPA in addressing issues critical to NPL delisting. It is understood that remedial and decommissioning tasks will have to be completed in full compliance with 10 CFR 40, Appendix A before the EPA, pursuant to 40 CFR Parts 300.425(e) and 300.515(c) (3), and in consultation with the NMED, can determine NPL delisting.

2.2 License History

2.2.1 Operational History

Uranium milling operations that produced uranium concentrate at the Grants site began in 1958 and were terminated in February 1990. Milling facilities were originally constructed and operated as two distinct partnerships, with HMC acting as the managing partner of both. The smaller mill was organized as Homestake-New Mexico Partners, with a nominal milling capacity of 750 tpd. The larger of the two mills was organized as Homestake-Sapin Partners, with a nominal milling capacity of 1,750 tpd. The smaller mill started processing ore in April 1958, and the larger mill in May 1958. Both mills employed alkaline leach circuits, concentrating uranium oxide from ores with average grades of 0.05 to 0.30 percent uranium oxide (U_3O_8). The smaller mill only operated until 1961, when the two milling operations were combined, resulting in a single mill with a nominal throughput capacity of 3,400 tpd. The Homestake-Sapin Partners Mill continued to use a portion of the smaller mill's facilities. In April 1986, United Nuclear Corporation acquired an interest in the partnership, and the operation became known as United Nuclear-Homestake Partners. United Nuclear's interest was purchased by HMC in March 1981, and the operation became Homestake Mining Company – Grants. In 2001, HMC merged with Barrick Gold Corporation as a wholly owned subsidiary.

The feed ore into HMC's mill(s) came from many sources, some company owned, others owned by outside organizations. The main supply of ore over the years came from five mines owned by HMC in the Ambrosia Lake District in McKinley County, New Mexico. The ore was mined from depths of about 400 to 800 feet below the surface. These mines went into production in 1957 and 1958. All of HMC's Ambrosia Lake mines were reclaimed in 1992. Ore was also shipped from the open-pit Homestake Pitch Mine in south-central Colorado.

A schematic of the mill process flow diagram is depicted on **Figure 2.2-1**. The facilities that existed at the mill site at the time of the mill shutdown in 1990 are illustrated on **Figure 2.1-2.**

A brief description of the mill process is as follows:

1. During mill operations, ore was stockpiled at the ore pad north of the mill. Each truckload of ore was weighed and sampled for uranium content when it arrived at the mill. The ore was then stockpiled on the ore pad until it could be crushed. In the crushing section, the ore was run through an impact breaker and a series of sizing screens which reduced the ore size to a particle size of approximately 5/8 inch. The crushed ore was then stored in one of four ore storage bins. The mill, with a processing capacity of up to 3400 tpd, used an alkaline process to leach uranium from the ore.
2. Actual processing of the uranium ore commenced when it entered the grinding circuit. The ore was mixed with bicarbonate mill solution in 10-foot diameter ball mills and was ground to 10 percent + 48 mesh in size. Sodium carbonate solution was added to the grinding circuit slurry mixture for leaching purposes.
3. The uranium was extracted from the ore in the leach circuit where the ore was processed through a series of heated and pressurized autoclaves (digesters). The pressure in the autoclaves was 60 pounds per square inch (psi) with a temperature of 200° F. During the leaching process, the slurry was constantly mixed in the tanks and air, necessary for oxidation, was fed into the bottom of the autoclaves. To further enhance uranium extraction, the slurry was then pumped into Pachuca tanks, where additional leaching occurred at atmospheric pressure and 170° F. Air was fed into the bottom of the 150-ton Pachuca tanks (air-agitated, solid-liquid mixing vessel) to provide additional oxidation. Rotary drum vacuum filters were used for dewatering the slurry. During the filtering process, recycled water from other parts of the process was used as wash water. When filtering and washing were completed, the waste solids were pumped to the tailings facility for disposal, and the uranium-bearing pregnant solution was pumped to the precipitation circuit for further processing.
4. Sodium hydroxide was added to the pregnant solution, which caused the yellowcake to precipitate out of solution. At that point, vanadium, sodium, and carbonate were removed from the yellowcake. This was accomplished by first roasting the yellowcake at about 1,700° F, then leaching the contaminants out with water. The yellowcake was then re-dissolved with

sulfuric acid in an agitator tank. The overflow from these wash tanks discharged into another tank where ammonia was added. The uranium re-precipitated as yellowcake containing less than 0.5 percent sodium and other contaminants, and was filtered and washed before being dried and packaged.

5. An ion exchange plant was used to extract uranium from solution recycled back to the mill from the tailings facility. The uranium recovered by this technique was also processed in the mill precipitation circuit.
6. The dried yellowcake was packaged in powder form in 55-gallon drums and was transported by trucks to uranium hexafluoride (UF_6) conversion facilities (i.e., Sequoia Fuels and Allied Chemical) for further upgrade and processing into fuel pellets for nuclear-powered electricity-generating facilities.

A detailed summary of the mill operation, including process chemistry and tailings characteristics, is provided in Appendix B of the HMC Updated CAP (HMC 2012b). The schematic of the mill process flow diagram is shown in **Figure 2.2-1**.

As discussed above, two tailings piles were developed on the Grants site. The first and smaller of the two piles (STP) contains tailings from ore milled under contracts with the federal government. The total quantity of tailings placed in the STP was 1.22 million tons. It is located in the SE ¼ and SW ¼ of Section 26, Township 12 North, Range 10 West, NMPM. Tailings deposited within this pile were contained entirely by an embankment composed of compacted natural soils. The embankment was compacted by heavy equipment and raised to a height of 20 to 25 feet. The crest was a minimum of 10 feet wide, with the base being approximately 40 feet wide. The pile covers an area of about 40 acres. In 1990, EP-1 was constructed in the STP to assist in the dewatering of the LTP and to hold water pumped from the collection wells associated with the groundwater remediation program. More recently, this evaporation pond, along with other lined ponds constructed nearby, have been used to evaporate the brine from the RO WTS and other wastewater generated as part of the groundwater remediation program.

The LTP, located in the N ½, Section 26, Township 12 North, Range 10 West, NMPM, contains tailings from ore milled under both federal government and commercial contracts. The total quantity of tailings generated under AEC contracts was 11.41 million tons. Another 10.89 million tons of commercial tailings were generated and commingled with the AEC tailings. Until 1966, HMC deposited tailing material into only one cell of the LTP. Subsequently, HMC added an additional cell adjacent to and west of the existing cell. From 1966 until 1990, tailings disposal alternated between the two

cells (east and west) as necessary to maintain optimal operating conditions. The starter dike for the LTP was constructed in compacted 6-inch lifts of natural soils excavated from within the LTP area. The dike was constructed to a height of approximately 10 feet and a width of approximately 10 to 15 feet at the top and 25 to 30 feet at the bottom. The pile's perimeter embankment was raised by the centerline method until 1981, when an inboard offset of the embankment was made to improve the tailings pile stability. Subsequent lifts were added to the offset perimeter embankment by the centerline method. The LTP presently covers approximately 215 acres and is approximately 85 to 90 feet high. There were east and west tailings collection areas within the LTP that covered approximately 125 and 90 acres, respectively, as measured from the toe to the edge of the reclaimed pile.

Throughout most of its operation, the LTP was constructed by splitting the slurried mill tailings into coarse and fine fraction using a cyclone separator. The coarse fraction was hydraulically placed along the centerline and outslope in order to build out the area within the LTP by the centerline method. The fine portion of tailings was discharged across the beach toward the center in each cell. Mill tailings are composed of uranium-depleted fine and coarse sand fractions and slimes consisting of minus No. 200 mesh-sized materials. The clarified liquid discharged into the LTP was recycled through decant towers back to the mill for reuse as process water. During the latter stages of mill operations, when production rates were low, cyclone separation was not used, and the tailing slurry was discharged directly across the beaches into the LTP. This method of operation confined disposal to a single pond at a time, with the other pond used for evaporation as needed. The LTP received 21.05 million tons of tailings. HMC discontinued milling operations in February 1990. About 82.5 million pounds of uranium were produced (HMC 1993b).

2.2.2 Completed Reclamation/Decommissioning Activities

In January 1991, HMC submitted a proposed tailings reclamation and milling decommissioning plan to the NRC (AKG et al. 1991). This plan revised and updated the 1986 plan (Kuhn and Jenkins 1986) in order to address comments from the NRC. On January 11 and March 16, 1993, HMC provided additional information regarding the HMC site environment and environmental impacts of the proposed site closure plan to the NRC (Craft 1993a and 1993b). On October 29, 1993, HMC submitted an Updated Reclamation Plan that superseded the 1991 submittal (AKG and Jenkins 1993a and 1993b). Milling operations ceased on February 2, 1990. The ion exchange system (National Institute of Metallurgy [now Mintek] Column Ion Exchange [NIMCIX]) was operated until April 10, 1990 when it was shut down, cleaned, and placed back into operation mid-May, 1990. It continued to operate, removing uranium and other

constituents from groundwater until November 21, 1990, with the eluate solution from the NIMCIX operation being sold to the Quivira Mining Company.

The major cleanup actions that occurred during Phase 1 of the decommissioning and reclamation of the site (1993 through 1996) are summarized in **Table 2.2-1.** Further cleanup of the site has been extended due to the lengthy process of groundwater restoration.

Mill decommissioning and reclamation activities for soil cleanup began in September 1993. Mill decommissioning, surface reclamation and remediation, stabilization of the tailings piles, and site closure have been conducted under the direction of the NRC as per the approved Reclamation Plan Revision October 1993 as amended, and License Condition Nos. 29, 36, and 37 (AKG and Jenkins 1993a and 1993b; NRC 1992, 1993a, and 1993b). HMC's requests for a reduction in the radon barrier thickness for the LTP and STP were approved by the NRC in 1995 and 1997 (License Amendments 22 [License Condition 37A] and 27 [License Condition 37B]) respectively, (see discussions in **Section 2.2.2.2**).

The mill facilities are described in detail in Sections 1.2 and 1.3 of the Reclamation Plan, October 1993 Revision (AKG and Jenkins 1993a).

Homestake's Mine Ion Exchange (IX) plant (Mine IX Plant) was located adjacent to the Homestake Section 25 Uranium Mine facilities. The Mine IX Plant was used to extract uranium from water that pumped from nearby uranium mines. The facility operated under the same license as the uranium mill. Decommissioning activities began in August 1991 and were completed in August 1992, in accordance with 10 CFR Part 40, Appendix A. The demolition debris and contaminated soils were transported to the mill site for subsequent burial, and the 5-acre plant site has been reclaimed (HMC 1997).

2.2.2.1 Mill Decommissioning and Reclamation History

The mill facilities and major pieces of equipment decommissioned between 1993 and 1995 are shown on **Figure 2.2-2**. Completed mill decommissioning activities are discussed in HMC's 1996 Completion Report for mill decommissioning (AKG 1996). The Completion Report was approved by the NRC on January 28, 1999 by issuance of License Amendment No. 32 (NRC 1999). The mill facilities were decommissioned and demolished by several specialty contractors working under contract directly to HMC. Slurry grout was mixed, hauled, and placed in debris pits by a specialty contractor. Mill decommissioning and demolition were completed on December 10, 1995.

Health and safety radiation procedures employed during Phase 1 of decommissioning are described in Section 2.1 of the 1993 Reclamation Plan (AKG and Jenkins 1993a and 1993b). All radiological training, monitoring, sample collection, and recordkeeping were performed by HMC personnel under the direction of the site Radiation Protection Administrator (RPA). The HMC uranium mill facilities were decommissioned under the guidance of Radiation Work Permits (RWPs) developed in accordance with NRC License Condition 24 and with the programs listed in License Condition 10 pertaining to ALARA, quality assurance, bioassay, respirator protection, emission control, and monitoring programs. The standard procedures established at the beginning of decommissioning are included in Appendix A of the 1993 reclamation plan (HMC 1993b). The health and safety procedure for decommissioning contained the following sections:

- Management control
- Radiation safety training
- Radiation work permits
- Radiation protection and monitoring
- Security
- Hazard control

HMC employed quality control procedures for construction activities associated with site reclamation (HMC 1994). HMC's quality control procedures (QCPs) were intended to assure that:

- Reclamation work was performed in accordance with approved plans, specifications, and practices.
- Any deviations from approved plans, specifications, or practices were identified and correctly promptly.
- Variances from approved plans, specifications, or practices were evaluated and justified sufficiently to support acceptance prior to implementation.
- Reporting and documentation provided a complete, factual record that was readily retrievable.

The QCP was in force for all activities and tasks required to achieve reclamation of the HMC Grants site. Implementation occurred at every level of the work, with responsibility for implementation as described in Section 2 of the 1993 Reclamation Plan (AKG and Jenkins 1993a and 1993b).

A brief summary of these completed decommissioning activities follows:

- On October 30, 1989, unused and waste non-radioactive hazardous chemicals and materials in the mill area were identified, and disposal of such materials at approved commercial disposal facilities commenced.
- On May 30, 1990, clean out of liquid and solid process vats, tanks, vessels, and other containers was completed.
- Byproduct materials consisting primarily of scale, sludge, and tailings in tank precipitators were removed by mechanized equipment when possible and by hand tools otherwise, loaded into trucks, and hauled to the LTP for disposal. No significant amounts of byproduct materials were disposed of within the mill area, which was ensured by removing an average of 24 inches of the mill area soil after mill decommissioning and placement in the LTP.
- Demolition activities began on May 5, 1992 with the commencement of removal of asbestos-containing materials (ACM) from various mill facilities prior to demolition by a specialty contractor. The ACM was disposed of in a disposal pit designed specifically only for asbestos waste material at the toe of the original slope of the LTP (**Figure 2.2-2**). The disposal program was approved by the NMED (NMED 1993). The location of asbestos burial was surveyed before placement of the ACM, and no ACMs were disposed of outside of the boundaries of this designated area. The contractor conducted its asbestos removal operations from May 13 through September 11, 1992 and from November 1 to November 22, 1993. Demolition activities were carried out as per the Specifications for Demolition of Uranium Mill Facilities (AKG 1993a; Appendix F).
- Following removal and disposal of ACM, mill components were tested for radioactive contamination prior to demolition. Any component with radiological contamination, as measured by alpha readings, exceeding 220,000 disintegrations per minute (dpm) was buried in the LTP (AKG 1996). Other components were decontaminated to the extent necessary to allow safe handling, broken down into manageable sizes, and buried in seven pits within the mill area or in three pits located between the LTP and the evaporation ponds. An eighth pit (located in the previous mill area) was used for burial of debris from demolition of the caustic terminal that was located outside the license boundary. Machinery that was not readily broken down and that was potentially contaminated – the yellowcake dryer and roasters – was buried in the LTP east side slope. The maintenance shop was decontaminated for continued use in supporting groundwater reclamation and final decommissioning. Less contaminated mill-related structures, including the

office building, change house, and guard house, were later demolished (March 1995) and buried in the STP.

- Heavy equipment owned and operated by an HMC contractor was used as per the contractor's approved procedures to demolish all mill structures with the exception of the shop, office building, change house, and guard house, which were left in place until March 1995 to support site reclamation and groundwater restoration operations after demolition of the major mill facilities. All remaining buildings except the buildings in the Trucking Yard (i.e., Main Office/Warehouse Building, Warehouse Building 1 [two bays], previous Ore Truck Washing Building), and Warehouse Building 2 (previous Soil Preparation Room) were demolished in March 1995, and the debris was buried in the STP or in place. The Truck Shop and Truck Storage buildings were decontaminated and released for later removal from the property.
- In general, concrete structures were broken down by steel ball, and steel and other metal structures were demolished using hydraulically powered cutting tools mounted on heavy equipment. Steel and other debris other than concrete were cut into sizes necessary for handling and subsequent disposal. To reduce personnel exposure and limit generation of fugitive dust, water sprays were used to suppress dust during demolition (typical disposal procedures are shown in photos in the mill decommissioning completion report; AKG 1996).
- Debris was placed in each disposal pit in lifts no thicker than 5 feet, after which slurry grout was poured into the pit until it had filled the voids and reached a level approximately equal to the top of the debris lift. This process was repeated until each pit was filled with debris and slurry grout to not less than 4 feet below the surrounding ground surface. The remaining portion of the pit-to-ground surface was subsequently backfilled with soils to approximately the original grade. On completion of backfilling of a pit, its corners were surveyed to accurately record the actual dimensions and location of the pit. Details of the mill and mill area decommissioning, including photos of burial disposal activities, can be found in the HMC Completion Report for mill decommissioning (AKG 1996).

Samples of slurry grout were obtained during burial of debris in disposal pits for visual examination and approval. Those samples established that the slurry grout met specified requirements, namely the sand/water/Portland cement grout formed a cemented, essentially non-compressible solid upon setting and drying. Photos and video taping, slurry grout samples, and visual observations confirmed that the grout penetrated essentially all macro-voids within the debris lifts.

An engineered erosion protection cover was placed on the mill yard and debris disposal areas.

Locations of the burial pits are shown on **Figure 2.2-2,** and the material buried in the burial pits is described in **Table 2.2-2.**

Two generators, an air compressor, and two vacuum pumps were decontaminated to allow for release to the general public and sold (AKG 1996).

Diversion Levee

As part of the mill site reclamation activities, a surface water diversion levee was constructed to the north of the mill area, and an engineered erosion protection cover was placed on the levee. Placement of diversion levee fill material began on January 23, 1995 and was completed on April 24, 1995 (Knight Piesold 1996). The diversion levee was constructed as per the Specification for Construction of the Diversion Levee (AKG 1994a; **Appendix F**). The levee was constructed of uncontaminated soils from the North Borrow Area and generally consisted of clayey sands and sandy clays. The total quantity of diversion levee fill placed and compacted was 65,880 yd^3. The slopes of the levee are protected against erosion using the same cover specified for the tailings pile top surfaces. This flood diversion levee was constructed to divert surface water discharges from the Lobo Canyon portion of the San Mateo watershed that cuts across the northeast corner of the mill site. During flood events, the levee will divert Lobo Canyon flood waters to the North Diversion Channel located north of the LTP (**Figure 2.2-9**), thereby preventing discharges from flowing across the mill area (**Figures 2.2-2** and **3.1-2**).

Rock and Soil Borrow Areas

Work for erosion protection (rock materials and placement) was carried out as per Specification for Erosion Protection – Rock Materials and Placement (AKG 1993b; **Appendix F**). HMC developed one Rock Borrow Area (quarry) and a number of soil borrow areas on HMC property adjacent or near the HMC license boundary. The locations of the rock quarry and stockpiled rock cover material are shown on **Figure 2.1-1,** and the soil primary borrow areas are depicted on **Figure 2.2-3**. The soils were used for replacement of soils removed during soil cleanup (e.g., windblown contamination, decommissioned mill area), LTP and STP backfilling, LTP recontouring, and construction of a diversion levee. The rock material was used for final cover on the side slopes and toes of the LTP, and will be used for final reclamation of the LTP and STP. The quantities of rock and soil materials from borrow areas used for site reclamation and decommissioning are shown in **Table 2.2-3**.

The erosion protection phase of construction for the Grants site began in May of 1994 with the production of rock (D50 = 1.16 inches) for use on top of the LTP and levee. Sampling and gradation of rock continued throughout the production of rock and at intervals outlined in the project specifications.

In July of 1994, the contractor also began production of rock (D50 = 5.5 inches) for use on the outslopes of the LTP. Material was stockpiled adjacent to the top rock (D50 = 1.16 inches), intended for use on top of the pile, approximately 0.5 mile east of the crusher operation (Knight Piesold 1996).

- Rock Borrow Area and Stockpile

  HMC operated a rock quarry approximately 1.0 mile to the west of the LTP on County Road #63 and was stockpiled approximately 0.5 mile east of the crusher operation (**Figure 2.1-1**). The purpose of the rock material is for rock cover on the side slopes/toe and tops of the LTP, STP, reclaimed mill area, reclaimed WDC, and any other areas requiring rock products. The approximate 120-acre rock quarry encompasses an area of El Malpais basalt lava outcrops. Rock material has been stockpiled for use in final reclamation and decommissioning activities (**Figure 2.1-1**).

- Soil Borrow Areas

  There are four major borrow areas for soils used in the reclamation/decommissioning of areas within the license boundary: North Borrow Area, Northwest Borrow Area, West Borrow Area, and East Borrow Area (**Figure 2.2-3**).

  Borrow area investigations and laboratory analyses were performed between 1986 and 1992 (Knight Piesold 1994). Results of the findings are documented in Appendix D of the 1991 Reclamation Plan (AKG et al 1991) and in the HMC submittal to the NRC in December 1992. The results of the previous investigation indicated that availability of sufficient clay in the borrow areas was limited. Based on this information, the radon barrier design was modified to consist of a clayey sand material. HMC employed a third-party consultant (Knight Piesold) to perform a field investigation to evaluate the presence of potential clay borrow sources at the Grants site. The results of this investigation were reported in a borrow investigation report that presented the field procedures, findings, and onsite laboratory results of the geochemical

investigation which targeted potential clay and clayey sand borrow sources (Knight Piesold 1994).

The borrow area investigations took place between January 18 and April 21, 1994, concentrating on the uncontaminated alluvial overburden in the general vicinity of the LTP. A material search for clayey borrow sources that met material specifications of 25 percent passing the No. 200 sieve and Atterberg limits plotting above the "A" line, as specified in Condition 37 of the NRC License SUA-1471, including the following:

- Excavation of 85 test pits in the West Borrow Area
- Excavation of 32 test pits in the Northwest Borrow Area
- Excavation of 221 test pits in the North Borrow Area
- Onsite laboratory testing of selected soil samples gathered from the test pits

Based on the results of the field and laboratory investigations, the estimated borrow area specific quantity of radon barrier material available is summarized below (Knight Piesold 1994):

- West Borrow Area 136,000 cubic yards (yd^3)
- Northwest Borrow Area 178,000 yd^3
- North Borrow Area 1,470,000 yd^3

The methods followed during site field and laboratory work and results of the site investigation are discussed in the 1994 borrow investigation report (Knight Piesold 1994).

Prior to excavation and placement of uncontaminated materials on the LTP and other reclaimed areas, the selected borrow areas were stripped of all organic materials and sampled to evaluate the presence of residual radioactive contamination (Knight Piesold 1996). Borrow sources were investigated for contamination by HMC through radioactive testing methods (ERG 1995). Any soil containing more than 5 pCi/g of radium-226 above background (5.5 pCi/g for surface soils), which resulted in a site background concentration of 10.5 pCi/g, was considered contaminated. Borrow soils with a background radium content of not more than 10.5 pCi/g was not considered contaminated soil, unless any excess concentrations were demonstrated (by soil tests) to be naturally occurring radium and uranium. Based on the results of the testing,

specific borrow areas were designated as contaminated or uncontaminated (clean) materials. If residual contamination was present, the contaminated areas would be removed and retested. These respective borrow areas were not used as uncontaminated sources until test results yielded concentrations below 10.5 pCi/g of radium-226 (Knight Piesold 1996).

Contaminated borrow and fill used for recontouring the LTP was generally obtained from the main pile within the borrow area, predetermined contaminated zones, and windblown areas. Contaminated materials encountered generally ranged in character from silty sands to sandy clay.

Uncontaminated borrow materials were excavated from predetermined clean borrow areas and generally consisted of clayey sands and clays (Knight Piesold 1996). The placement of uncontaminated soil provided a clean working surface over the existing contaminated material, thereby minimizing potential cross-contamination. In addition, these zones also allowed for "clean" access for placement or reclamation materials. Prior to excavation and placement, clean borrow materials were preconditioned by using water sprinklers and water trucks. Samples of materials removed during excavation operations were tested to characterize the material as fill placement progressed. Testing and resulting properties of these samples are discussed in Knight Piesold's interim construction and quality control report (Knight Piesold 1996).

A significant amount of dust control was required during excavation and placement activities. Dust control was accomplished using water trucks and water wagons as conditions warranted.

- West Borrow Area

  The West Borrow Area is located in an area immediately to the west of the LTP (primarily in the NE¼ of Section 27 of T12N R10W), and occupies approximately 142 acres (**Figure 2.2-3**). The disturbed areas of the borrow area were recontoured and reseeded, and vegetation was reestablished.

- Northwest Borrow Area

  The Northwest Borrow Area is located at the northwest corner of the LTP primarily in the S½ of SE¼ of Section 22 of T12N R10W (**Figure 2.2-3**),

and occupies approximately 29 acres. The disturbed areas of the borrow area have been recontoured and reseeded, and vegetation was reestablished.

- North Borrow Area

The North Borrow Area is located to the north of the LTP, primarily in Section 23 of T12N R10W and SW¼ of Section 24 of T12N R10W. (**Figure 2.2-3**), and occupies approximately 788 acres. The disturbed areas of the borrow area have been recontoured and reseeded, and vegetation was reestablished.

- East Borrow Area

The East Borrow Area is located due east of the old mill area and Hwy 605 (**Figure 2.2-3**). The borrow area is located in Sections 24 and 25 of T12N R10W and occupies an area of approximately 419 acres. The disturbed areas of the borrow area have been recontoured and reseeded, and vegetation was reestablished. There are no current plans for additional mining of gravel from the East Borrow Area.

The majority of the soil to be used for final reclamation and decommissioning of the site is expected to come from the North Borrow Area. However, materials from other borrow areas with characterization acceptable to the NRC may be used if needed. The current final radon barrier designs for the LTP and STP, approved by License Conditions 37 A. and B., respectively, require the use of North Borrow Area material. Therefore, any use of material from alternate borrow areas will require updates to the designs and amendments to License Conditions 37 A. and B.

HMC regraded and revegetated the areas of the mill site, soil borrow areas, and areas of contaminated soil cleanup as per Specification for Site Regrading and Revegetation (AKG 1994b; Appendix F) (**Figure 2.2-4**). The site was regraded to minimize surface irregularities and to provide positive drainage of runoff from and across the site. The regraded and other disturbed areas other than the tailings piles were revegetated, and vegetation was reestablished.

Completion of Mill Site Decommissioning

Actual mill demolition activities began October 25, 1993 and were completed on March 8, 1994. Mill equipment and buildings were demolished and, with the exception of several large pieces of mill equipment, disposed of in onsite burial pits. Following mill

demolition, contaminated soils remaining in the mill area were removed by HMC's contractor and placed on the east end of the LTP. An average of 24 inches of soil was removed, which rendered the radioactive material content in soils to near background concentrations. The soils contaminated by windblown tailings and other byproduct materials on and around the Grants site were removed and disposed of as per Specification for Excavation and Disposal of Contaminated Soil (AKG 1994c; Appendix F).

After removal of contaminated soil, the mill area was checked for radon flux using charcoal canisters by a method equivalent to method 115 of 40 CFR 61 (NRC 1995a). These measurements were made on May 21 and 22, 1994 and documented in the report titled "Radon Flux Characterization of the Remediated Mill Site at the Grants Uranium Mill" by Environmental Restoration Group Inc., June 1994. The average of all flux values was 5.6 picoCuries per square meter per second (pCi/m^2s), well below the 20 pCi/m^2s limit required by 10 CFR 40, Appendix A. A 24-inch layer of clean soil was then placed on the mill area to restore the area to the original grade. Replacement of mill cover material began on June 6, 1995 and was completed on December 10, 1995 (Knight Piesold 1996). The materials placed were composed of clean fill obtained from the East Borrow Area and generally consisted of silty sands. The total quantity of mill cover material placed and compacted was 99,364 yd^3. The final grades of the mill cover surface were originally designed to limit probable maximum precipitation (PMP) peak runoff shear stress to not more than the allowable stress for gravelly soil (AKG 1995). However, when the supply of gravelly sand from the East Borrow Area was exhausted, a switch had to be made to silty sand; crushed basalt had to be added to the top lift of the soil cover to provide the erosion protection that had been lost when the gravelly sand was no longer available (AKG 1998). Crushed basalt rock was mixed into the top lift of this soil cover as per Amendment No. 1 of the Specification for Construction of Soil Cover over Mill Area and Disposal Pits (AKG 1995; Appendix F). Crushed basalt rock was applied in a single lift of 2 to 6 inches, then mixed with the underlying soil to a depth of not more than two times the rock lift thickness.

Demolition of the mill and surface reclamation were completed in December 1995.

The final configuration of the mill area and cover was the result, in part, of conditions that changed over the course of reclamation, driven by the contaminated soil cleanup program (AKG 1998). The cleanup program produced much more contaminated soil to place on the east side of the LTP than was initially estimated. The east slope advanced eastward enough that it necessitated repositioning the diversion levee and it impacted mill area cover placements and gradients on the north half of the mill area.

The final position of the LTP toe and, therefore, the final extent and surface slopes of the mill area cover, were in a state of flux until about mid-1995, when the mill cover was placed. It was only after the final mill soil cover surface was developed that the rock could be selected for the rock/soil mixture of the top cover lift. The rock available consisted of 0.5- to 1.5-inch rock. The larger rock was used on surfaces with gradients generally greater than 0.017 or at the downstream end of longer slopes. The smaller rock was used on surfaces with gradients less than 0.017. Final surfaces were surveyed to determine gradients and locations of larger and smaller rock. Quality control of both earthwork and rock in the mill cover construction was performed and completely documented by a third-party engineering firm responsible for construction quality control (CQC; AKG 1998).

On March 7, 1996, HMC submitted a completion report to the NRC for the site decommissioning activities and an amendment request for deleting License Condition 29, which specified applicable decommissioning requirements (NRC 1999).

Current assets at the mill site used as part of the ongoing groundwater restoration project are identified in **Section 2.1.2**. Contaminated soils associated with remaining decommissioning activities will be addressed after the groundwater restoration project has been completed (see further discussions in **Section 9.8**).

Based on a review of HMC's completion reports for off-pile areas (ERG 1995), mill decommissioning (AKG 1996), and soil cleanup and verification (HMC 1995a), the NRC determined that the cleanup of soil and buildings at the mill site met applicable standards in 10 CFR Part 40 and applicable license conditions (NRC 1999). Source Material License SUA-1471 was amended to clarify completion of decommissioning as stated in License SUA-1471 and to identify remaining reclamation and decommissioning activities associated with the ongoing groundwater restoration program.

Reclamation of Off-Pile Windblown Tailings Contaminated Areas

In 1987, HMC committed to a contaminated soil cleanup effort in which COC concentrations in soil materials exceeding 5 pCi/gm above background in the top 15 cm would be returned to the tailings facility (HMC 1987). The cleanup of windblown contaminated soils began early in 1988 (ERG 1995). A February 16, 1989 plan approved by the NRC as License Condition No.19 committed HMC to remediating certain areas near the tailings piles that exceeded the 10.5 pCi/g cleanup criteria for radium-226 (ERG 1995). There was a period of inaction during soil cleanup due to site decommissioning activities. After the mill decommissioning was complete, cleanup of

the windblown contamination and other off-pile contaminated materials resumed in 1993 using cleanup criteria and verification procedures specified in License Condition 29C, issued on August 25, 1993. Areas to be covered with clean materials were verified according to the NRC-approved procedure applicable at the time. As surveys using global positioning systems (GPS) became available, a revised verification and sampling plan was submitted on September 15, 1994. A new verification plan was approved by the NRC on March 1, 1995 via License Amendment 20 (revised License Condition 29), as amended by a subsequent submittal on December 13, 1994. Approved verification and sampling procedures used for the cleanup are included in Appendix A of the Completion Report for the reclamation of the off-pile areas (ERG 1995).

Cleanup continued through 1994 and 1995, with the final verification completed on September 20, 1995. The cleanup of windblown contaminated soils at the mill site was conducted in accordance with NRC-approved procedures. The mill soil cover was constructed as per Specification for Construction of Soil Cover Over Mill area and Disposal Pits (AKG 1995; **Appendix F**). The cleanup criteria used for the site are specified in 10 CFR Part 40, Appendix A, Criterion 6. The radium-226 cleanup level for land, averaged over 100 m^2, may not exceed the background layers by more than 5 pCi/g in the top 15 cm layer beneath the surface. For 15 cm layers at a depth of more than 15 cm below the surface, the average radium-226 concentration is limited to 15 pCi/g above natural background levels. Therefore, the cleanup criteria for the HMC site limits the radium-226 concentration to 10.5 pCi/g and 20.5 pCi/g for the surface and subsurface 15 cm thick layers, respectively (ERG 1995).

For areas not meeting the soil cleanup levels, the radon emissions must be limited to 20 pCi/m^2s, and the area must meet the criterion for longevity of stabilization.

Surface soils from approximately 1,200 acres of land were removed and consolidated with the tailings in the tailings piles (**Figure 2.2-4**). Most of the material was placed on the eastern side slope of the LTP, but significant quantities were placed on the southern end of the STP and the aprons of the LTP.

Specific areas verified for soil cleanup included the following (ERG 1995):

- Trucking Yard area
- North toe area
- West toe area
- Ore spillage area near the north ore storage pad

- Road rights-of-way (State Highway 605 and County Road #63)
- Inner and outer zones used for soil verification (grid blocks established by GPS-based radiological survey data).

Excluded from the cleanup were the tailings piles, evaporation and water collection ponds, and the debris disposal pits. The soil excavation and cleanup verification zones are shown in **Figure 2.2-4.**

The Trucking Yard (currently referred to as the Administration Compound) area was included in this cleanup. The contaminated soils within the Trucking Yard were removed and replaced with fill material on September 15, 1994. The materials placed at the Trucking Yard were composed of clean fill obtained from the East Borrow Area and generally consisted of clayey sands (Knight Piesold 1996).

Prior to excavation and replacement of material on the ore pad, the surficial soils were sampled to evaluate the presence of residual radioactive contamination. If residual contamination existed, the contaminated areas were removed, and the exposed surface was retested prior to placement of clean borrow materials. Clean fill materials were obtained from the North Borrow Area and generally consisted of clayey sands. Replacement of ore pad fill material began on November 10, 1994 and was completed on March 23, 1995 (Knight Piesold 1996).

Temporary cover material was placed on the eastern extension of the LTP in order to contain the contaminated windblown material until the final radon barrier cover is installed. Materials placed consisted of clean fill material from the North Borrow Area and generally classified as clayey sands and sandy clay. The total quantity of temporary cover placed and compacted was 64,226 yd^3. The placement of the temporary cover fill material began on December 12, 1995 and was completed on January 12, 1996 (Knight Piesold 1996).

On December 18, 1995, HMC submitted the Completion Report for the reclamation of the off-pile areas at the HMC site to the NRC (ERG 1995). The purpose of the report was to provide the results of soil sampling and gamma survey monitoring to be used for verifying that reclaimed areas meet approved cleanup standards. The only additional area that was not verified to meet the cleanup criteria was a deep pit that contained water just north of the STP. It was assumed that this difficult-to-verify area would become contaminated during the remediation of the STP. Consequently, the decision was made to verify this area after remediation at the STP was completed. The

NRC approved the Completion Report by issuing License Amendment No. 32 on January 28, 1999 (NRC 1999).

There were two zones considered for soil verification, with different approaches taken for each zone. The inner zone encompassed the area in the immediate vicinity of the LTP, STP, and mill site, as shown on **Figure 2.2-4**. All surface soil within the inner zone, excluding the tailings piles, two debris pits, and the mill site, were included in the inner zone. All areas noted as excluded have been or will be covered with fill or radon barrier as indicated in the NRC-approved October 1993 Reclamation Plan. The outer zone shown on **Figure 2.2-4** included all of the area outside of the inner zone that had been affected by windblown tailings or ore dust. The verification procedures are presented in Appendix A of the Completion Report for reclamation of the off-pile areas (ERG 1995). The Completion Report contains the verification data from a 3-year reclamation period for the cleanup as well as radium-226 results for samples of radon barrier material used as interim cover for the top of the LTP and final cover on the side slopes of the LTP. The results indicated that the radium-226 concentrations were below the 5 pCi/g plus background limit specified in the Reclamation Plan.

Site drainage was reestablished following soil cleanup activities, with the work being conducted in 1994 and 1995. This consisted of regrading drainage areas for the Grants site, including areas adjacent to the LTP, mill and ore storage areas, windblown cleanup areas, and borrow areas. Site drainage material was regraded began on February 27, 1995 (Knight Piesold 1996) and was completed within a short period of time (quality assurance records indicate no further soil placement during and after March 1995). The material placed was composed of clean fill obtained from the East Borrow Area and generally consisted of clayey sands. The total quantity of site drainage material placed and compacted was 12,440 yd^3. Site surface runoff channels that have been constructed and are planned for construction are shown on **Figure 2.2--9**.

2.2.2.2 Tailings Pile Reclamation

As previously discussed, there were two tailing piles developed on HMC's Grants site: one small (STP) and one large (LTP). The STP was operated from 1958 to 1962, and the LTP was operated from 1958 to 1990.

Small Tailing Pile

The STP resulted from early contracts with the AEC for the delivery of yellowcake to the federal government. The total quantity of tailings placed in this first and smaller pile was 1.5 million tons. Tailings material deposited within the STP was contained entirely

by an embankment composed of compacted natural soils. The embankment was compacted by heavy equipment and brought to a height of 20 to 25 feet. The crest was a minimum of 10 feet wide, with the base being approximately 40 feet wide. The STP covers an area of about 40 acres. In 1990, EP-1 was constructed in the inactive STP to assist in the dewatering of the LTP and to hold water pumped from the collection wells of the groundwater restoration program.

The STP was radiologically characterized in 1989 by pushing continuous sampling tubes on the top of the pile. The results of the tailings characterization are discussed in a final radon design report submitted to the NRC as part of a License Amendment in 1997 (ERG 1996). The STP, which contains EP-1, has been partially reclaimed but will not be fully reclaimed until the groundwater restoration program is finished and EP-1 is no longer needed. Therefore, the design for the final radon barrier was prepared on the basis of assumed conditions at the time of pond decommissioning (HMC 1996) and using methodologies and cover materials previously approved for the LTP radon barrier design (NRC 1997).

The pentagon-shaped STP holds EP-1 and a contaminated soil disposal area, both of which sit atop tailings (ERG 1996). EP-1 occupies the northern two thirds of the pile, and a contaminated disposal area (generated by off-pile contaminated soil cleanup) occupies the uppermost layer of the southern one third of the pile (**Figure 2.2-5**). At final decommissioning, the EP-1 or EP-2 basin will be reclaimed, with contaminated sediment and liners being removed and disposed of in the WDC (EP-1 and/or EP-2). After the designated WDC contaminated materials have been removed, non-contaminated soils will be used for fill in the pond basin(s) to the design grades. Planned decommissioning activities for the STP and WDC are discussed in **Section 9**.

The southern portion of the STP contains tailings slimes, which are absent to the north due to natural drainage to the south end of the pile (**Figure 2.2-6**). All visible slimes were excavated and placed in the south portion of the STP when EP-1 was constructed. The southern portion of the STP currently consists of a slimes tailings layer, a sands tailings layer, and a thick layer of windblown contaminated soils at least 16 feet thick. The clay starter dike is shown on the southern portion of the cross section on **Figure 2.2-6**. The northern end of the STP underlying the bottom of EP-1 consists of a compacted tailings sand layer (maximum thickness of 9 feet) that overlies the original natural ground surface.

After off-pile contaminated soil cleanup was completed, an interim cover was placed on the portion of the STP that was not covered by the evaporation pond in order to

decrease the potential for tailings dispersal and erosion. The interim cover was constructed as per the Specification for Construction of Interim Soil Cover on the STP (AKG 1994d; **Appendix F**). Placement of the uncontaminated interim cover began on March 31, 1995, and was completed on October 13, 1995 (Knight Piesold 1996). The 12-inch compacted interim cover material for the STP was obtained from areas around of the LTP and generally consisted of clayey sands. Quality control tests were performed to ensure that required specifications were met. An average depth of 1 foot of soil was placed on top of the STP as an interim cover and is awaiting final settlement before the final radon barrier is placed on top of the current cover. Prior to placement of the final cover on the STP, reclamation of EP-1, which is located on top of the STP, will be addressed (see **Section 9.29** for details). A design for the final STP radon barrier was submitted on April 6, 1996 (HMC 1996) and approved by the NRC in September 25, 1997 as License Amendment 27 (NRC 1997).

Large Tailing Pile

The LTP is estimated to contain 21 million tons of tailings and occupies approximately 215 acres, originally standing 85 to 90 feet tall. Reclamation efforts started in 1993 have stabilized the mass through slope grading and contouring to a configuration of 5.0 horizontal and 1.0 vertical.

The LTP was segmented into the east and west cells during mill production. The existing tailings material in the cells were saturated and unstable. Activities undertaken to stabilize the LTP began in late 1993 and were completed in 1995. The design details for the reclamation plan of the LTP are shown on **Figure 2.2-7**.

Stabilization of the LTP has included four distinct, but overlapping steps:

1. Dewatering

   Until 1993, both ponds of the LTP (east and west) contained standing water. The first step in stabilizing the LTP was the removal of the free-standing water. Although some of this water infiltrated into the tailings and became pore fluid within the tailings, most of the standing water was removed by evaporation, both natural and spray-enhanced.

   With the commencement of dewatering activities, there was a large volume of pore water within the tailings of the LTP. It was expected that much of the pore water would be retained (specific retention in the pore space of the tailings, especially in the slimes) indefinitely. However, a substantial volume of the moisture was drainable under the influence of gravity. This water was

drained through the upslope toes and the bottom of the LTP. Due to recontouring of the LTP (see discussions below), a toe drainage system was required to intercept toe seepage due to placement of tailings sands and contaminated soil in the toe areas (HMC 1992a). The toe drainage system was completed on August 22, 1992. The toe drainage system of the LTP was completed as per the Specification for Toe Drainage System of the LTP (AKG 1992; **Appendix F**).

This toe drainage system was augmented by a shallower French drain with perforated pipe constructed around the existing outslope toe and 5 feet outboard of the toe drain alignment. Construction of the French drain started in October 1993 and was completed December 2, 1993. The purpose of this additional drainage was to intercept shallow seepage from the tailing outslope that was escaping over the deeper toe drain. The shallow seepage, where it occurred at or very near the ground surface, was a problem for construction of the recontoured outslope, causing soft wet ground that would not support heavy equipment. The French drain was effective in drying up the seepage face at the north outslope toe, and together with the deeper toe drain, resulted in capturing seepage that had been emerging from the toe.

Dewatering activities allowed for the eventual backfilling of the LTP and placement of an interim radon barrier on top of the LTP.

Water draining from the bottom of the pile is being and will continue to be collected by wells and directed to the existing collection ponds or treated through the RO WTS. Water draining through the side slopes is being collected by a buried pipe drain installed around the entire side slope perimeter in 1992.

Water is being re-injected into the LTP and extracted via a large number of wells located on the LTP as a means of flushing out contaminants present in the tailings. Injection is expected to continue through 2014 and extraction through 2016. See **Sections 2.2.2.5 and 9.10.1.1** for additional discussion of planned groundwater restoration activities.

2. Recontouring

Stabilization began by placing geotextile in the saturated areas and highly unstable (saturated) areas to provide reinforcement sufficient for placement of a working surface for construction equipment access (i.e., scrapers and track

dozers; Knight Piesold 1996). As part of the recontouring effort, excavated tailings material was selectively placed in the unstable areas until a working surface capable of supporting heavy equipment was achieved. Once a stable working surface was achieved, recontouring of the LTP consisted of redistribution of material within the pile (cut to fill) and addition of contaminated materials found in the surrounding area. The recontoured surface was designed to promote surface runoff and to concentrate surcharge loads over the east and west ponds areas which contained the highest amount of tailings slime. Recontouring also included an eastern extension of the pile, which was required due to the additional contaminated material encountered in borrow areas and surrounding windblown areas. The recontouring activities were conducted simultaneously with fill placement and excavation activities. The recontouring was conducted as per the Specification for Recontouring of the LTP (AKG 1993c, HMC 1992b; **Appendix F**).

The top and side slopes of the LTP were reshaped in a final 5:1 (horizontal: vertical (horizontal:vertical) slope configuration. The initial phase of the recontouring was the displacement of the LTP dike crests inward to fill the east and west basins. These basins were filled primarily with sand tailings but also received some scrap or demolition debris, contaminated equipment, contaminated soils, or any combination of these. This first phase of recontouring was accomplished primarily by dozers, with additional earth movement by scrapers as appropriated. HMC started filling the basins of the LTP in September 1993.

After HMC began filling the LTP basins, and while the necessary time passed between successive pushes in the filling of the basins, HMC performed the earthwork required to flatten the LTP side slopes to a 5:1 (horizontal:vertical) slope configuration. This flattening was achieved primarily by moving sand tailings from higher on the slope to positions lower on the slope by a combination of pushing by dozer and excavation and fill placement.

The west side of the LTP was recontoured in 1993, and the east side of the LTP was completed in 1994.

3. Radon Barrier Placement

Final radon barrier material was placed only on outslopes of the LTP and not on the top surface. An interim radon cover to meet the 20 pCi/m^2/sec radon flux standard was placed on the top surface of the tailings pile. The final radon

barrier placement on the top surface will not take place until groundwater restoration activities have ceased (e.g., tailings pile flushing/injection) and consolidation of the tailings has reached 90 percent of the ultimate consolidation.

Placement of the radon barrier to the north, west, and south side slopes and interim cover on the top of the LTP began in early 1994 and was completed in the fall of 1994. The radon barrier was placed on the east side slope and aprons in July 1995. Apron structures were built by placing off-pile slightly contaminated soils near the toe of the north and south slopes of the pile, which were incorporated into the LTP, effectively reducing the slopes of the north and south sides near the bottom. An average depth of 3.8 feet of radon barrier material was placed on the north, west, and south slopes of the LTP with the exception of the extended eastern portion, and north and south, where only 2 feet was placed and compacted. Radon flux was measured on this extended area to evaluate the depth of material required to effectively buffer radon emissions. The required placement depths were decreased to 2 feet for aprons and 3.8 feet in all other areas. The total quantity of radon barrier placed and compacted on the LTP was 725,107 yd^3.

An average depth of 1 foot of soil was placed on top of the LTP as an interim cover and is awaiting final settlement before the final radon barrier is placed on top of the current cover. A final erosion protection layer of rock of approximately 6 to 9 inches thick was placed on the side slopes of the LTP. The 12-inch compacted interim cover material for the LTP was obtained from the borrow areas near the LTP. The interim soil cover and radon barrier on the side slopes was placed per the Specification for First Phase Cover Construction of the LTP (AKG 1994e; **Appendix F**). Erosion control (rock materials) was placed on the side slopes of the LTP as per Specification of Erosion Protection – Rock Materials and Placement (AKG 1993b; **Appendix F**).

Overall placement of interim cover fill material on the LTP began on February 17, 1994 and was completed on September 27, 1995 (Knight Piesold 1996). Clean materials were obtained primarily from the West Borrow Area and generally consisted of clayey sands and sandy clays (Knight Piesold 1996). Approximately 388,938 yd^3 of clean borrow material was placed as interim cover fill. The radon barrier fill material placed on the outslopes of the LTP

was composed of clean fill materials from the West, North, and Northwest Borrow Areas and primarily consisted of clay (Knight Piesold 1996).

Additional interim cover was placed on the extended portion of the LTP due to supplementary design considerations and additional quantities of contaminated material. Several depressed areas on top of the LTP, caused by settlement of the tailing mass in the east and west pond area, also required additional interim cover fill placement to maintain adequate drainage and address specific areas with elevated radon flux measurements (see discussions as to radon flux measurements in **Section 12.2.4**).

The radon barrier work was done according to a revised radon barrier design request for the LTP (HMC 1995b) on June 16, 1995, and was approved on October 10, 1995 by the NRC as License Amendment No. 22 (NRC 1995b).

4. Settlement Monitoring

Although the reclamation design has allowed for relatively large settlements of the top of the LTP by providing for additional height of fill over the centers of the pile, the actual settlements that develop as a result of slime consolidation continue to be monitored. This is accomplished by the installation and periodic survey of settlement monitoring points, which began in October 1993. Fifty-four settlement monitoring points were initially installed on the top surface of the LTP at the node points of a 250- to 300-foot square grid. Each point was installed at its designated location as soon as possible after recontouring earthwork hds established a stable working surface at that location. The settlement monitoring program was carried out according to the Specification for Settlement Monitoring (AKG 1993d; **Appendix F**). The settlement data are used to monitor and evaluate the rate and the magnitude of the consolidation of the slimes and to identify the total and differential settlements that could result in negative gradients, depressions, or other disturbance to the cover.

There are currently 45 functional settlement monitoring points located on top of the LTP, after losing six due to damage by reclamation activities. Three additional sampling points have been damaged and are no longer reliable. Monitoring data for the settlement monitoring points from the years 2001 through 2011 are shown in **Table 2.2-4** (consecutive year to year comparison) and **Table 2.2-5** (cumulative annual variations). The locations of the settlement monitoring points are shown on **Figure 2.2-8**. A schematic of a settlement monitoring point is shown on **Figure 2.2-7.**

The 2011 annual settlement monitor point survey was conducted October 1 through 3, 2011 (Kuhn 2012). All but two of the remaining 45 settlement points showed some settlement. The other two indicated very small elevation increases that are within the expected survey accuracy band of +/- 0.05 foot. The largest settlements were recorded in the southwest quadrant and ranged from 0.33 foot at point X-1 (which historically has shown the largest settlements year-to-year) to 0.22 foot. The results of the annual 2011 settlement survey indicate a general overall settlement and more in the southwest quadrant, probably in response to variations in the injection program through the year. The settlements are consistent with gradual consolidation and dewatering of the tailings.

Some heave of the surface has been observed in the past. A potential, but unlikely, cause is small, widespread heave caused by the injection of water into the tailings as part of the LTP flushing system. However, the more likely cause of these recorded elevation increases is a systematic survey error of about 0.10 to 0.20 foot carried across the entire pile surface (Kuhn and Jenkins 2009). In either case, the changes in settlement monitor point elevations do not indicate substantial changes in the LTP settlements. Long-term monitoring of the settlement monitoring points is discussed in **Section 9.1**. The remaining reclamation steps (final top surface contouring, radon barrier, and rock cover) to be completed for the LTP and long-term monitoring of the settlement monitoring points are discussed in **Section 9.1.1**.

Corrective Actions to STP and LTP in 2010 due to Heavy Rainfalls

The HMC Grants site experienced severe rainstorms on July 25, 2010. The rainfall resulted in surface water runoff from the STP and LTP berms and drainage pathways. The NRC inspected the HMC Grants mill site on August 11, 2010 to determine if the site had sustained any material damage caused by the severe weather event (NRC 2010).

- STP

  The high rainfall resulted in minor rilling to the STP berm. The berm was reconstructed, and culverts were installed at selected locations to help prevent recurrence from future drainage. A lined drainage channel was added to the south end of the STP triangle to collect rainfall and snowmelt runoff. EP-1, located on top of the STP, was not significantly impacted by the rains. At no time did contaminated water escape from the evaporation pond, with the pond

water levels remaining well below the required freeboard limits during the rain events.

- LTP

HMC has committed to the repair of water-eroded areas of the radon barrier and replacement of stormwater down drains.

Radon Barrier Repair Project

A contractor repaired the radon barrier soil cover over the tailings in the LTP. Locations where the radon barrier was to be repaired were relatively small and isolated, and all areas were located on the south side of the LTP. Repairs were necessary due to erosion in four locations from leakage between joints of corrugated steel pipe (CSP) stormwater down drains.

The radon barrier work consisted of removing and stockpiling the erosion protection layer on the affected area for later use, removing the radon barrier to the depth of the erosion and stockpiling for replacement, and obtaining additional radon barrier material from the NRC-approved North Borrow Area as needed for restoration to the original thickness. The radon barrier was placed in lifts, compacted, and tested according to the original specifications. Radon flux was measured prior to placement of the erosion protection layer. All work was documented and done in accordance with the quality assurance and control program used in the original radon barrier placement. HMC filed a Completion Report (DBE 2010b) for the radon barrier repair work by email dated February 03, 2011 (HMC 2011a).

Stormwater Down Drains Project

Due to the leakage between joints of CSP stormwater down drains during the high rainfalls in July 2010, these down drains were replaced with continuously fused high-density polyethylene (HPDE) down drain pipes in October and through early December of 2010, just prior to initiation of the above-referenced radon barrier repair work.

Cast-in-place concrete anchors were constructed to secure the tops of the new HDPE down drains into the perimeter berm, which are necessary to avoid future failure of the system or significant maintenance to prevent failure due to downward migration of the HDPE down drains.

In addition, the concrete anchor blocks were constructed with rebar to provide long-term structural integrity, and a culvert apron was placed facing down slope within the poured concrete block to help anchor the pipe. To further ensure that the HDPE pipe would not pull out of the concrete blocks due to thermal changes, chains were secured around the pipe downgradient of the anchor blocks, and were attached to rebar and pipe brackets within the anchor block and included in the poured concrete. Further pipe anchoring was provided by the fusion of Central Plastics Brand Electrofusion Flex Restraints to the upstream side of the concrete anchor block. The Completion Report for the stormwater down drains project (DBE 2010a) was submitted to the NRC by email dated February 03, 2011 (HMC 2011b). The follow-up work in 2011 referenced above was reported in the 2011 annual inspection of the Grants tailings piles and ponds (Kuhn 2012)

2.2.2.3 Surface Water Runoff Control- Onsite

In 1995, HMC's contractors regraded and revegetated the site in accordance with Specification for Site Grading and Revegetation (AKG 1994b; Grogan 1995 [revision]; **Appendix F**). The reclaimed areas affected by these activities were the mill site, soil borrow areas, cleanup areas of windblown contamination, and other cleanup contamination areas. The purpose of the site grading was to provide positive sheet flow drainage, smooth contours, and minimum surface gradients for safe conveyance of runoff from and across the site. Overall revegetation resulted in timely site stabilization and minimized any soil erosion to runoff.

The site was graded to establish those gradients that assure positive drainage of surface water runoff away from the LTP and STP and the reclaimed mill area. Once groundwater restoration has been completed, remaining surface structures will be demolished, removed, and disposed of, and ponds will be reclaimed. One or two evaporation ponds will be converted to WDCs. Some additional site grading and revegetation will be required to ensure positive drainage associated with the remaining reclamation work. The final grades of the site will be as close as possible to the original natural grades, with surfaces sloping generally to the south and southwest of the site.

A diversion channel was constructed along the north (North Diversion Channel) and west (West Diversion Channel) side of the LTP, diverting flow to an area where the 100-acre center pivot irrigation area is now located (**Figure 2.2-9**). This channel was constructed while a contractor was placing interim cover on the LTP and STP (completed in October 1995). The primary purpose of the channel is to divert surface

water runoff originating from north and east of the site around the LTP. As part of the reconstruction of County Road 63 due to the cleanup of windblown contamination, two drainage crossings on the county road were constructed in the second quarter of 1994 (**Figure 2.2-9**). The diversion channel and drainage crossings were not part of the 1993 design/reclamation plan and occurred as a field engineering change. Some definition of the diversion channel was lost when additional borrow soil was removed during LTP/STP cover placement. As part of any required additional site recontouring during final reclamation activities, the diversion channel will be cleared of windblown sediments and reestablished as needed.

As discussed in **Section 2.2.2.2**, part of the design for recontouring of the LTP was to promote surface runoff around the LTP in order to control potential erosion (Knight Piesold 1996).

Figure 2.2-10 shows an overlay of the 2010 Federal Emergency Management Agency (FEMA) Floodplain boundaries in relation to the HMC Grants Site (FEMA 2010). The FEMA 100-Year Floodplain Boundary encompasses much of the HMC Grants Site; extends southwest into the Murray Acres, Broadview Acres, and Felice Acres subdivisions; and demonstrates the lack of channeled flow of water in established drainages in this area. **Figure 2.2-10** shows the site features (e.g., LTP, STP collection ponds, EP-1, EP-2, and existing levee), which could alter the flow of a 100-year flood event in the immediate area of the features. The existing levee located on the southeast toe of the LTP was constructed in order to direct the flow of flood water to the north and west of the LTP and to protect the LTP toe and evaporation ponds to the south.

As part of final reclamation activities, HMC will assess completed surface water runoff control measures and determine what additional measures may be required as a result of final reclamation actions. HMC will develop a final surface water runoff control plan during final site closure and reclamation, which will consider, to the extent feasible, the location and extent of the FEMA 100-Year Floodplain. Detailed survey data will support the plan development so that onsite runoff generated by HMC Grants will be controlled to the extent practicable in a manner that it does not exacerbate offsite flooding. See **Section 9.9** for planned activities.

Erosion Control

Below-grade scour protection for the north and west sides of the reclaimed LTP was constructed in 1995 as per Specification for Construction of Rock Covers and Other Erosion Protection on the LTP (AKG 1993b; **Appendix F**). The purpose of the scour

protection is to handle stormwater runoff from extreme storm events and prevent erosion. The configuration of the scour protection, as shown on **Figure 2.2-7**, is discussed in the Revised Reclamation Plan (AKG and Jenkins Environmental 1993a). The scour protection was constructed first by excavating a trench (inside slope of 30 degrees) of at least 7.7 feet below the side slope toe elevation. The trench was then backfilled by placement of rock material with a top width of at least 5 feet and a bottom width of at least 1 foot, as shown on **Figure 2.2-7**. The construction of the trench was completed by backfilling the top remaining open space of the trench with soil that was initially excavated from the trench. The soil was placed and compacted by a dozer because no specific compaction of the soil was required. The scour trench runs from the northeast corner to the southwest corner of the LTP along the north and west toe of the outslope (Knight Piesold 1996; **Figure 2.2-9**).

In late August of 1995, when construction of the scour trench commenced, some excavated material was found to be contaminated and was removed and placed in the STP in accordance with project specifications. Clean material was imported to replace the contaminated soils that were removed. Quality control personnel observed construction practices and checked trench depths. In addition, radiological sampling and analyses determined when sufficient contamination had been removed.

2.2.2.4 Remaining Structures and Groundwater Restoration Support Structures and Associated Byproduct (11e(2) Material)

As indicated before, most of the mill structures were demolished as a part of the mill decommissioning. The only buildings that remain are in the Administration Compound (office/shop building, two storage buildings; previously the Trucking Yard) and the RO WTS building located near the west collection pond. The buildings in the Administration Compound were decontaminated as part of the mill decommissioning. A radiological survey was conducted to ensure that contamination was less than U.S. NRC Reg. Guide 1.86 levels (ERG 1998). The RO WTS building is potentially contaminated and currently in use.

These current assets at the mill site are being used as part of the ongoing groundwater restoration project and are discussed in **Section 2.2.2.5**. These assets will be decommissioned after the groundwater restoration project has been completed (see further discussions in **Section 9**).

The Final Radon Barrier Design for the STP (ERG 1996) included plans for disposing of all remaining byproduct material associated with the groundwater restoration activities. The plan is to place all byproduct containing debris and residues from the

groundwater restoration program in the WDC (EP-1 and/or EP-2). Once EP-1 is reclaimed (either clean-closed or used as the WDC), the STP will then be contoured and radon barrier and erosion protection material placed on the pile. The final radon barrier design was approved by License Amendment No. 27 (License Condition 37B), dated September 25, 1997 (NRC 1997).

Tasks planned for the remaining reclamation and decommissioning activities are discussed in detail in **Section 9**.

A chronological list of completed reclamation, decommissioning, and groundwater restoration activities is presented in **Appendix A**.

2.2.2.5 Groundwater Restoration History

When the Grants Mill was built, it was located in a remote ranch land area. In the 1960s and 1970s, several subdivisions were developed in the vicinity of the Grants Mill. Many of the original owners of these residences used domestic wells completed in alluvium and shallow bedrock aquifers in which the natural water quality was generally poor (MFG 2006).

Beginning in the 1950s, the AEC required monitoring associated with uranium recovery facilities for groundwater protection. Groundwater sampling and laboratory analyses were conducted quarterly at the HMC site, with the analytical results reviewed by the AEC. The AEC regulations specified detailed limits on releases to both air and water. Groundwater monitoring for the HMC site did not show any increase in radioactive materials through the mid-1970s. However, groundwater contamination near the HMC site was first reported observed in the early 1960s by the New Mexico State Engineers Office (Chavez 1961, EPA 2006, USPHS 1962).

In 1974, the U.S. Congress passed the Safe Drinking Water Act (SDWA) to help protect the nation's public water supply against pollution. In 1975, the NMEID (now the NMED) requested that the EPA study the impacts of uranium mining and milling activities in the Grants Mineral Belt on area groundwater and surface water (EPA 1989). The EPA study determined that groundwater being used for domestic purposes in one of the neighboring subdivisions exhibited elevated selenium levels in part of the alluvial aquifer downgradient from the HMC site. At that time, HMC and others undertook a more comprehensive groundwater sampling program. The source of the selenium was uncertain. Possible sources included: a) groundwater from Poison Canyon, an area named from the locoweed which grows selectively on the selenium-rich soil (causing the background groundwater selenium levels to be very high) found

in the canyon; b) seepage from the HMC tailings pile as a result of the carbonate leach process, which causes a portion of the natural selenium contained in the ore to be soluble; and c) discharges from other mines and mills in the area. Several residential wells in two subdivisions south of the HMC site were subsequently found to be contaminated.

As a result of the findings of the 1975 sampling program, an agreement (Groundwater Protection Plan) was signed on August 18, 1976 between the NMEID and United Nuclear-Homestake Partners (the HMC site owner at that time; NMEID & United Nuclear 1976). This agreement established a groundwater injection and collection system to contain seepage from the tailings, an associated monitoring program, and provided domestic bottled water to downgradient residents. This groundwater containment program was the first restoration activity at the site, and eventually evolved into a key component of the current groundwater corrective action program. In 1975, HMC began providing bottled water to residents of the subdivision upon request. HMC also implemented an extensive hydrology study of the area, which was one of the first groundwater restoration and protection programs related to effects from uranium mill tailings.

In 1976, HMC determined that a contaminated plume originating from its tailings pile existed in the alluvial aquifer and was moving to the south and west (HMC and Hydro-Engineering 2010a). HMC implemented the remainder of the groundwater remediation program in 1977 with the installation and operation of a line of groundwater injection wells near the southern portion of the mill site boundary adjacent to the downgradient subdivisions. The purpose of this line of injection wells was to create a hydraulic gradient to prevent migration of groundwater with elevated selenium from the property boundary and to move contaminant concentrations back towards the tailings facility (MFG 2006). HMC also installed a series of groundwater collection wells close to the tailings piles and evaporation ponds designed to collect seepage from the tailings pile as well as to retrieve groundwater that may already have migrated from the pile (EPA 2006, CH2M Hill 2001, HMC and Hydro-Engineering 2006). The groundwater collection system was installed between 1977 and 1982.

In 1983, the HMC site was placed on the EPA's NPL. As a result, HMC and the EPA signed an Agreement and Stipulation in 1983, which required HMC to provide a water service extension from the Village of Milan municipal water system to four residential subdivisions located south and southwest of the mill site which were in the affected area of groundwater contamination (EPA 2006). The affected subdivisions were: Broadview Acres, Felice Acres, Murray Acres, and Pleasant Valley estates. In

addition, under this agreement, HMC was required to pay for residents' use of the water supply for a period of 10 years. The subdivisions' residences were connected to the Village of Milan's water supply system in 1985, and HMC paid for this water use until 1995 (EPA 2006). HMC has been released from its obligations under this Agreement, and residences now have permanent connections to alternate water supplies. At the time of the Agreement, the EPA did not require additional response actions to remediate the groundwater because HMC was already implementing a state-approved plan.

Homestake agreed to continue with the groundwater injection and collection programs to assist in groundwater cleanup, and on September 15, 1989, HMC submitted an Updated CAP for groundwater remediation to the NRC (Hydro-Engineering 1989). The plan was approved by the NRC via License Amendment No. 8, dated July 20, 1990, by adding the requirement for implementation of the corrective action program as License Condition 35 (NRC 1990). The containment program was converted to a groundwater restoration program after the mill was shut down in 1990. Subsequently, the NRC approved an HMC plan for site reclamation and continued groundwater restoration. Since beginning these activities in 1993, a number of the originally defined groundwater restoration tasks were modified, and certain new tasks were deemed necessary to comply with the NRC site closure requirements. These groundwater activities are discussed in the HMC Updated CAP filed with the NRC in March 2012.

A comprehensive alternative evaluation for the restoration of the shallow groundwater aquifer underlying the HMC site was carried out in 1994 by a third-party consultant in order to: summarize background studies and investigations; define the existing groundwater conditions; and provide alternatives and recommended feasible solution(s) for correcting the problems identified at that time (Montgomery Watson 1995). This effort resulted in a clearer understanding of background water quality levels, as well as defining the extent and magnitude of existing aquifer and water contamination. This evaluation also included reviews and cost estimates for several different alternate systems for increasing the rate of contaminated water disposal. A third-party consultant evaluated the HMC groundwater quality restoration project at the Grants site. The assessment focused on the shallow alluvial aquifer system and uranium concentrations in groundwater underlying and adjacent to the LTP (Montgomery Watson 2000).

A technical review of the groundwater remediation program at the Grants site was conducted by a third-party consultant (Adrian Brown 1995). This technical review included a review of key background data reports including a reverse osmosis and

alternatives analysis (Montgomery Watson 1995), geochemical conditions, monitoring results from 1977 to 1995, site tour, and briefing by HMC staff. The objective of the review was to evaluate the current understanding of the plume, evaluate alternatives currently under consideration for expediting the remediation, and identify possible other solutions that may have improved costs/benefit relationships. The technical review was summarized and key management alternatives for remediation were presented.

A Revised CAP was submitted by HMC to the NRC on December 12, 2006 (MFG 2006) as a result of modifications to the groundwater corrective action operations over the past 20 years, recommendations originating from evaluations of the ongoing activities by professional and experienced third-party consultants. It incorporates lessons learned regarding the hydrologic and geochemical responses observed in each aquifer system. The groundwater restoration program has continued to evolve in response to changing conditions. A flow diagram and summary of the current major components of the 2006 Revised CAP are shown on **Figure 2.2-11**.

Groundwater remediation has been ongoing since 2006, and the program has been modified in response to monitoring results. These additional activities are discussed below.

Recent History

Groundwater Restoration Overview

In 2010, the NRC requested that HMC update the 2006 Revised CAP to document the adjustments in the restoration program over the last several years and to present the proposed future of the groundwater corrective action plan. Changes in the 2006 Revised CAP have been described in the annual reports and approved in the license conditions. The purpose of the Updated CAP is to document these changes and the future plans in one report.

Groundwater at the site is contaminated with radiological (e.g., uranium, thorium-230, radium-226, and radium-228) and non-radiological (e.g., selenium, molybdenum, sulfate, and TDS) contaminants (HMC and Hydro-Engineering 2006, ACOE 2010b). The primary groundwater contaminants at the Grants site have been uranium, selenium, molybdenum, and sulfate. Although impacts have been widespread in the alluvial aquifer, contaminants with slight to moderate concentrations have also been identified in the Upper, Middle, and Lower Chinle aquifers near their subcrops with the overlying alluvial system near the project site (HMC and Hydro-Engineering 2006). Contaminant concentrations in the alluvial aquifer are highest under and near the LTP

and STP and the former mill processing building location. The sources of the selenium are not clearly understood. Possible sources included: (a) groundwater from Poison Canyon, an area with selenium rich soils that are known to impact background water quality; (b) seepage from the tailings piles, as the carbonate leach process causes some of the selenium in the tailings to be soluble; and (c) discharges from other mines and mills in the area.

There are two plumes in the alluvial aquifer containing uranium and selenium that extend near and under residential areas along preferential groundwater flow paths, with one to the west of the site and the other south-southwest of the site (**Figures 2.2-12 and 2.2-13**; HMC and Hydro-Engineering 2012). Impacts have also been observed on the concentrations of TDS and sulfate in the alluvial groundwater. The mobility of dissolved uranium and selenium in the alluvial aquifer is expected to be enhanced due to the expected aerobic nature of the aquifer (ACOE 2010b).

HMC manages a groundwater restoration program as defined by the NRC License SUA-1471 and NMED (HMC and Hydro-Engineering 2010a). Groundwater restoration is scheduled to be completed in 2022. An irrigation program was started in 2000 to aid restoration of low-contaminant concentrations in the offsite area while producing a beneficial crop. The long-term goal of HMC is to restore the groundwater aquifer to COC levels as close as practicable to the upgradient site background levels.

The current groundwater remediation system at the Grants mill site is composed of a tailings flushing and dewatering system, groundwater collection and injection system, an RO WTS, two collection ponds, three evaporation ponds, an offsite contaminated groundwater collection and irrigation treatment system, and associated equipment and structures. The locations of collection, injection, and irrigation wells are shown on **Figure 2.2-14,** and major surface support facilities are shown on **Figure 2.1-1**. The groundwater restoration program is designed to remove target contaminants from the groundwater by flushing the alluvial aquifer with deep-well supplied fresh water (from the San Andres formation) or water produced from the RO WTS (HMC & Hydro-Engineering 2012). These waters are injected into a series of wells or infiltration trenches arranged to form a continuous injection line across the site, creating a hydraulic gradient that results in containment of the contaminants within the collection system (HMC and Hydro-Engineering 2010b). A series of collection wells collects the contaminated water, which is pumped to the RO WTS for treatment or, alternatively, to one of the three lined evaporation ponds (e.g., passive or forced spray treatment). Evaporative spraying is conducted seasonally and only during times of low wind velocities (ACOE 2010b).

The RO WTS is used to treat and manage the majority of collected groundwater. The RO WTS produces higher quality water than the natural alluvial water. A groundwater collection system area has been established and is bounded by a downgradient perimeter of injection/infiltration wells and trenches (**Figure 2.2-14**). The alluvial groundwater that flows under the tailings enters this collection system and is eventually captured by a collection well system (**Figure 2.2-14**). Groundwater is extracted from the alluvial aquifer downgradient of the LTP, under the STP, upgradient of the LTP, and approximately 0.5 mile south-southeast of the STP.

The East and West Collection Ponds are components used for management of water flows and volumes associated with the RO WTS. These ponds store and recirculate water for treatment through the RO WTS. EP-1 receives water from EP-2, which manages waters from the series of groundwater collection wells located within and around the perimeter of the LTP located to the north of the ponds, and brine waste water from the RO WTS (**Figure 2.2-5**). Water is pumped into EP-1 from EP-2, and spray nozzles are used to emit an aerosol spray of water into the air over the ponds to increase evaporation. Additional volumes of water are also pumped from EP-1 by HDPE pipeline to newly constructed EP-3, which consists of east and west cells.

Since 1977, the combination of injection wells and the upgradient collection system has withdrawn the contaminated groundwater plume upgradient of the current hydraulic barrier which assists in aquifer restoration of groundwater concentrations to at or below site background levels (HMC and Hydro-Engineering 2010b)

HMC also operates a groundwater collection and irrigation system (four fields) for remediation of portions of the downgradient ends of two contaminant plumes which have migrated from the mill site (**Figure 2.2-14**). The irrigation program was started in 2000 to assist with the restoration of low contaminant concentrations in the offsite area while being used for crop production (HMC and Hydro-Engineering 2011). This land application methodology was reviewed and approved by the NRC and NMED through letter authorizations (MFG 2006). The upper limit for the uranium concentration in irrigation water was set at the NRC's effluent standard of 0.44 milligrams/liter (mg/l), and the maximum allowable concentration of selenium in the irrigation water was set at the New Mexico Water Quality Control Commission's standard of 0.12 mg/l. With five exceptions, measured uranium and selenium concentrations in irrigation water have been below these limits since inception of the irrigation program through 2011. The irrigation water supply configuration and production rates were adjusted to ensure that season averages met established limits. The 2011 Irrigation Report (HMC et al 2012) presents the monitoring results which show no effects on the uranium and selenium

concentrations in the underlying groundwater from HMC irrigation/land treatment program.

Additionally, groundwater is extracted from the Upper Chinle aquifer south of the LTP and from the Middle Chinle aquifer north of the LTP. There is also additional extraction within and just below the LTP.

The groundwater restoration program has undergone a number of operating adjustments since remediation activities began in 1977 in order to improve cleanup activities including the installation of additional groundwater and injection and collection wells; addition of another 300 gallons per minute (gpm); RO WTS and evaporation ponds to increase groundwater treatment capacity; discontinued use of wells no longer useful; addition of a series of toe drains, injection wells, and collection wells to flush and dewater the tailings; and addition of an offsite contaminated groundwater collection and irrigation treatment system. The groundwater restoration program has been effective in preventing further migration of contaminants offsite and in partially restoring portions of the affected aquifers. It is anticipated that, with the implementation of the groundwater 2012 Updated CAP (discussed in more detail below) and inclusion of any other identified valid improvements to the program, HMC will be able to complete the remaining groundwater restoration tasks as scheduled, pending timely regulatory review and approval.

A chronological list of completed reclamation, decommissioning, and groundwater restoration activities is presented in **Appendix A**.

Updated CAP

The 2012 groundwater Updated CAP is a fundamental component of the Updated DRP for the site; therefore, the reader should refer to the Updated CAP (HMC 2012b) for detailed information about current site conditions, recent modifications to the groundwater restoration program, and key aspects of the proposed future implementation of the Updated CAP. This section of the Updated DRP only presents the basic conclusions taken from the Updated CAP document.

A Remediation System Evaluation (RSE) was conducted in 2008 for the HMC Grants site with the draft of the final report being issued on December 19, 2008 (EQ 2008). This is referred to as the original RSE. The work was performed by Environmental Quality Management, Inc. (EQ) for the EPA. The study was a broad evaluation that considered the goals of the Grants site remedy, site conceptual model, aboveground and subsurface performance, and site closure strategy. Based on stakeholder

comments, the EPA decided that there were additional issues to be addressed regarding the implemented remedy at the site (ACOE 2010a). A draft of the Addendum to the RSE (focused review of specific remediation issues) was issued in February 2010 by the EPA and the U.S. Army Corps of Engineers (ACOE; 2010a). The work was conducted by the ACOE on behalf of the EPA. HMC submitted comments on the draft to the EPA by letter dated May 07, 2010. The final RSE Addendum was issued on December 23, 2010. The EPA submitted comments/recommendations on the final RSE Addendum (ACOE 2010b) to the NRC by letter dated March 24, 2011 (EPA 2011d). The EPA requested that the NRC incorporate the EPA recommendations listed in their submittal into the Updated CAP revision, along with a schedule integrating these activities into the other response measures required by the Updated CAP. The NMED submitted a letter to the NRC dated April 20, 2011 (NMED 2011b), stating their support for EPA's positions on the RSE Addendum as presented in their letter dated March 24, 2011. The NRC provided a response to the EPA's letter dated March 24, 2011 (with a copy to the NMED) by letter dated April 21, 2011. The response stated that, although the NRC agreed with some of the RSE recommendations, the RSE report did not provide the level of detailed information that would be necessary to justify imposing the recommendations on HMC. A meeting was held on January 25, 2012 with representatives of the NRC, EPA, NMED, DOE, and HMC to discuss the RSE recommendations. Given the significant progress being made by HMC at the site, the NRC advised the participants that the agency did not plan to specifically require HMC to implement any of the recommendations. However, HMC would have to address some of the issues in the Updated CAP for the site to demonstrate compliance with the license termination criteria. At the meeting, HMC expressed a willingness to evaluate a number of the RSE recommendations to determine if remedial process efficiencies could be improved. The NRC committed to working with HMC to incorporate any revisions requested by HMC into the Updated CAP, with the EPA and NMED given the opportunity to review and comment on NRC's evaluation of the Updated CAP before approval.

On March 15, 2012, HMC submitted the Updated CAP for the Grants site to the NRC for review and approval. The Updated CAP addresses NRC's comments on the December 15, 2006 revision to the CAP, as well as comments provided by the NMED and EPA in correspondence with the NRC dated November 27, 2011 and December 13, 2011, respectively (NRC 2012b).

The 2012 update to the CAP documents the status of the groundwater restoration effort at the site and the anticipated path forward, including the predicted duration of

each component of the CAP. HMC is committed to successfully restoring groundwater to the established site standards, and input from all of the stakeholders is valued in achieving this goal. Thus, HMC is proactively incorporating multi-agency input into its evaluation and operation of the groundwater restoration program. This update to the CAP compiles relevant information from the annual monitoring reports and NRC license amendments into a single document, so that the information presented in this update is complete and current. It fulfills the relevant NRC acceptance criteria for groundwater CAPs and addresses the Requests for Additional Information (RAIs) from the NRC's recent review of the 2006 update. Relevant comments and recommendations from the EPA and the NMED are also addressed in this update. The EPA and NMED will provide additional comments to the NRC on the 2012 Updated CAP, and the NRC will incorporate these comments into the NRC RAIs to be submitted to HMC.

The groundwater CAP began at the site in 1977 and is now expected to continue through 2020, with final evaporation and site closure and decommissioning continuing through 2022. Factors contributing to this extension to the CAP schedule include the 3-year delay in obtaining the necessary approval to construct EP-3 coupled with recent limitations on land treatment. There are five current operational components of the Updated CAP: (1) source control, (2) plume control, (3) RO WTS, (4) evaporation, and (5) land treatment. HMC continues to evaluate these strategies and has undertaken several evaluations to determine if the performance and/or the operation of these five components can be optimized.

HMC is conducting a rebound evaluation in the LTP to evaluate the current source control program. This investigation will provide a defensible, technically sound prediction of long-term COC leaching behavior in and downgradient of the LTP after flushing ends. The rebound evaluation includes bench-scale tests to evaluate leaching behavior from the tailings solids, a dissolved gas tracer study to characterize the flow regime in the LTP, and monitoring relevant geochemical parameters in a 1.3-acre area of the LTP where flushing was discontinued in May 2011. Post-flushing monitoring will be performed for at least 1 year to characterize and verify rebound characteristics.

A dissolved uranium mass removal analysis verified the efficacy of the plume control program. Between 2001 and 2009, approximately 50,000 kilograms (kg) of dissolved uranium were removed from the alluvial aquifer. This analysis demonstrates that the plume control program removes COC mass through the extraction wells within the site hydraulic barrier and aquifer plume areas; observed decreases in COC concentrations

are attributable to mass removal, not dilution. In addition, from 2002 to 2009, approximately 75,000 kg of dissolved uranium were removed from the LTP itself.

HMC is currently evaluating the condition and performance of the RO WTS and is identifying strategies to increase treatment capacity, improve reliability, and reduce operating costs. These potential improvements include equalization and characterization of influent feed water, physical modifications to address hydraulic capacity constraints, adjustment of chemical feed locations, and increasing process water quality monitoring. The preliminary results of this evaluation indicate that the RO WTS is in generally good condition and can be operated reliably for the next 10 years with some investment in rehabilitation and replacement of equipment as required, extending the plant's useful life.

In addition to source control, plume control, and RO WTS optimization evaluations, HMC is also investigating several alternative treatment technologies. If bench- and pilot-scale tests are successful, HMC may implement one or more of these technologies upon receiving appropriate agency approval to enhance groundwater restoration for the five existing CAP components. Currently, HMC is evaluating three different alternative treatment technologies: *in situ* phosphate treatment, *ex situ* zeolite treatment, and electrocoagulation (EC). Phosphate treatment would be used in a variety of implementation approaches to remove uranium *in situ*. HMC is operating a pilot test of the technology in the LTP after performing extensive bench-scale tests. Both zeolite and EC treatments are pump-and-treat technologies that have the potential to supplement the RO WTS. HMC is currently operating an *ex situ* zeolite pad on top of the LTP and is testing EC at the bench scale.

In conclusion, the five current components of the CAP work in combination to achieve source control and plume remediation. These have demonstrated success in making progress towards achieving the HMC site standards. HMC will continue to seek opportunities to improve the performance of these CAP components. The proposed 2020 schedule can only be met if the performance of the CAP strategies, including proposed land treatment, are not compromised or delayed.

2.2.3 Spills and Releases

Hydrocarbon Spills

The HMC site currently maintains a Spill Prevention Control and Countermeasure (SPCC) Plan for the reclamation and decommissioning activities at the Grants site (Kump and Bokich 2012). The SPCC Plan is required primarily because the site stores

more than the regulatory threshold amount of 1,320 gallons of vehicle gasoline and diesel fuel contained in two aboveground storage tanks at the Administrative Compound.

Over the period of operations from 1958 to 1990, minor surface spills occurred in the mill area. However, such spills were cleaned up as per site operating procedures and SPCC Plan. None of the spills were discharged from the license area. Any areas that had experienced spills in and around the old mill area were addressed with the soil cleanup associated with the decommissioning of the mill (**Figure 2.2-4**).

On December 17, 1992, soil saturated with diesel fuel was discovered in the area of the 1,500-gallon underground diesel fuel tank located to the west of the mill processing area. On December 18, 1992, the decision was made to remove the underground storage tank (UST) and associated lines. A third-party consultant with experience and qualifications for such tank removals and cleanup oversaw the remediation activities. On December 18, 1992, removal of the UTS began. The tank and lines were drained of all product and purged to remove all flammable vapors. The tank was transported to Albuquerque, New Mexico to a firm that reclaimed steel materials. Approximately 21,800 yd^3 of contaminated soils (based on sampling analysis) were removed and placed in an onsite designated area for land farming. Existing downgradient monitor wells were monitored to determine if there was any associated hydrocarbon contamination.

The UST removal, soil cleanup and treatment, and groundwater monitoring were carried out under the direction of the NMED Underground Storage Tank Bureau (USTB). Based on the results of a cleanup description and the soil and groundwater sampling results, the NMED advised HMC on April 1, 1994 that the site did not pose an immediate public health or environmental threat (NMED 1994). Therefore, no additional work was required at that time.

2.2.3.1 Non-Hydrocarbon Spills/Releases

Ore Spills

Ore spillage occurred during operations in an area contiguous to the north end of the ore pad located between the mill processing area and the Trucking Yard area (current Administration Compound). As part of decommissioning of the ore pad, approximately 2 feet of contaminated surface soils were removed and consolidated with the tailings (ERG 1995). Follow-up radiological surveys verified that the area of ore spillage was cleaned up with approximate 2 feet of clean borrow material placed on the area to restore it to the initial grade (ERG 1995).

Highway 605 was used to haul ore to the areas uranium processing mills. HMC decontaminated Hwy. 605 and County Road 63 rights-of-way affected by windblown contamination originating from the site (ERG 1995). HMC removed and disposed of soils contaminated by windblown tailings and other byproduct materials from public roadways using the Specification for Excavation and Disposal of Contaminated Soil from Public Roadways (AKG 1994f; **Appendix F**).

Tailings Release

HMC experienced a release of tailings material on February 5, 1977. In the process of switching tailing slurry from one cyclone truck to the other, a pipe coupling failed. The failure caused a leak in a high pressure line, resulting in the crest of the LTP washing out. The erosion process eventually resulted in the tailings solution and slimes flowing through the washed out area. The breach of the LTP south berm caused a spill of approximately 100,000 tons of tailing sand and slimes, and approximately 20,000,000 gallons of tailings solution spilled out and spread over about 100 acres of the HMC property, just south of the LTP (**Figure 2.2-15**).

Immediately after emergency shutdown orders were issued, actions were taken to ensure that none of the spilled material would leave the restricted area. An emergency 6-foot high dirt berm was constructed along the west boundary of the HMC property, just south of the LTP, to contain the solution within the restricted area boundary. The released tailings material nearest the LTP was cleaned up by re-slurrying and pumping slimes back into the tailings circuit, and the remainder of the drier material was cleaned up with dozers, scrapers, and trucks and disposed of in the inactive STP (UN-HP 1978). Several small ponded areas of tailings solution were pumped back to the tailings circuit. Approximately 12 to 18 inches of soils in the spill area were removed and placed on top of the west side of the STP, with the deposited material ranging in depth from 1 to 8 feet and covering approximately 5 acres. The majority of the area of the spill was later part of a soil cleanup effort to address windblown contamination (ERG 1995). The top layer of contaminated soils was removed and disposed of, followed by sampling to verify that the excavated area met cleanup levels. As part of final site decommissioning and reclamation, site verification will be made to ensure that soils over the site, including the spill area, meet NRC-approved cleanup criteria.

The HMC Grants site experienced severe rainstorms on July 25, 2010 that resulted in surface water runoff which caused some erosion to certain areas of the berm of the STP and drainage pathways. Affected areas of the berm were reconstructed, and culverts were installed at selected locations to help prevent recurrence from future drainage (see **Section 2.2.2.2**). HMC filed a Completion Report (DBE 2010a) with the

NRC for this project. EP-1, located on top of the STP, was not significantly impacted by the rains. At no time did contaminated water escape from the evaporation pond, with the pond water levels remaining below the required freeboard limits during the rain events.

The high rainfalls on July 25, 2010 also resulted in erosion to portions of the berm of the LTP as well as drainage pathways. Locations where the radon barrier was affected were relatively small and isolated, and all were located on the south side of the LTP. HMC advised the NRC by letter dated September 23, 2010 of plans to repair and restore three water-eroded areas of the radon barrier created as the result of the recent rainfall events at the site. Discussions of the corrective actions taken in repair of the radon barrier are presented in **Section 2.2.2.2** and in the December 14, 2010 Completion Report. HMC filed a Completion Report (DBE 2010b) for the radon barrier repair work by email dated February 03, 2011 (HMC 2011a).

2.2.4 Fires

There have been no significant fires at the mill site since operations began, including the reclamation and decommissioning period from 1990 to the present time.

Due to past decommissioning activities and the removal of the mill structures, there are few structures remaining (**Figure 2.1-1**). The office building and other structures located in the former Truck Yard, and the RO building, are metal buildings located in vegetation-cleared areas, which reduce the potential for external caused fires. Therefore, the potential for major fires is limited. In the event of a fire, mill site personnel can contact the nearby City of Grants and City of Milan fire departments. In the event of a grass/brush fire in the immediate area, the HMC does have heavy equipment (such as dozers) that could assist the fire departments with fire breaks and other fire control procedures.

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3. Site Description

3.1 Site Location and Description

The HMC Grants Reclamation Project site is located approximately 5.5 miles north of the Village of Milan, County of Cibola, New Mexico, in Section 26, Township 12 North, Range 10 West. A map showing the general location of the site is presented on **Figure 3.1-1**.

The HMC site occupies an area of approximately 1,085 acres, which includes the 185-acre area added for the construction of EP-3 in 2010. The site is located near the confluence of the ephemeral Lobo Creek and San Mateo Creek drainages, both of which are tributary to Rio San Jose. Site elevation averages approximately 6,600 feet above mean sea level (MSL). The project area is located within a semi-circular valley defined by a series of mesas ranging in elevation from approximately 7,000 to 8,600 feet above MSL. The valley itself is approximately 10 miles in diameter. Site topography is generally flat with occasional low, rolling hills (including the tailings piles) and shallow arroyos in the vicinity (**Figure 3.1-2**).

The previous operational facilities at the time of shutdown (1990), as compared to the current facilities at the site, is described in **Section 2.2.1**. The previous operating assets are shown on **Figure 2.1-2**.

3.2 Population Description

3.2.1 Cibola County

Cibola County was created by a division of Valencia County in 1981; therefore, population data for the new county before 1981 are estimated. In 1970, the county's population was 20,125, rising to 30,109 in 1980 and falling to 20,794 in 1990. Those population changes were mainly related to uranium mining activity in the area.

The most recent available population estimates for Cibola County by the U.S. Census Bureau is 27,658 for the year 2011 (USCB 2012a). The population was estimated at 27,213 in 2010. The population change from April 1, 2010 to July 1, 2011, was 1.6 percent (USCB 2012a).

The population density in 2010 was six people per square mile (USCB 2012a). It is estimated that the county population will increase to approximately 32,293 in 2020 and 34,624 in 2035 (BBER 2008). The institutionalized population was estimated at 997.

The average household size in the county from 2006 through 2010 was 3.11 people, compared to 2.61 people for the State of New Mexico (USCB 2012a). The estimated median household income from 2006 through 2010 was $37,361, compared to the state median income of $43,820 (USCB 2012b). Cibola County residents with incomes below the poverty level from 2006 through 2010 was 24.0 percent of the population, compared to 18.4 percent for the State of New Mexico (USCB 2012b). The January 2011 cost of living index in Cibola County was 81.3, which is below the U.S. average of 100 (City-Data 2012a).

The median price for 2006 through 2010 for owner-occupied houses was $74,800 (USCB 2012a), being somewhat higher in 2009 at $76.762 (City-Data 2012a). These values are lower than the state mean price of $158,400 in 2009 (USCB 2012b). The 2009 mean price for a detached house in Cibola County was $150,344, $487,526 for townhouses or other attached units, and $100,693 for mobile homes, compared to the state mean prices of $226,412, $192,453, and $56,348, respectively (City-Data 2012a). The median monthly housing costs for homes and condos with a mortgage in 2009 was $927 per month, and the median monthly housing costs for units without a mortgage was $202. The median contract rent in 2009 for apartments was $354 per month (range of $250 to $481), compared to the median state average of $585 per month (City-Data 2012a). In 2009, there were 6,424 county owner-occupied houses and condos and 1,903 renter-occupied apartments (City-Data 2012a). The percentage of renters in the county of 23 is below the state renter percentage of 31.

The county encompasses a land area of 4,539 square miles, with a surface water area of 2.5 square miles (City-Data 2012a).

Industries providing employment in Cibola County as of 2009 were: educational, health, and social services (27.4 percent); arts, entertainment, recreation, accommodation, and food services (12.8 percent); public administration (12.3 percent); and retail trade (10.5 percent) (City-Data 2012a).

The types of workers within Cibola County include: private wage or salary (58 percent); government (35 percent); self-employed, not incorporated (6 percent); and unpaid family work (1 percent). Unemployment in April 2010 was 7.4 percent, compared to the state rate of 8.1 percent (City-Data 2012a).

The most common industries for males (percent) are (City-Data 2012a):

- Construction (14 percent)
- Public administration (14 percent)

- Educational services (8 percent)
- Arts, entertainment, and recreation (7 percent)
- Mining, quarrying, and oil and gas extraction (5 percent)
- Health care (4 percent)
- Accommodation and food services (4 percent)

The most common industries for females (percent) are (City-Data 2012a):

- Educational services (22 percent)
- Health care (13 percent)
- Public administration (10 percent)
- Accommodation and food services (8 percent)
- Arts, entertainment, and recreation (7 percent)
- Social assistance (7 percent)
- Department and other general merchandise stores (4 percent)

The most common occupations for males are (City-Data 2012a):

- Law enforcement workers including supervisors (7 percent)
- Building and grounds cleaning and maintenance occupations (6 percent)
- Vehicle and mobile equipment mechanics, installers, and repairers (5 percent)
- Driver/sales workers and truck drivers (4 percent)
- Electrical equipment mechanics and other installation, maintenance, and repair occupations including supervisors (4 percent)
- Other management occupations except farmers and farm managers (4 percent)
- Construction trades workers except carpenters, electricians, painters, plumbers, and construction laborers (4 percent)

The most common occupations for females are (City-Data 2012a):

- Preschool, kindergarten, elementary, and middle school teachers (8 percent)
- Other teachers and instructors, education, training, and library occupations (5 percent)
- Secretaries and administrative assistants (5 percent)
- Cooks and food preparation workers (5 percent)
- Cashiers (5 percent)

- Other management occupations except farmers and farm managers (4 percent)
- Information and record clerks except customer service representatives (4 percent)

Ethnicity in Cibola County for the year 2011 consist of the following (by percentage) (USCB 2012a):

• White persons [a]	54.8
• Persons of Hispanic or Latino Origin [b]	37.6
• American Indian and Alaska Native persons [a]	41.0
• White persons not Hispanic	21.5
• Persons reporting two or more races	2.1
• Black persons [a]	1.3
• Asian persons [a]	0.6
• Native Hawaiian and other Pacific Islander persons [a]	0.1

[a] Includes persons reporting only one race.
[b] Hispanics may be of any race, so also are included in applicable race categories.

Note: The total can be greater than 100 percent because some Hispanics could be counted as other races.

The median resident age is 33.1 years, compared to the state median age of 34.6 years.

A mix of rural and industrial activities has characterized the Cibola County economy with uranium mining as the biggest factor in both the "boom" cycles of the 1950s, '60s, and '70s and the "bust" cycle of the 1980s. The location of federal and state prisons in the county has helped buffer some of the consequences of the economic downturn, and the county is currently on a pronounced economic upswing, as evidenced by the recent location in Grants of a Wal-Mart Superstore and the construction of an inter-agency "gateway to the region" Visitor Center. Recent interest in nuclear power has revived the possibility of a resurgence of uranium mining in the area. Energy companies still own viable uranium mining properties and claims in the area.

Table 3.2-1 contains pertinent U.S. Census Bureau data for population and housing estimates, county business patterns, economic census, building permits, and other activities for Cibola County (USCB 2012a).

3.2.2 City of Grants

The City of Grants is the largest incorporated area near the proposed project site and is the county seat of Cibola County. Grants began as a railroad camp in the 1880s. The population of Grants as of 2011 was 9,332 (4,171 males [44.7 percent] and 5,160 females [55.3 percent]; USCB 2012c). Between 2000 and 2011, the population increased from 8,787 to 9,332 (+4.3 percent; City-Data 2012b).

The City of Grants encompasses a land area of approximately 14.86 square miles, with 618 persons per square mile (USCB 2012c). The nearest township is Milan, which is located approximately 1.8 miles to the west. The next nearest city with a population of 50,000 or more is Rio Rancho, located approximately 66.8 miles east of the City of Grants, with a population of 51,765. The City of Albuquerque is located approximately 69.8 miles east of the City Grants with a population as of July 2009 of 448,607 (City-Data 2012b).

The estimated median household income for the City of Grants in 2009 was $30,865, compared to $30,652 in 2000, and $43,028 for the State of New Mexico in 2009 (City-Data 2012b). The estimated per capita income in 2009 was $14,722.

The average household size in the City of Grants in 2009 was 2.5 people, compared to 2.3 people for the State of New Mexico (City-Data 2012b). The percentage of family households in the city is 68.1 percent, compared to 60.7 percent for the State of New Mexico. The percent of persons below the poverty level from 2006 through 2010 was 23.5 percent (USCB 2012c).

The races in the City of Grants for the years 2009 and 2000 consist of the following (City-Data 2012c):

Race	2009		2000	
	Number	Percentage	Number	Percentage
American Indian	1,295	14.7	972	11
Hispanic	4,854	55.1	4,611	52.4
White Non-Hispanic	2,503	28.4	2,863	32.5
Black	30	0.3	138	1.6
Two or more races	88	1.0	114	1.3
Asian alone	23	0.3	79	0.9
Other race alone	20	0.2	25	0.3

Note: The total can be greater than 100 percent because some Hispanics could be counted as other races.

The types of workers within the City of Grants include: private wage or salary (48.3 percent); government (32.4 percent); self-employed, own incorporated (3.7 percent); self-employed, own not incorporated (5.3 percent); private not-for-profit wage and salary workers (9.3 percent); and unpaid family work (1.1 percent) (City-Data 2012b).

The most common industries for males (percent) in 2005 through 2009 are (City-Data 2012b):

- Public administration (17 percent)
- Construction (13 percent)
- Educational services (10 percent)
- Retail trade (10 percent)
- Mining, quarrying, and oil and gas extraction (7 percent)
- Administrative and support and waste management services (7 percent)
- Accommodation and food services (6 percent)

The most common industries for females (percent) are (City-Data 2012b):

- Health care and social assistance (17 percent)
- Public administration (17 percent)
- Educational services (16 percent)
- Retail trade (11 percent)
- Other services, except public administration (10 percent)
- Finance and insurance (4 percent)

The most common occupations for males are (City-Data 2012b):

- Law enforcement workers including supervisors (10 percent)
- Building and grounds cleaning and maintenance occupations (7 percent)
- Other management occupations except farmers and farm managers (6 percent)
- Driver/sales workers and truck drivers (6 percent)
- Electrical equipment mechanics and other installation, maintenance, and repair occupations including supervisors (4 percent)
- Construction trade workers except carpenters, electricians, painters, plumbers, and construction laborers (4 percent)
- Vehicle and mobile equipment mechanics, installers, and repairers (4 percent)

The most common occupations for females are (City-Data 2012b):

- Preschool, kindergarten, elementary, and middle school teachers (10 percent)
- Cooks and food preparation workers (5 percent)
- Bookkeeping, accounting, and auditing clerks (5 percent)
- Other management occupations except farmers and farm managers (5 percent)
- Secretaries and administrative assistants (5 percent)
- Other teachers and instructors, education, training, and library occupations (4 percent)
- Registered nurses (4 percent)

According to City-Data (2012b), in comparison to the State of New Mexico average, the City of Grants exhibits the following:

- Median house value is below state average.
- Unemployed percentage is above state average.
- Black race population percentage is significantly below state average.
- Hispanic race population percentage is significantly above state average.
- House age is below state average.
- Institutionalized population percentage is above state average.
- Percentage of population with a bachelor's degree or higher is below state average.

The local government employment and payroll for the City of Grants as of March 2007 is shown in **Table 3.2-2**.

A large number of jobs is classified in the public sector (or funded by the public sector, e.g., prisons) that provide the Grants community with a solid employment base (BBER 2008). Retail and other travel-related businesses generate gross receipts revenues adequate to fund the necessary services, thereby resulting in sound public finances. The potential for renewed uranium mining and milling in the area could result in additional growth by increasing wages and spending in the local economy (Mitchell et al. 2007).

3.2.3 Village of Milan

The Village of Milan is a suburb of the City of Grants and had a population of 3,245 (2,222 male [68.5 percent]) and 1,023 female [31.52 percent]) as of 2010 (City-Data 2012c; USCB 2012d). The median resident age in 2010 was 35.8 years, compared to 45.5 years for the State of New Mexico (USCB 2012d; City-Data 2012c).

The estimated median household income in the Village of Milan in 2009 was $43,368, compared to $24,635 in 2000, $30,865 for the City of Grants, and $43,028 for the State of New Mexico (City-Data 2012c). The estimated per capita income in 2009 was $16,811.

The local government employment and payroll for the City of Milan as of March 2007 is shown in **Table 3.2-3**.

The mean prices in 2009 for housing were: all housing units ($67,559); detached houses ($101,141); townhouses or other attached units ($261,382); and mobile homes ($46,614) (City-Data 2012c).

The average household size in 2009 was 2.7 people, compared to 2.3 for the State of New Mexico (City-Data 2012c). The percentage of family households in the village is 68.3 percent compared to 60.7 percent for the State of New Mexico. Residents with income below the poverty level in 2009 were 35.1 percent, compared to 23.5 percent for the State of New Mexico.

The races in the Village of Milan in 2009 consist of the following: American Indian (240 [11.7 percent]); Hispanic (1,143 [55.7 percent]); White Non-Hispanic (587 [28.6 percent]); two or more races (33 [1.6 percent]); and Black (50 [2.4 percent]) (City-Data 2012c). The total can be greater than 100 percent because some Hispanics could be counted as other races.

Race	2009		2000	
	Number	Percentage	Number	Percentage
American Indian	240	11.7	242	12.8
Hispanic	1,143	55.7	989	52.3
White Non-Hispanic	587	28.6	590	31.2
Black	50	2.4	25	1.3
Two or more races	33	1.6	40	2.1
White Non-Hispanic	587	28.6	590	31.2
Black	50	2.4	25	1.3
Two or more races	33	1.6	40	2.1

The types of workers within the Village of Milan include: private wage or salary (404 [60.1 percent]); local government (57 [8.5 percent]); state government (63 [9.4 percent]); federal government (39 [5.8 percent]; self-employed, own incorporated (3 [0.4 percent]); self-employed, own not incorporated (61 [9.1 percent]); private not-for-profit wage and salary workers (33 [4.9 percent]); and unpaid family work (12 [1.8 percent]) (City-Data 2012c)

The most common industries for males from 2005 through 2009 were (City-Data 2012c):

- Retail trade (21 percent)
- Construction (16 percent)
- Mining, quarrying, and oil and gas extraction (12 percent)
- Transportation and warehousing (8 percent)
- Public administration (8 percent)
- Other services, except public administration (8 percent)
- Accommodation and food services (5.8 percent)

The most common industries for females from 2005 to 2009 were (City-Data 2012c):

- Health care and social assistance (23 percent)
- Retail trade (21 percent)
- Accommodation and food services (18 percent)
- Public administration (13 percent)
- Educational services (7 percent)
- Finance and insurance (6 percent)
- Information (4 percent)

The most common occupations for males from 2005 to 2009 were (City-Data 2012c):

- Electrical equipment mechanics and other installation, maintenance, and repair occupations including supervisors (10 percent)
- Vehicle and mobile equipment mechanics, installers, and repairers (10 percent)
- Law enforcement workers including supervisors (7 percent)
- Driver/sales workers and truck drivers (7 percent)
- Other production occupations including supervisors (5 percent)

- Construction trades workers except carpenters, electricians, painters, plumbers, and construction laborers (4 percent)
- Building and grounds cleaning and maintenance occupations (4 percent)

The most common occupations for females from 2005 to 2009 were (City-Data 2012c):

- Cashiers (12 percent)
- Building and grounds cleaning and maintenance occupations (9 percent)
- Cooks and food preparation workers (7 percent)
- Other teachers and instructors, education, training, and library occupations (5 percent)
- Secretaries and administrative assistants (5 percent)
- Material recording, scheduling, dispatching, and distributing workers (5 percent)
- Information and record clerks except customer service representatives (4 percent)

According to City-Data (2012c), in comparison to the State of New Mexico average, the Village of Milan:

- Median household income is below state average.
- Median house value is below state average.
- Unemployed percentage is above state average.
- Black race population percentage is significantly below state average.
- Hispanic race population percentage is significantly above state average.
- Median age is below state average.
- Foreign-born population percentage is below state average.
- House age is significantly below state average.
- Number of college students is below state average.
- Percentage of population with a bachelor's degree or higher is significantly below state average.

The local government employment and payroll for the Village of Milan as of March 2007 is shown in **Table 3.2-3**.

3.3 Historical Land Use Associated with Grants Mill Site

Although the original 750-acre mill site was somewhat isolated and laid out on a property large enough to provide a buffer between milling and community activities, the "boom" in community expansion created peopled environments within one-half mile of the mill site (HMC 1994a). The sister towns of Grants and Milan each more than doubled in populations; outlying rural communities sprang up overnight; at least a half-dozen mobile home parks in the Ambrosia Lake basin itself were fully occupied. The Grants mill site, once 4 miles from the outskirts of the Town of Milan, was soon approached by community growth. A mobile home park, now abandoned, was developed immediately across the street east of the mill site. Four real estate ventures – Pleasant Valley Estates, Felice Acres, Murray Acres, and Broadview Acres – conglomerate subdivisions of framed houses and mobile homes - were also developed and approach the mill site's southern and western boundaries. These continue to be active and widespread, but sparsely populated, rural residential areas.

In 1977, to provide additional "space" between the mill tailings area and to also create an injection and collection well system strip, HMC purchased approximately 1,000 acres form the Roundy Ranch, providing an additional 0.5-mile wide buffer around the northern, eastern, and western perimeters of the original property (HMC 1994a). On March 21, 1990, HMC and La Jara Mesa Mining Company, in a joint venture, purchased the entire remaining 23,769 acres of the Roundy Ranch. This purchase secured suitable borrow areas for clayed soils to be used as a radon cap on the tailings piles. Since the purchase, approximately 12,000 acres, surplus to needs, has been sold.

3.4 Current and Future Land Use

3.4.1 Current Land Use

As part of License Amendment 34 to the Grants reclamation Project Radioactive Material License SUA-1471-Docket 40-8903 (approved June 19, 2002), License Condition No. 42 of License SUA-1471 requires that HMC prepare an annual monitoring report that includes a land use survey, with the most recent being in early 2012 (HMC and Hydro-Engineering 2012). The last annual report was submitted to the NRC by letter dated March 30, 2012 (HMC 2012b). This report was the tenth annual land use review/survey pursuant to License Condition 42.

The general focus of the land use survey is to document and summarize the current land uses and any identified changes to land use in proximity to the Grants

Reclamation Project; in particular, land use activities for those areas proximal to the tailings pile areas undergoing reclamation and closure and immediate surrounding areas where ongoing groundwater restoration continues to be reviewed. This land use survey report helps to assure that land use activities in the immediate area surrounding the Grants Reclamation Project are regularly reviewed and assists in confirming that those uses do not present a new concern with local groundwater usage until project groundwater restoration activities are completed. The primary issue of concern is whether any of the occupied dwellings of the neighboring subdivisions are using private wells, particularly private domestic wells that are completed into the underlying shallow alluvial aquifer, and not water service from the Village of Milan system for potable water consumption. HMC and the NMED are currently working under a Memorandum of Agreement (MOA; HMC and NMED 2009) whereby residents within a designated Area of Concern (AOC) that are not on the Village of Milan water supply for domestic potable water are allowed the opportunity to be hooked up to the municipal water system at HMC's expense.

Current major land uses south and southwest of the site consist of residential development, agriculture, and livestock raising (EPA 2011). The five residential subdivisions near the site include Felice Acres, Broadview Acres, Murray Acres, Pleasant Valley Estates, and Valle Verde. Some of the lands within these subdivisions are also used for agricultural and livestock purposes. Carrot farming was historically a major land use but has decreased in importance (Vorenberg 1999). There are large areas north, east, and west of the HMC mill site that are mostly unused except for grazing (ACOE 2010). Cattle are the main livestock produced in Cibola County, followed by sheep (USDA 2007).

Most of the HMC-owned property surrounding the mill site remains undeveloped and is used for livestock grazing on a lessor/lessee tenant arrangement. Most of the current land area within the present site boundary has been excluded from livestock grazing and other land use except those directly related to ongoing groundwater restoration activities. Livestock grazing is not allowed in the immediate tailings pile areas, evaporation pond areas, or the office and maintenance shop locations. These areas have been fenced to exclude grazing. Some small portions of the southern and western HMC property within the site boundary are seasonally used for livestock grazing (HMC and Hydro-Engineering 2012).

Much of the land surrounding the mill site to the north, east, and west has been purchased by HMC over the years. Land currently owned by HMC is shown on **Figure**

3.4-1. The entire land base of the mill site property within the license boundary is owned in fee title by HMC.

Several small lot/small acreage parcels (e.g., residential lot[s]) held by HMC in the general area of the reclamation site are idle and are essentially not in use except in certain instances where fresh water injection and water collection is underway as part of the ongoing groundwater restoration program. Consideration is largely given to possible agricultural use on select lot(s) in the future. For example, Block 1 Lot 5 and Block 2 Lot 2 in Murray Acres were planted and irrigated in 2008 through 2010.

The other significant land use situated on HMC-held lands in the area includes land treatment/crop irrigation in four fields used for crop production. Water used for irrigation is an integral part of the ongoing groundwater restoration and cleanup program for the project. Prior to 2002, HMC had 270 acres of land under irrigation consisting of a flood irrigation area comprising 120 acres (Section 34) and a center pivot spray irrigation area comprising 150 acres (Section 33). During 2002, an additional center pivot irrigation system was commissioned that comprises 60 acres (Section 28). In 2003, 24 acres of flood irrigation were added to the irrigation system in Section 33. In 2005, the 60-acre center pivot irrigation system in Section 28 was expanded by 40 acres to a total of 100 acres. The locations of the present injection and collection systems in the irrigation system are presented on **Figure 2.2-14.** For 2011, HMC lands under crop irrigation totaled 100 acres in one field situated in Section 28 (HMC and Hydro-Engineering 2012). The remaining 294 acres in the other three farm fields were not irrigated during 2011.

In addition to the land use on HMC land in the Grants Reclamation Project area, the other major land use immediately proximal to the site consists of residential development located in the Pleasant Valley Estates, Murray Acres, Broadview Acres, and Felice Acres residential subdivisions. HMC provided these subdivision areas with a potable water system as an extension of the Village of Milan water supply in the 1980s to address a concern over the quality of groundwater used for domestic purposes.

In early 2012, the four subdivisions referenced above were assessed to review present land uses, occupancy, and status for the various lots within the subdivisions (HMC and Hydro-Engineering 2012). Over the years, permanent residential homes, modular homes, and mobile homes have been established in the subdivision area and immediate adjacent areas, as would typify a rural residential neighborhood. A number of lots remain vacant, or are used for uses such as horse barns, corrals, equipment

storage, and other activities. In some cases, dwellings are present on several lots throughout the subdivisions but are currently vacant or have been permanently abandoned and are in various states of disrepair. In 2012, the annual review also included an assessment of the residential areas adjacent to Felice Acres, Pleasant Valley Estates, and the Valle Verde residential areas and adjacent lots. The 2012 review of land use for HMC properties and the residential subdivision areas to the south and west of the Grants Reclamation Project indicated that present land uses in the area have not changed significantly. As a result of the annual survey of the residential areas within the MOA AOC during early 2012, five residential properties remain to be addressed in terms of providing a domestic water supply hookup, or otherwise addressing water supply. Two of these five remaining properties are on hold until NMDOT permits can be secured for water supply east of State Highway 605. Residential owner communications with the remaining three parties will continue during 2012 to attempt final resolution. Survey results indicate that all other water users in the AOC area are supplied by the Village of Milan water supply.

3.4.2 Future Land Use

Land uses in the area surrounding the site have not been observed to change to any major extent since the HMC site ceased operations in 1990, and land uses are not anticipated to change in the foreseeable future. Agriculture has not been identified as a local growth industry, and agricultural land uses are not expected to expand from their current extent. Expansion of existing manufacturing, transportation, and warehousing land uses could occur in the future (NNMCG 2009). Post-decommissioning use of the site for uranium milling activities is unlikely.

Once the Grants Reclamation site has been turned over to the DOE for long-term care, HMC will likely sell a majority of the current land holdings in the area. However, lands in close proximity to the current license boundary may be retained to serve as a buffer for the site.

3.5 Meteorology, Climatology, and Air Quality

3.5.1 Regional Climate Summary

The climate of western New Mexico is generally a mild, arid to semi-arid, continental climate characterized by low precipitation, abundant sunshine, low relative humidity, and a large annual and diurnal (day and night) temperature range. Temperature and precipitation are largely controlled by elevation and slope aspect. Summer precipitation generally falls due to southeasterly circulation from the Gulf of Mexico, whereas winter

precipitation is generally associated with fronts moving eastward from the Pacific Ocean (NMSU 2013).

Thunderstorms, often accompanied by hail, are relatively frequent in the summer compared to other parts of the nation and average from 40 thunderstorms per year in southern New Mexico to more than 70 in northeastern New Mexico. Approximately nine tornadoes occur statewide each year (NMSU 2013).

3.5.2 Local Climate Summary

The Homestake site has an arid to semi-arid, temperate continental climate. Most precipitation falls in the form of rain during the late summer and early autumn. Severe thunderstorms are not common in the area, but short-lived cloudbursts during the summer can produce flash flood conditions in nearby drainages and may be accompanied by significant lightning and hail events. No tornadoes have been observed in the area, but dust devils occur occasionally.

The HMC Grants site maintains an onsite meteorological station located at (**Figure 2.1-1**):

Latitude 35° 14' N
Longitude 107° 51' W

The station is equipped to measure horizontal wind speed and wind direction at 10 meters, temperature at 9.5 meters, solar radiation at 9.5 meters, relative humidity at 9.5 meters, precipitation at 0.4 meter, and barometric pressure at 8.8 meters. The sensors at the site are listed in **Table 3.5-1**.

The meteorological station is setup to meet EPA Prevention of Significant Deterioration (PSD) quality assurance requirements. HMC's meteorological consultant audits meteorological instrument performance at least annually for the meteorological station in accordance with EPA's Ambient Monitoring Guidelines for Prevention of Significant Deterioration, 1987 and Quality Assurance Handbook for Air Pollution Measurement Systems, Volume IV: Meteorological Measurements, March 2008.

3.5.3 Temperature

3.5.3.1 National Weather Station

Because annual and seasonal conditions can vary widely from year to year in the southwestern United States, long-term historical average monthly maximum and minimum temperatures for the Grants Airport, Bluewater 3 WSW, and San Mateo

climate stations are presented in **Table 3.5-2**. These stations were selected to represent the regional climate of areas surrounding the site due to their proximity and elevation similar to that of the site. The Grants Airport station is located approximately 5.5 miles south of the site at an elevation of approximately 6,530 feet above MSL. The Bluewater 3 WSW station is located approximately 7 miles west of the site at an elevation of approximately 6,800 feet above MSL. The San Mateo station is located approximately 13 miles northeast of the site at an elevation of approximately 7,330 feet above MSL.

3.5.3.2 Homestake Onsite MET Station

Temperature was measured hourly at the Homestake site's onsite meteorological station from January 1, 2009 through December 31, 2012. Summary statistics of the temperature data as well as the total measured precipitation are listed in **Table 3.5-3**.

During the course of the monitoring period, 4710 hourly measurements were missing or invalid and were not included in summary tables. The total number of monitoring records for the period was 35,032. The data for this monitoring period was 87 percent complete.

Average and seasonal temperatures observed at the Homestake site are consistent with long-term regional observations. Minimum and maximum temperatures of -22.2°F (-30.1°C) and 93.7°F (34.3°C), respectively, were observed during the 2-year period of record.

3.5.4 Precipitation

3.5.4.1 National Weather Station

Long-term historical average monthly precipitation, annual precipitation, and annual snowfall are summarized for the representative regional climate stations in **Table 3.5-4**. Precipitation in the area averages approximately 10 inches per year. Summer precipitation is typically associated with thunderstorms, which form with the arrival of warm, moist air from the Gulf of Mexico. Winter snowfall usually occurs when storms move eastward from the Pacific Ocean or northeast from the Gulf of California (NRC 2007).

3.5.4.2 Homestake Onsite MET Station

Precipitation was measured hourly at the Homestake Site's onsite meteorological station from January 1, 2009 through December 31, 2012. Summary statistics of the total measured precipitation data are listed in **Table 3.5-3**.

Onsite precipitation during the 2-year period of record was 29.78 inches, which is less than the range of expected values given the regional average of approximately 10 inches per year. Dry conditions from July through September were compensated for by unseasonably high winter precipitation during this period. Abundant winter precipitation was likely due to an El Niño event during early 2010, which helped pull the westerly jet stream south and over the region, resulting in a higher frequency of Pacific Ocean-derived storms (CLIMAS 2010). Nearly all of the state of New Mexico is experiencing moderate or a more severe drought category with about 61 and 32 percent classified as severe or extreme drought, respectively (CLIMAS 2013). Between October 1, 2012 and January 16, 2013, precipitation events in most of the Southwest were below 50 percent of average (CLIMAS 2013).

3.5.5 Relative Humidity

3.5.5.1 National Weather Station

In 2012, relative humidity in Grants averaged approximately 43 percent, with the maximum average humidity of 65 percent and a minimum average humidity of 23 percent. (NMCC 2013).

3.5.5.2 Homestake Onsite MET Station

Relative humidity was measured hourly at the Homestake Site's onsite meteorological station from January 1, 2009 through December 31, 2012. Summary statistics of the relative humidity data are listed in **Table 3.5-5**.

The following hourly measurements of relative humidity were missing/invalid and were not included in the table mentioned above:

- 6 am on July 21, 2010 through 7 am on September 10, 2010

Site relative humidity averaged 44.8 percent for the period of record, with lowest values occurring during the spring and highest values during the winter and fall.

3.5.6 Barometric Pressure

3.5.6.1 Homestake Onsite MET Station

Barometric pressure was measured hourly at the Homestake Site's onsite meteorological station from January 1, 2009 through December 31, 2012. Summary statistics of the barometric pressure data are listed in **Table 3.5-6**.

Relatively low ranges in barometric pressure during the summer months reflect the lack of frontal systems that passed through the region during that season.

3.5.7 Solar Radiation

3.5.7.1 Homestake Onsite MET Station

Solar radiation was measured hourly at the Homestake Site's onsite meteorological station from January 1, 2009 through December 31, 2011. Summary statistics of the solar radiation data are listed in **Table 3.5-7**.

Solar radiation averages approximately 240 watts per square meter at the site, with the highest values occurring in the spring and lowest during the fall months.

3.5.8 Wind

The prevailing wind direction at the Grants Airport is from the northwest (WRCC 2013d). Surface wind speeds at the Grants Airport are highest in the spring, with a maximum monthly average of 14 miles per hour during April (NMCC 2013).

Homestake Onsite MET Station

Wind speed and wind direction were measured hourly at the Homestake Site's onsite meteorological station from January 1, 2009 through December 31, 2012. Wind roses for daytime and nighttime were plotted from the data (**Figures 3.5-1** and **3.5-2**). Additionally, frequency distribution was tabulated from all of the data (**Table 3.5-8**), and data specific to the months of January through March (**Table 3.5-9**), April through June (**Table 3.5-10**), July through September (**Table 3.5-11**), and October through December (**Table 3.5-12**).

HMC's meteorological consultant's quality assurance/quality control (QA/QC) program is designed to ensure that HMC's onsite monitoring data meet EPA and state requirements for completeness, representativeness, precision, and accuracy. The consultant uses software which displays the meteorological data in a meaningful, intuitive fashion, and will automate downloading of data from the HMC remote monitoring site, perform quality assurance checks on the data, generate a quality assurance report, produce time parameter plots of the data, and archive the data for future reference. The meteorological data generated for the HMC's station is used for MILDOS and any other modeling required by the NRC.

The prevailing and dominant wind directions for the HMC site's meteorological station are shown for daytime and nighttime conditions for the years 2009 and 2012 (**Figures**

3.5-1 and **3.5-2**). Prevailing winds faster than 2.1 meters per second are from the west and northwest, consistent with regionally prevailing northwesterly winds.

Dominant (strongest) winds are from the west and southwest and are associated with frontal systems moving from Pacific Ocean (**Figure 3.5-1**). Moderate winds from the south-southeast are fairly common and are typically associated with summer storms sourced in the Gulf of Mexico. Most of the light northeasterly breezes occur at night (**Figure 3.5-2**). Nighttime is also relatively calm compared to daylight hours.

Dominant winds from the south-southwest resulted in the majority of windblown contamination associated with past operations being deposited to the north and west of the mill site.

3.5.9 Air Quality

The air quality status of the HMC Grants Reclamation Project area is considered to be unclassifiable or in attainment with the National Ambient Air Quality Standards (NAAQS) for the regulated criteria pollutants including (40 CFR Part 81 Subpart C 81.332):

- PM_{10} (particulate matter less than 10 microns in diameter)
- $PM_{2.5}$ (particulate matter less than 2.5 microns in diameter)
- Nitrogen dioxide (NO_2)
- Sulfur dioxide (SO_2)
- Carbon monoxide (CO)
- Ozone

No known monitoring data for the HMC site area were found by review of New Mexico ambient air monitoring data (NMEDAQB 2013). The nearest monitoring sites are located in Albuquerque and Los Lunas, and these data are not considered representative of the HMC Grants Reclamation Project site.

Total suspended particulate matter (TSP) is an additional regulated air pollutant in New Mexico. TSP refers to small, solid particles or liquid droplets suspended in the air and having diameters of 25 to 45 microns. The major industrial point source of TSP is the coal-fired Coronado Generating Station, approximately 60 miles southwest of the project site (Bridges and Meyer 2007).

Current local area TSP sources in the HMC project area are predominantly windblown dust, vehicular traffic on unpaved roads, and windblown droplets from the aeration activities in the HMC evaporation ponds (Bridges and Meyer 2007). During final reclamation and decommissioning activities, the primary TSP sources will be suspended particulates from the removal, transport, and placement of soil cover as fill and/or radon barrier. HMC and its contractors will use best management practices to control particulate emissions during reclamation and decommissioning activities in order minimize potential impacts on adjacent and nearby neighborhoods and private/public lands. These requirements are addressed in the Technical Specifications for each of the planned work tasks discussed in **Section 9** and listed in **Appendix F**.

In addition the NAAQS requirements, there are national standards for the PSD of air quality (40 CFR 51.166). A goal of PSD regulations is to protect the air of all international parks, national parks that exceed 6,000 acres, and national wilderness areas and memorial parks that exceed 5,000 acres if these areas were in existence on August 7, 1977. These areas are defined mandatory Class I areas, while all other attainment or unclassifiable areas are defined as Class II areas. Those areas characterized as Class I allow for less incremental pollution increase, while areas characterized as Class II allow for additional incremental pollution increase.

There are no Class I areas located in Cibola County, while there are three Class II areas located in the county (El Malpais National Monument, El Morro National Monument, and Bluewater State Park). The distance of the nearest of these sites (El Malpais National Monument) is 23 miles. The nearest Class I Area (Bandelier Wilderness) is located approximately 100 miles northeast of Grants, New Mexico. Petrified Forest National Park, also a Class I Area, is located approximately 115 miles west of Grants.

Due to the limited emissions that will occur associated with final reclamation and decommissioning, no impacts to NAAQS parameters or PSD Class I or II areas are expected to occur. Once final reclamation and decommissioning tasks have been better defined (e.g., contractor's construction design and scope of work), potential air particulate emissions will be estimated to determine whether a permit will be required from the NMED.

3.6 Geology and Seismology

Significant effort has been made over the past 40 years to understand the regional and local geologic conditions of the site. Much of that information is summarized in the

Background Water Quality Evaluation of the Chinle Aquifer report (HMC and Hydro-Engineering 2003). **Figure 3.6-1** presents a portion of the geologic map of the Grants quadrangle (Dillinger 1990). This map shows the extent of bedrock, deposited from the Permian through the Tertiary, and overlying Quaternary alluvial deposits and volcanic flows. In general, progressively older units of Cretaceous through Permian bedrock outcrop from northeast to southwest as a result of regional deformation and subsequent erosion. The overlying Tertiary units consist predominantly of widely scattered Middle Tertiary (Pliocene and Miocene) andesite and basalt surficial flows related to the Mt. Taylor volcanic field cap. The Quaternary units consist of localized andesite and basalt flows and widespread alluvium, which is composed of eroded bedrock materials in the vicinity.

The site is located in the southeastern part of the Colorado Plateau physiographic province and is mostly on the south flank of the San Juan Basin. Regional structural features are shown on **Figure 3.6-2**. This region experienced minor structural deformation (regional folding and block uplift) associated with formation of the Zuni Uplift, which is characterized by a northwest-trending anticline composed of Precambrian crystalline basement rocks overlain by Permian to Jurassic sedimentary rocks. These sedimentary rocks were uplifted during the Laramide Orogeny near the end of the Late Cretaceous through the Eocene, approximately 80 to 40 million years before present (Cooley et al. 1969; Anderson et al. 2003; Lorenz and Cooper 2003). From oldest to youngest, bedrock units at the site consist of the Glorietta Sandstone (Early Permian), San Andres Limestone (Early Permian), and Chinle Formation (Late Triassic). As a result of Laramide deformation, these bedrock units have a shallow northeastern dip direction of approximately 3 to 10 degrees (Kelley 1967).

The three-dimensional geology and hydrogeology at the site are illustrated on **Figure 3.6-3**. The Quaternary alluvium directly overlies the Chinle Formation and San Andres Limestone above a pronounced angular unconformity. As a result, sandstone units within the underlying Chinle Formation are abruptly truncated at the base of the alluvium. The Chinle Formation sandstone units are laterally continuous and separated by thick sections of low permeability shale. These geologic and hydrogeologic relationships are depicted in detailed hydrogeological cross-sections A-A' through D-D' (**Figures 3.6-4** through **3.6-8**).

Kelly (1963) and Rautman (1980) present the details of uranium ore-bearing rocks and uranium production in this area. Production of uranium started in the 1950s in the underground mines in the Ambrosia Lake area, which represented the majority of uranium ore production from this region. The ore-bearing rocks in this area consist

primarily of Jurassic units, including the Westwater Canyon Sandstone Member of the Morrison Formation and the Todilto Limestone at the base of the Wanakah Formation (**Figure 3.6-1**). Both of these units outcrop to the north of the site within the San Mateo Creek and Lobo Creek alluvial drainages. The Quaternary alluvial materials at the site were partly derived from the erosion of ore-bearing bedrock. As a result, the alluvium contains significant concentrations of naturally occurring uranium, as well as selenium and molybdenum, which are typically present in uranium deposits.

3.6.1 Surface Geology

Surface sediments at the Homestake site are composed of San Mateo alluvium with lesser amounts of aeolian deposits (NRC 2007). Alluvial sediments beyond the site boundaries consist of the Lobo Canyon alluvium to the east and the Rio San Jose alluvium to the west. Because the source of alluvial sediments at the site includes uranium-ore bearing rocks upstream from the site, the alluvial deposits may contain elevated concentrations of naturally occurring uranium and selenium (NRC 2004). Alluvial sediments at and in the vicinity of the site were deposited on an uneven bedrock surface composed of the Chinle Formation. The Jurassic-age Morrison Formation and Cretaceous-age Dakota Formation are exposed east of the site on the flanks of La Jara Mesa. The Chinle Formation, which underlies the project area, is not exposed at the surface in the near vicinity of the project area (Dillinger 1990, NMBGMR 2003).

Located east of the site, Mount Taylor represents a composite volcano composed of Pliocene (5.3 to 2.6 million years ago) andesitic to dacitic volcanic rocks, and the capstones of La Jara Mesa, Black Mesa, and Grants Ridge are composed of associated basaltic and andesitic lava flows. The Malpais lava flow south of Grants is Holocene in age (younger than 10,000 years) and is also basaltic to andesitic in composition (Dillinger 1990, NMBGMR 2003).

Rock fall and landslides along the slopes of nearby mesas and ridges are the dominant mass wasting process in the vicinity of the site. No mass wasting, significant erosion, slumping, or land sliding has occurred within the site boundaries.

3.6.2 Bedrock Geology

The Chinle Formation is a sequence of terrestrial rocks deposited during the Triassic Period (approximately 250 to 200 million years ago) by streams that originated in the Mogollan and Uncompahgre Highlands (Cooley et al. 1969). Known thicknesses of the Chinle Formation vary from 360 to 2,080 feet within Cibola County (Baldwin and

Rankin 1995). Lithologically, the Chinle Formation is dominated by mudstones and siltstones deposited in a fluvial overbank setting. Fluvial channel deposits are represented by three significant sandstone units within the Chinle Formation that also form distinct aquifers (**Section 3.7**). Beneath the site, the Chinle Formation generally dips to the east or northeast, resulting in subcrops (subsurface contact with the base of the alluvium) of each of the sandstones on the west and south sides of the project area (NRC 2004).

The Chinle Formation is underlain by the San Andres Formation (Early Permian). This formation is composed of dense, fossiliferous limestone that may be interbedded with marine sandstone or dolomitic limestone. The upper contact between the Chinle and San Andres Formations may be uneven due to karsting within the upper San Andres Formation (Dillinger 1990, NMBGMR 2003). The San Andres Formation is underlain by the Glorietta Sandstone (Early Permian).

3.6.3 Structural Setting

The site is located within the southeastern part of the Colorado Plateau on the northeast flank of the Zuni Uplift. Regional structural features are shown in **Figure 3.1-2**. The Zuni Uplift is a northwest-trending anticline composed of Precambrian crystalline basement rocks overlain by Permian to Jurassic sedimentary rocks uplifted during the Laramide Orogeny of the Late Cretaceous and Early Tertiary (approximately 100 to 35 million years ago; Cooley et al. 1969). Uplift caused the northeastern flank of the Zuni Uplift to dip gently to the northeast at approximately 3 to 10 degrees (Kelley 1967). **Figures 3.6-1** through **3.6-5** depict the shallow northeasterly dip of the Chinle Formation near Grants. Steeply dipping normal and reverse faults near the Zuni Uplift south and east of the site generally trend to the northeast, radiating away from the core of the uplift. Most of these faults are downthrown to the southeast and originated as steep reverse faults during formation of the Zuni Uplift. Others, such as the Bluewater Fault, are downthrown to the west (Smith 1954). The development of more recent northeast-trending, high-angle normal faulting associated with the Rio Grande Rift resulted in a shift of the regional stress field from compressional to extensional, which may have reactivated some of these faults as normal faults (Lorenz and Cooper 2001). The large northeast-striking San Mateo normal fault, located 7 miles northeast of the site, has a vertical displacement of as much as 450 feet (Santos 1970).

Two small-scale normal faults (West Fault and East Fault) that cross the project area have created offset within the Chinle Formation (**Figure 3. 6-1**). The faults, which are roughly parallel, originate south of the tailings piles and trend to the north-northeast. In general, these two faults are approximately vertical, exhibit an east-side-down sense of

shear, and act as impermeable barriers to groundwater flow within the permeable units of the Chinle Formation in the vicinity of the site. Previous interpretations are consistent with recent evaluation of lithologic and geophysical logs from drilling investigations at the site and indicate that structural offset generally increases to the north along both faults (NRC 2004). Offset along the faults is generally greater to the north along both faults (NRC 2004). Structural offset within the Chinle Formation has resulted in juxtaposition of permeable sandstones and relatively impermeable mudstones and siltstones across the two faults.

The faults generally act as impermeable barriers to groundwater flow within the Chinle Formation aquifers in the vicinity of the site. However, the East Fault entirely loses slip displacement immediately south of the Felice Acres subdivision (i.e., aquifer units are not vertically offset) where water levels and pump test results indicate adequate hydraulic connectivity across the southernmost portion of this fault (**Figures 3.6-6** through **3.6-9**; HMC and Hydro-Engineering 2010). The magnitude of structural offset of the underlying San Andres-Glorietta regional aquifer is much lower than the vertical thickness of the unit and does not appear to significantly affect groundwater flow in this aquifer.

3.6.4 Seismology

Although numerous faults are present in the vicinity of the site (**Figure 3.6-1**), none exhibit evidence of movement or surface rupture during the Quaternary Period (past 2.6 million years) and they are not considered active by the USGS. Likewise, the closest fault in the USGS Quaternary Fault and Fold Database is located approximately 50 miles east of the site along the Rio Grande Rift (USGS 2011). The Jemez lineament is a fracture zone that extends from southwest of Grants to Los Alamos and Espanola in the Rio Grande valley before continuing east-northeast to the northeastern corner of New Mexico. The Jemez lineament is defined by numerous fractures and magmatic eruptive centers, but seismic activity within this zone is minor near the project area, with most earthquakes being of magnitude 3.0 or less (NMBGMR 2002).

One hundred and fifty-five earthquakes have been recorded since 1973 within 200 miles of the site (**Table 3.6-1** and **Figure 3.6-4**). Ninety-three of those earthquakes were of Richter Scale magnitudes 3.0 or greater and are summarized in **Table 3.6-1**. Sixty-eight percent of these earthquakes have occurred at depths of approximately 3 miles and approximately half of all earthquakes were magnitude 3.4 or below. Five earthquakes have been detected at magnitudes greater than 4.5 and had focal depths ranging in depth from 3 to 15.5 miles.

The most significant earthquake that affected the site was a magnitude 4.1 event that occurred on December 24, 1973. The epicenter of this earthquake was approximately 7 miles east of the site at a depth of 18 miles. Minor damage was reported in the Grants area, and ground motion was also felt at Laguna, Bluewater, and Fort Wingate. The maximum reported Mercalli Intensity was V, or rather strong shaking that can be felt by most people outdoors, some people indoors, may break dishes and windows, and feels similar to the passing of a large train nearby (NEIC 2010).

The NRC evaluated the seismic design aspects of the reclamation plan submitted by HMC to the NRC in the 1993 reclamation plan revision (AKG and Jenkins 1993). The NRC concluded that HMC's seismic design of the slopes of the LTP was acceptable, and the seismic design evaluation issue was closed. Based on NRC's evaluation, the staff concluded that the design of the LTP was sufficient to withstand the recommended Peak Ground Acceleration (PGA) associated with the maximum credible earthquake. Therefore, the slopes were deemed to meet Criterion 4(e) of Appendix A to 10 CFR Part 40. The details of the NRC staff review were discussed in the Technical Evaluation Report (NRC 1999).

3.7 Surface Water Hydrology

A complete description of the surface water hydrology is provided in section 3.2 of the Updated CAP.The site is located within the San Mateo Creek, Lobo Creek, and Rio San Jose drainages (**Figure 3.7-1**). A drainage map of the vicinity of the Homestake Grants site is shown in **Figure 3.7-2**. Detailed information about the San Mateo Creek and the Rio San Jose drainages is presented in Appendix D of the Updated CAP.

Although there are no streams on the site, the site employs a variety of strategies to limit or manage groundwater interaction with both stormwater and water used in CAP operations. Details of these strategies are provided in sections 3.2.1, 5.3.4, and 5.3.5 of the Updated CAP (HMC 2012a).

Several ponds were constructed at the Site as part of site operations and reclamation (**Figure 2.1.-1**).

Two collection ponds (East Collection Pond and West Collection Pond) were constructed in 1985 and commenced operations in October 1986. These were originally part of the main milling process receiving a brine waste stream from an ion exchange plant designed to extract uranium from the tailing pond solution. More recently, the two collection ponds have been used as part of the groundwater

restoration program. A detailed discussion on these ponds is provided in **Section 9** of this report.

EP-1 was constructed in 1990 on the STP to assist the dewatering of the LTP and to hold water pumped from the collection wells of the groundwater restoration plan. EP-2 was designed and constructed in 1995 to increase storage and treatment capacity for contaminated groundwater as part of HMC's ongoing groundwater restoration program under NMED DP200 and DP725 and NRC license conditions. HMC requested approval from the NRC in 2006 for the construction of a third evaporation pond (EP-3) to allow HMC to run the RO WTS at its designed capacity. Construction of EP-3 was approved by the NRC in August 2008 (NRC 2008b). Additional approvals were required by the Office of the State Engineer (OSE) Dam Safety Bureau and the NMED (Kleinfelder 2011).

Until 1993, there were two impounded areas (East and West Cells) within the LTP that contained standing water. Although some of the impounded tailings water within the cells in the LTP infiltrated into the tailings and became pore fluid within the tailings, most of the water within the cells was removed by evaporation, both natural and spray-enhanced (AKG and Jenkins 1993). Protection against erosion by surface water has been designed for the runoff that would be caused by the greatest possible precipitation event, the PMP storm for San Mateo Creek. For the Homestake Site, two PMP events are applicable – the regional or general PMP storm that affects the entire San Mateo watershed and the local PMP that affects the mill site (AKG and Jenkins 1993). The former determines the parameters of the flood, the Probable Maximum Flood (PMF) that would originate upstream and pass across portions of the site, while the latter determines the maximum rainfall (PMP) directly onsite and the resulting PMF runoff originating on the site itself (**Figure 3.1-2**). Hydrologic analyses conducted for the general storm or regional PMP/PMF event show that the peak PMF discharge would be 169,800 cubic feet per second (cfs) resulting from a PMP of 12.2 inches over a storm duration of 24 hours (HMC 1988). Consequently, the erosion protection designs took into account two different and separate PMP/PMF events. The other PMP/PMF event that affects potential erosion is the local 1-hour PMP/PMF, the rainfall and resulting runoff from the site. The local 1-hour PMP would result in rainfall totaling 9.94 inches (AKG and Jenkins 1993). The details of the resulting velocities and discharges of runoff determined for the regional, local, and 1-hour PMP/PMF event are reported in the 1993 Reclamation Plan Volume 1 (AKG and Jenkins 1993).

To reduce the potential erosion due to onsite precipitation to a minimum, several design measures were used in the reclamation plan. To reduce the potential for

erosion of the tailing piles, the top surfaces were contoured to minimize slope gradients and flowpath lengths to the extent possible without compromising other design objectives. Hydrological analyses of the regional or general storm of the San Mateo watershed indicated that the toe portions of the north and west side slopes of the LTP required protection against potential erosion caused by the regional PMF (approximately 8-foot thick layer of sand and rock covering; HMC 1988, AKG and Jenkins 1993). For the rest of the site, cover placement and recontouring in the mill area were designed to keep surface gradients sufficiently flat, so that PMP runoff produces shear stresses lower than allowable shear stresses for the cover materials used (i.e., gravelly sand; AKG and Jenkins 1993).

In addition, surface water discharges from the Lobo Canyon portion of the San Mateo watershed follow a drainage course that cuts across the northeast corner of the mill site. The channel of this water course is poorly defined during flood events; some of this discharge would flow across a portion of the mill area and between the tailings piles. A flood diversion levee was constructed to divert not only San Mateo flood flows and Lobo Canyon floods to the north and west of the mill and the reclaimed tailing embankments, but also a large portion of what would otherwise be the upstream end of the onsite watershed (**Figure 3.1-2**; AKG and Jenkins 1993). Additional discussion of the diversion levee is presented in **Section 2.2.2.1**.

Starting in 2000, Homestake has applied land treatment water from alluvial water supply wells to four fields located in Section 28 (100-acre center pivot irrigation), Section 33 (24-acre flood irrigation area and 150-acre center pivot irrigation area), and Section 34 (130-acre flood irrigation area) corresponding to approximately 400 acres (**Figure 2.1-1**). **Table 3.7-1** provides the total annual land treatment water usage for these four irrigation fields between 2000 and 2011 (HMC et al. 2012). Surface land treatment during this time has varied from 201 acre-feet in 2010 applied to the 120 acres of section 34 to 1,054 acre-feet in 2008 applied to the 394 acres of Sections 28, 33, and 34. Only 213 acre-feet of water were applied to the Section 28 area in 2011. No further information on the East Ditch was available. Land treatment is discussed in detail in the Updated CAP for the site.

3.8 Groundwater Hydrology

The City of Grants (Cibola County) is included within the Bluewater Underground Water Basin, which falls under District I (Albuquerque) of the NMOSE. The shallow unconfined aquifer within the Grants area includes the Quaternary Alluvium and surficial volcanic flows (basalt composition) related to the Mt. Taylor volcanic field cap. Deeper confined aquifers include three sandstone aquifers within the Chinle Formation

and a regional aquifer in the San Andres Limestone and the Glorietta Sandstone. In general, the San Andres Limestone and the Glorietta Sandstone are considered to be a single aquifer in the Grants area. Detailed descriptions of each aquifer unit are provided in HMC's Updated CAP.

3.9 Natural Resources

No known sources of naturally occurring metallic or non-metallic minerals or ores are present at the site. Industrial aggregate and limestone are mined at the Tinaja Pit approximately 20 miles southwest of the site, and a gravel pit formerly operated east of the site. However, development of similar resources within the site is not expected to be in demand in the foreseeable future. Perlite is mined at the United States Gypsum Mine and Mill, approximately 7 miles south in Grants (NMBMI 2001).

Proposed uranium developments in the area include Roca Honda Resources' Roca Honda Mine in McKinley County and Laramide Resources' La Jara Mesa Mine in Cibola County. At this time, neither proposed mine has been approved. Coal is being developed in Cibola County, but not in the immediate vicinity of the site, and coal resources do not exist at the site (NMEMNRD 2010).

Twenty-three oil and gas wells have been drilled in Cibola County, all of which have been subsequently plugged and abandoned (NMOCD 2011). Oil and gas operations development is not anticipated to occur in the vicinity of the project area in the foreseeable future.

The San Mateo Creek basin contains 85 legacy uranium mines that were operational at one time and four legacy uranium mill sites (NMED 2010 and 2009). The HMC Grants site is one of these mill sites. The background concentrations of groundwater COCs (a.k.a., cleanup levels) in four aquifer units impacted by historical HMC activities generally exceed federal and state drinking water standards (NMED 2010). Contamination from upgradient legacy uranium mine and mill sites within this basin may, in part, serve as the origin of these elevated background contamination concentrations. According to HMC, far upgradient geochemical data indicate that overall alluvial groundwater quality relative to drinking water standards is worse in the immediate upgradient vicinity of HMC, possibly due to the continual migration of groundwater that has been impacted from the high concentration of legacy uranium sites located in this area of the basin (NMED 2010).

Surface water and groundwater hydrology for the HMC Grants site are discussed in detail in the Updated CAP (HMC 2012a). Groundwater impacts onsite and offsite have

rendered alluvial groundwater and, to an extent, water produced from the Chinle Formation, non-potable. Alternative water sources have been developed for most residences downgradient of the site. Groundwater within and downgradient of the site, within the alluvial and Chinle aquifers, is not considered to represent a usable natural resource at this time.

No perennial natural surface waters are present within the project boundaries. Water contained within the evaporation ponds is not considered a natural resource.

3.10 Ecology/Endangered Species

This section describes the existing ecological resources within the HMC Grants Reclamation Project. Information sources reviewed for this section include historical documents that summarize ecological information for the project area (HMC 1982, Salter 1990, NRC 1993a, Bridges and Meyer 2007, NRC 2008a), county lists of threatened and endangered species and species of concern (USFWS 2010, NHNM 2011), online natural history information databases (New Mexico Rare Plant Technical Council 1999, Biota Information System of New Mexico 2009, NatureServe 2010), and topographic and aerial maps of the project area.

3.10.1 Regional Setting

The project area is located within the Semiarid Tablelands ecoregion of the Arizona/New Mexico plateau (EPA 2010). The Semiarid Tablelands ecoregion contains areas of high relief and some low relief plains. It is characterized by canyons, valleys, mesas, and plateaus formed primarily from flat to gently sloping sedimentary rocks, in addition to areas of Tertiary and Quaternary volcanic fields. Bedrock exposures are common features in this ecoregion. The tablelands are vegetated with woodland, shrubs, and grass. Shallow, stony soils support scattered to dense stands of junipers (*Juniperus* spp.), and pinyon-juniper woodland is common in some areas. Other characteristic vegetation includes saltbush (*Atriplex* spp.), alkali sacaton (*Sporobolus airoides*), sand dropseed (*Sporobolus cryptandrus*), and mixed grama grasses (*Bouteloua* spp.). Vegetation is not as sparse as in the San Juan/Chaco Tablelands and Mesas ecoregion to the north or the Albuquerque Basin ecoregion to the east. The Semiarid Tablelands ecoregion lacks the dense pine forests typical of the higher-elevation Arizona/New Mexico Mountains ecoregion (EPA 2010).

3.10.2 Baseline Data

Baseline ecological data were not collected for the HMC project site prior to initial disturbance in 1957, because collection of baseline data was not required by regulations at the time. Pre-mining land uses included grazing and farming (HMC 1982), and vegetation and wildlife found within the project area during that time were likely similar to those currently found in the habitats beyond the HMC project site footprint. Baseline ecology data were collected in 1990 for a proposed tailings disposal area that was to be located in T12N, R10W, sections 9, 10, 15, and 16. This area is located northwest of EP-3. For this baseline study, a wildlife biologist walked regular north-south transects at 300-foot intervals throughout the tailings basin, recorded wildlife observations, and mapped habitat types (Salter 1990). No sensitive ecological resources (e.g., threatened and endangered species or their habitats) were observed in this baseline study.

A biologist visited the site in 2006 to collect baseline data for the environmental assessment for the construction of EP-3 on an additional 185 acres to be included in the license boundary (Bridges et al. 2007, NRC 2008a). No sensitive ecological resources (e.g., threatened and endangered species or their habitats) were observed in this baseline study. The NRC issued an Environmental Assessment of License Amendment 41 in July 2008 and concluded that construction and operation of EP-3 was not anticipated to have any effects on threatened or endangered species or their habitat. Therefore, no mitigation measures were deemed to be required at that time in order to prevent impacts to threatened and endangered species (NRC 2008a). Mitigation measures would be required if it was determined that wildlife or migratory bird mortality was found to be occurring. License Amendment No. 41, which addressed the construction of EP-3 (**Figure 2.1-1**), was approved by the NRC on August 7, 2008 (NRC 2008b). Once the HMC mill site groundwater restoration program is completed, EP-3 and associated assets will be removed and, along with any contaminated soils, will be disposed of in EP-1 and/or EP-2 as part of the overall mill site decommissioning plan. The 185-acre site will be returned to unrestricted use following achievement of NRC clean closure requirements and removed from the license boundary via a license amendment request.

3.10.2.1 Vegetation

Vegetation types within the project area and immediate vicinity largely consist of semi-desert grassland, mixed salt desert scrub, and greasewood flat (Southwest Regional Gap Analysis Project 2004). The project area has been subject to human disturbance for more than 50 years. In 1995, much of the project area was bladed and reseeded

with a seed mixture consisting of western wheatgrass (*Pascopyrum smithii*), blue grama (*Bouteloua gracilis*), sand dropseed (*Sporobolus cryptandrus*), Indian ricegrass (*Achnatherum hymenoides*), alkali sacaton (*Sporobolus airoides*), and fourwing saltbush (*Atriplex canescens*) (NRC 1993a). Other common plant species found within the project area include kochia (*Kochia* spp.), bottlebrush squirreltail (*Elymus elymoides*), Russian thistle (*Salsola tragus*), broom snakeweed (*Gutierrezia sarothrae*), three-awn (*Aristida* spp.), spike dropseed (*Sporobolus contractus*), galleta grasses (*Pleuraphis* spp.), greasewood (*Sarcobatus vermiculatus*), sand sage (*Artemisia filifolia*), and narrowleaf yucca (*Yucca angustissima*). Limited areas of saltcedar (*Tamarix ramosissima*) are present along the ephemeral San Mateo Creek (HMC 1982, Bridges et al. 2007, NRC 2008a).

3.10.2.2 Wildlife

Due to the continuing human disturbance within the HMC project site, wildlife species found in the project area include those that are common in desert landscapes and relatively tolerant of human disturbance. **Table 3.10-1** lists species known to occur within the project area or immediate vicinity.

Based on HMC aerial photography (11/2009), there are several small prairie dog colonies in the vicinity of the HMC project site, including one in the southernmost portion of the project area totaling about 7 hectares. Discussions with site management and a tour of the area on January 25, 2011, indicated that prairie dog populations are limited on the southernmost portion of the project area. HMC site personnel indicated that prairie dogs have been observed to the southwest and west of the mill site. In addition to the species in the table above, various species of shorebirds and waterfowl have been observed using the evaporation ponds in the project area during spring and fall migration (HMC 1982, Bridges et al. 2007).

3.10.2.3 Aquatic Ecology

The ephemeral San Mateo Creek exists within the project area and flows only after heavy precipitation events or snow melt. There is no distinct channel for this drainage within the HMC project site (Bridges et al. 2007). The evaporation ponds are the only source of surface water within the HMC project site boundary. There are no native aquatic habitats, riparian areas, or wetlands within the project area. The significant aquatic habitat nearest to the project area is Bluewater Lake, a man-made impoundment of Bluewater Creek, located about 14 miles to the west.

3.10.2.4 Threatened and Endangered Species and Species of Concern

The websites of the U.S. Fish and Wildlife Service (USFWS) New Mexico Ecological Services Field Office and Natural Heritage New Mexico (NHNM) were queried for lists of threatened and endangered species and species of concern known to occur in Cibola County. **Table 3.10-2** lists these species and describes their potential for occurrence within the project area.

As described in **Table 3.10-2**, the majority of listed species and species of concern known to occur in Cibola County have no potential to occur in the project area due to a lack of suitable habitat. The exceptions are American peregrine falcons, arctic peregrine falcons, and bald eagles, which may occasionally pass through the project area during migration; cinder phacelia, mountain plovers, and western burrowing owls, which can inhabit disturbed areas and areas near people; and spotted bats, which may occasionally obtain water or forage in the project area.

3.11 Cultural Resources

3.11.1 HMC Project Licensed Area

The HMC mill and tailings disposal system was originally constructed between 1956 and 1958. There were no surveys for historic and cultural resources performed prior to the initial disturbance. The areas disturbed by mill construction and operation and soil cleanup included most of Section 26, portions of the S½ of Section 23, the SW corner of Section 24, and the NW¼ of Section 25 of T12N R10W (HMC 1993a). Prior to mill construction, portions of Section 26 and the S½ of Section 23 were used for agriculture (i.e., crop production). From records available, there is no indication that an historic or cultural inventory was conducted in these sections prior to agricultural activities or the mill construction in 1956 through 1958. The area immediately surrounding the mill area and LTP and STP in Section 26 of T12N R10W (mill and surrounding area, LTP and STP) was heavily impacted by construction and operations over the years. Information available is not sufficient to ascertain the existence, or lack thereof, of any historic or cultural resources that might have been impacted by earlier agricultural or milling activities (HMC 1993a).

Decommissioning activities, including the extension of the LTP embankment side slope as part of the reclamation, only impacted areas which already had been heavily impacted. Therefore, with the commencement of decommissioning in 1993, no impacts to historic or cultural resources were expected or identified. Other undisturbed areas, such as soil or rock borrow areas, windblown contaminated areas, and nearby

EP-3, were eventually surveyed for historic or cultural resources prior to and during disturbance (see discussions below).

In June 1993, the New Mexico State Historic Preservation Office (NMSHPO) contacted the NRC in order to ensure that the requirements of 36 CFR 800, specifically Criteria Consideration G of National Register Bulletin 15 for structures less than 50 years old, were addressed prior to the NRC authorizing demolition of the mill. The NRC concluded that, because the HMC mill did not represent the sole survivor of the uranium milling era and did not use unique processing methods, it was not of exceptional importance and did not achieve special significance. The NRC provided their conclusion that the HMC mill was not eligible for inclusion in the National Register of Historic Places (NRHP; NRC 1993b). The NMSHPO concurred with the NRC that the site was not eligible for inclusion in the NRHP (NMHPD 1993a).

Beginning in 1990, there were a total of eight cultural resource inventory surveys, as well as several testing and evaluation activities, conducted for areas planned for disturbance associated with reclamation and decommissioning. These areas had not been previously subjected to major soil disturbance activities (i.e., Rock Borrow Area, soil borrow areas, and windblown contamination areas subject to contaminated soil removal). All of these surveys were conducted by professional third parties with specialization in cultural resource management. All of the inventory reports and associated submittals were submitted to the NMSHPO for review. Concurrence was granted for all of the inventory reports, which in some cases required follow-up actions (e.g., testing, evaluation, and monitoring; and research design and data recovery pan). Copies of cultural resource investigations within the license boundary (i.e., EP-3) were submitted to the NRC for review and handling per provisions of the National Historic Preservation Act of 1966, as amended through 1992 and state standards for cultural resource management. Cultural resource inventory tasks were carried out under consultation of the NMSHPO. There are no outstanding issues associated with the completed cultural surveys.

No additional cultural resource inventories are planned because all areas to be disturbed have either already been disturbed (e.g., Section 26 of T12N R10W, borrow areas and windblown contaminated areas) or cultural surveys have already been conducted. In the event undisturbed areas outside of the license boundary need to be disturbed (e.g., stormwater diversions and drainages), HMC will consult with the NMSHPO.

This section provides a summary of the cultural resource surveys conducted for the Rock Borrow Area, soil borrow areas, and windblown contaminated areas. Details can be viewed in the individual reports referenced in this section. **Figure 3.11-1** shows the individual cultural resource survey locations. The purpose of these surveys was to evaluate rock and soil borrow areas, areas containing windblown contamination, and the area of construction of EP-3 (shown on **Figure 2.2-3**) for cultural artifacts prior to any surface disturbances.

3.11.2 Rock Borrow Area

HMC operated a rock quarry approximately 1.5 mile to the west of the LTP in the N½ of the NE¼ of Section 28, T12N R10W (**Figure 2.1-1**). The area of the rock quarry occupies approximately 120 acres and encompasses the El Malpais outcrops of basalt lava.

A cultural resources survey of the Rock Borrow Area was conducted by an archaeological consulting firm for HMC during the middle of April, 1993 for an area of approximately 1,200 acres (SAC 1993a). This surveyed area included the area of the proposed rock quarry located in the NE¼; portions of the NE¼ and SE¼ of the NW¼ of Section 28 of T12N R10W (**Figure 3.11-1**).

There were 11 sites identified in the study area, with all sites recommended as significant based their demonstrated research potential. Three of the sites were further addressed in a treatment plan attached to a research design and data recovery plan provided by HMC's archaeological consultant (SAC 1993b). HMC agreed to avoid these sites during quarry operations by adjusting the boundary of the mining activities. Two of the sites close to the quarry operations were fenced prior to operations in order to assure protection. All identified cultural resources sites were not disturbed during the quarry activities. The NMSHPO concurred that the quarry project would have no adverse effect on properties eligible to the NRHP, provided that the "treatment plan" provided by HMC was properly implemented (NMHPD 1993c).

3.11.3 Soil Borrow Areas

There were four major borrow areas for recovery of soils for reclamation/decommissioning of areas within the license boundary: West Borrow Area, Northwest Borrow Area, and North Borrow Area, and East Borrow Area (**Figure 2.2-3**). Cultural resource inventory surveys were made in these areas prior to disturbance, with the results summarized below.

The borrow areas should not be confused with a typical open and deep gravel pit. These are areas that have only been scraped down to an average of approximately 2 to 4 feet. The sites remain relatively flat and blend into the surrounding terrain. Soils are only removed from specific areas of each borrow area in order to acquire the preferred soils based on testing. Therefore, much of the borrow areas are typically only minimally impacted. The largest of the borrow areas, the North Borrow Area and the East Borrow Area, are located outside of the license boundary. Therefore, there has been minimal impact from these types of activities within the Grants license boundary.

3.11.3.1 West Borrow Area

The West Borrow Area is composed of an area immediately to the west of the LTP, where a cultural resource survey was conducted: Section 27 (NW¼; NE¼; and NW¼ of the SE¼) and Section 28 (NE¼; portions of the NE¼ and SE¼ of the NW¼) (Location ID No. 1 of **Figure 3.11-1**). The location of the borrow area is shown on **Figure 2.2-3**. The borrow area occupies approximately 142 acres.

A cultural resources survey was conducted by an archaeological consulting firm for HMC during the middle of April 1993 for an area of approximately 1,200 acres (SAC 1993a; Location ID No. 1 of **Figure 3.11-1**). This survey included the rock borrow area discussed above and the area of the West Borrow Area located in the sections described above. There were two sites identified in the proposed borrow area, with these sites recommended as significant based their demonstrated research potential. One of these sites was determined to be a site that could not be avoided due to soils removal. A treatment plan was developed to address further assessment of this site. The proposed treatment plan was that the site be excavated and sampled. The cultural resources inventory report was submitted to the NMSHPO in August 1993 (HMC 1993b). The NMSHPO concurred that the area including the West Borrow Area would have no adverse effect on properties eligible to the NRHP, provided that the treatment plan proposed by HMC was properly implemented (NMHPD 1993b). A treatment plan was submitted by HMC to the NMSHPO in December 1993 (HMC 1993c). The other site was recommended as a site to avoid, and HMC committed to not disturb this site. The NMSHPO approved the treatment plan in December 1993 (NMHPD 1993c).

3.11.3.2 Northwest Borrow Area

The Northwest Borrow Area, which comprises approximately 29 acres, is located at the northwest corner of the license boundary in the SE¼ of Section 22 of T12N R10W (**Figure 2.2-3**). This area was included in the cultural resource inventory survey

conducted for the areas containing the Rock Borrow Area and West Borrow Area (SAC 1993a). There were no cultural resources identified in this area (Location ID No. 1 of **Figure 3.11-1**) that were recommended as significant based on their demonstrated research potential (SAC 1993a).

3.11.3.3 North Borrow Area

The North Borrow Area is located north of the license boundary (**Figure 2.2-3**) and comprises approximately 788 acres. Plans are to use this borrow area for soils required during final reclamation and decommissioning. Two different cultural resource surveys were conducted in the North Borrow Area.

A cultural resources survey was conducted by an archaeological consulting firm for HMC during March 1994 for an area of approximately 404 acres (SAC 1994; Location ID No. 3 of **Figure 3.11-1**). The cultural resource inventory was conducted in an area included in T12N R10W Section 23 (N½ of N½) and Section 24 (NW¼ of NW¼) (**Figure 3.11-1**). In addition to assessing this site as a potential borrow area, a secondary purpose was to gather additional information on a possible Pueblo III community identified in an earlier survey (SAC 1993b). The NMSHPO responded to the request (HMC 1994b) for consultation for the proposed use of the 404 acres with recommendations for protection and mitigation of selected sites (NMHPD 1994).

Five sites identified in the study area were recommended as significant based on their demonstrated research potential. One site was located outside of the proposed borrow area. Only one of the sites could be avoided due to borrow activities. Therefore, the remaining four sites were subject to further investigation. The investigation of these sites was included in the cultural resource testing, evaluation, and monitoring of eight sites in March 1995 (CASA 1995). Based on the results of the testing and review by the NMSHPO, four sites were not eligible to the NRHP, and two sites should be protected during surface disturbance in the area. The NMSHPO concurred with HMC's recommendation to re-fence all eligible sites until completion of reseeding and the removal of the fencing once vegetation had become established (NMHPD 1995b). HMC carried out these tasks.

A second survey was conducted in area of the North Borrow Area just to the north of the LTP. This area is located directly north of the LTP (Part of S½ of S½ of Section 23 of T12N R10W; Location ID No. 7 of **Figure 3.11-1**). One cultural resource (LA100359) subject to testing and evaluation in this area is discussed in cultural resource inventory reports conducted in 1993 (SAC 1993a) and 1995 (CASA 1995). One of the sites in the 1993 report was one of the sites determined to not be avoidable

due to windblown tailings material and must be removed per NRC requirements. Therefore, the approved recommendation was for excavation. The other site in the borrow area is discussed in a 1995 cultural resources inventory survey report (CASA 1995; see section below discussing the North Borrow Area). The stipulation of the NMSHPO was that this site be protected during cleanup activities (NMHPD 1995a). The NMSHPO determined that one site was not eligible to the NRHP (NMHPD 1995a). The NMSHPO concurred with HMC's recommendation to re-fence all eligible sites until completion of reseeding and the removal of the fencing once vegetation had become established (NMHPD 1995b). HMC carried out these tasks.

3.11.3.4 East Borrow Area

The East Borrow Area is located to the east of State Hwy. 605 east of the LTP (**Figure 2.2-3**). A cultural resource survey was conducted by an archaeological consulting firm for HMC during March 1994 (SAC 1993a). At the time of the survey, previous gravel operations at the site over a number of years had resulted in disturbed areas (pits, stockpiles, and other features). The East Borrow Area encompasses approximately 419 acres. The cultural survey only included the area within T12N R10W Section 25 (NE¼, and SW¼ of the NW¼; eastern block of Location ID No. 1 of **Figure 3.11-1**). The cultural resource survey identified three sites (lithic and shard scatter) that will be avoided by HMC in the event gravel operations at the site take place. Currently, there are no plans to use the East Pit for final reclamation.

3.11.3.5 37-Acre Borrow Area East of Mill Site

A Class III cultural resource inventory was undertaken on a proposed borrow area on private lands east of the HMC mill site (T12N R10W NW¼ Section 30; Location ID No. 4 of **Figure 3.11-1**) in August 1994 by an archaeological consultant for HMC (CASA 1994a). The field work was done under the provisions of New Mexico State Permit 94-023. A 2,000-foot long by 800-foot area totaling approximately 37 acres was surveyed. No cultural resources, either sites or isolated finds, were reported within the survey parcel (CASA 1994a). A recommendation for a cultural resource clearance was submitted by HMC's consultant to the NMSHPO (CASA 1994b). This borrow area was never used. Currently there is no planned use of the borrow area, but if needed, it would be used.

3.11.4 Acreages with Wind-Blown Contamination

3.11.4.1 85-Acre Area Northeast of Mill Site

A Class III cultural resource inventory was undertaken on a parcel of private land northeast of the HMC mill site (T12N R10W SW¼ Section 24; Location ID No. 5 of

Figure 3.11-1) in September and October 1994 by an archaeological consultant for HMC (CASA 1994c). The field work was done under the provisions of the New Mexico State Permit 94-023. An irregular shaped area totaling approximately 85 acres was surveyed. There were two isolated finds that were not considered significant. A cultural resource clearance was recommended by HMC's consultant for the 85-acre parcel.

3.11.4.2 135-Acre Area Northeast of Mill Site

A Class III cultural resource inventory was conducted on approximately 135 acres of land situated just northeast of the HMC mill site (T12N R10W Section 24; Location ID No. 6 in **Figure 3.11-1**) in September, October, November, and December 1994 by an archaeological consultant for HMC (CASA 1994d). The surveyed site was primarily on private lands owned by HMC with approximately 20 acres located on U.S. Bureau of Land Management (BLM) land. The field work was done under the provisions of the New Mexico State Permit 94-023 and New Mexico CRUP 12-2920-93-1. The 135-acre survey area includes the 85 acres previously surveyed (CASA 1994c). This area was subject to cleanup for windblown contamination.

The results of the survey resulted in the location of no cultural resource sites. Two isolated finds, both small shard scatters, were recorded. These isolated finds were not considered significant or eligible for nomination to the NRHP. HMC's consultant recommended a cultural resource clearance for the acreage.

3.11.4.3 Eight Sites North of HMC Mill Site Subject to Additional Investigation

Archaeological significance testing, evaluation, and monitoring were conducted on eight sites lying within the windblown contamination cleanup area north of the HMC mill site (T12N R10W Section 23; Location ID No. 7 of **Figure 3.11-1**). Section 23 is also the location of the North Borrow Area. Therefore, the results of this study are also discussed for applicable sites located in these borrow areas, which were discussed earlier in this section.

The cultural resource inventory was conducted on private lands owned by HMC under consultation with the NMSHPO (CASA 1995). There were a total of eight cultural resource sites identified that were considered eligible for nomination to the NRHP. Five were located within an area designated for removal of windblown contaminated material, and three were located within proposed borrow areas.

Testing was conducted in March 1995 to determine whether significant subsurface deposits or features were present in the eight sites. Testing suggested that three of

the sites contained significant subsurface deposits and features, and that five sites were small surface artifact scatters. Five sites were monitored during the contaminated material removal process in April 1995. Monitoring at two of the sites suggested that these sites may also contain subsurface features and cultural deposits. As a result of testing and monitoring, five sites were considered significant and eligible for nomination to the NRHP. Three sites were not considered to be significant or eligible for nomination to the NRHP. No cultural deposits or features were disturbed during removal of windblown contaminated materials. Three sites were completely avoided by borrow activities and will be avoided in the future. All sites considered eligible for nomination to the NRHP were referenced for avoidance during reseeding activities. The NMSHPO agreed with the recommendations of HMC's archaeological consultant, with the exception of one site. The NMSHPO recommended that this site be considered eligible and either protected from damage during the cleanup or subjected to data recovery (NMHPD 1995b). The NMSHPO concurred with HMC's recommendation to re-fence all eligible sites until completion of reseeding and the removal of the fencing once vegetation had become established.

3.11.4.4 Evaporation Pond No. 3

License Amendment No. 41, dated August 7, 2008, approved the construction of EP-3 and provided License Condition 43, which requires HMC to conduct cultural resource inventories for all disturbances in areas not previously assessed by the NRC in compliance with the National Preservation Act (as amended) and implementing regulations and the Archaeological Resources Protection Act and its implementing regulations. EP-3 was located on private lands approximately 1,800 feet north of the current northern license boundary (County Road 63), and the current license boundary was expanded by approximately 185 acres to include this facility (HMC 2006). The area impacted by the EP-3 consists of approximately 33 acres, which includes the service corridor and earthen containment dike. The actual evaporation pond surface area is approximately 26.5 acres. The location of the cultural resources survey is shown on **Figure 3.11-1**.

The cultural resources survey was conducted in June 2006 for approximately 350.3 acres (TEC 2006). There were two separate block units (East and West) surveyed, which included an access road and a 50-foot buffer around the perimeter of the parcels. EP-3 was located in the eastern block (Location ID No. 8 of **Figure 3.11-1**). There were a total of 11 cultural resource sites, plus one previously recorded site, identified, with only three being recommended eligible for inclusion in the NRHP. The location of the evaporation pond avoided all eligible and undetermined archaeological sites. The NMSHPO concurred with site eligibility and recommendations provided by

TEC (Meyers 2007). The sites addressed by the TEC survey were to be monitored to confirm impacts. The NMSHPO provided a Discovery Clause that required HMC to cease work immediately and protect any uncovered bones, or prehistoric or historic archaeological materials during construction or earth-moving activities. HMC is then required to notify the NMSHPO to determine what steps would need to be taken. The concurrence by the NMSHPO fulfilled NRC's Section 106 responsibility.

Earth-moving and construction activities did not result in the discovery of prehistoric or historic archaeological materials, so there were no significant impacts associated with onsite cultural resources (Bridges and Meyer 2007).

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4. Radiological Status of Facility

Most of the contamination associated with the milling operation has been consolidated with the tailings or mill waste and is currently contained in the mill debris pits or tailings piles. Final cover has been placed over the mill yard. Interim cover exists on top of the tailings piles and debris pits to isolate the material from the environment. The radiological status of the existing site features is of interest in this reclamation plan. These site features include three buildings; two water towers; water collection and evaporation ponds (**Figure 2.1-1**); and wells, pumps, piping, and processing equipment associated with the groundwater restoration program.

4.1 Contaminated Structures

The two water towers supported mill operations and have been retained to support the site reclamation. They are located in the mill yard, which was decontaminated to near background levels and stabilized by placing an average of 2 feet of clean soil and an erosion protection layer over the area (AKG 1996). Upon decommissioning, the tower components will be surveyed to determine whether disposal will be in the onsite WDC or if all or part of the structures can be sold as scrap.

The truck maintenance shop was decontaminated at the time of the mill decommissioning, and it is currently used as a shop/office building. This building is now called the Office/Warehouse Building. A nearby building consists of two bays and is now referred to as Warehouse Building 1. One bay is used for vehicle storage and the other bay is used for general storage of equipment and supplies. The third smaller building is located immediately to the north of Warehouse Building 1 and is used for general storage of equipment and supplies. This building is referred to as Warehouse Building 2. A final release survey was conducted for these buildings in 1997 and 1998 (ERG 1998). While mud and other dirt have been tracked into these buildings over time, no known contaminated vehicles or equipment have been brought into the buildings over more than 10 years of use following the final release surveys. Surface contamination surveys are conducted annually in the office portion of the shop/office building to confirm that work and eating areas are free of contamination. A very small shed attached to the east side of Warehouse Building 1 contains contaminated equipment used for uranium ore assay. HMC anticipates demolishing this building and placing the rubble and shed contents in the WDC.

The above assets are located within the old Truck Yard, which is now referred to as the Administration Compound.

A metal building housing the RO WTS (RO Units No. 1 and No. 2), located near the southwest corner of the LTP, is potentially contaminated, especially the concrete floors and sumps. Bins containing process chemicals used in pretreatment of the feed water and a large clarifier are located outside of the building. Some of the tanks, pumps, and piping associated with pretreatment of water for the RO circuit may not be contaminated, although no data are currently available. Expansion of the RO WTS is currently projected for startup in 2016. Contamination associated with this expansion will be similar to the existing RO Unit, and cleanup and demolition will be similar to the existing system.

Two water collection ponds (East and West Collection Ponds) and three evaporation ponds were constructed by creating berms and lining the ponds with one or more synthetic liners. EP-1 was placed on the STP and has a single liner. The newer EP-2 and EP-3 were constructed on uncontaminated areas and have double synthetic liners with leak detection systems. Both water collection ponds have single liners. Small leaks in the liners of some of the older single-liner ponds have been repaired. The pond areas will be surveyed to determine if any material is contaminated. Any contaminated material will be appropriately placed in the WDC.

4.2 Contaminated Systems and Equipment

The groundwater restoration program consists of the following potentially contaminated items:

- Tailings pile and alluvial aquifer extraction and injection wells
- Pumps and piping
- The RO WTS
- Collection and evaporation ponds and associated spray evaporation systems
- Central pivot and flood irrigation piping and equipment
- Possibly pilot plants for groundwater restoration studies that are currently underway or planned
- Miscellaneous equipment, parts, and supplies located in the "bone yard" area outside of the Administration Compound

All pond liners and pond sludges are expected to be contaminated. Water pumps, valves, pipes, well casings, and RO WTS are potentially contaminated with mill-related radionuclides. Some monitoring wells, deep aquifer extraction wells, and associated equipment may be free of contamination.

4.3 Surface Soil Contamination

Currently, there is minimal surface soil contamination on the site. Upon final reclamation of EP-1, EP-2 and EP-3, these areas will be surveyed to determine the extent of contamination, if any, and removed and disposed of as necessary. In addition, soils in the areas between the LTP and the collection and evaporation ponds (EP-1 and EP-2) also will be surveyed to determine the extent of contamination, if any, and removed as necessary and placed in the WDC.

Finally, irrigation of fields using water containing low concentrations of uranium have slightly increased the uranium concentrations in surface and subsurface soils above the concentrations measured prior to the irrigation program. An extensive sampling program has been in place since 2000, and updates to the annual report are prepared to evaluate potential impacts associated with this program (HMC 2012). In terms of risk to human health, uranium levels are currently acceptable. The dose to man by way of food web uptake calculations is negligible, at 0.05 mrem/yr.

4.4 Subsurface Soil Contamination

Any subsurface contaminated soils located near or beneath structures that are to be decommissioned will be excavated and placed in the WDC. This includes the two water collection ponds, RO Building, EP-1 or EP-2 (dependent upon which is selected as the WDC), EP-3, and groundwater restoration fixtures. Final cover has been placed on the mill yard area (AKG 1996) and thus, no additional work is required. Final cover will be placed on the LTP, STP, WDC, and the two mill debris disposal pits south of the LTP.

Once groundwater restoration has been completed, surface structures have been demolished and disposed of, contaminated equipment and materials have been removed or disposed of, and contaminated soils have been removed and disposed of, radiological surveys of the site will be conducted to ensure that required cleanup levels have been achieved. Radiological surveys are discussed in **Section 15**.

4.5 Surface Water

No streams exist near the radiologically controlled area of the site, which is relatively flat with a slight slope to the south

4.6 References

AK Geoconsult, Inc. (AKG). 1996. Completion Report, Mill Decommissioning, Homestake Mining Company, Grants Uranium Mill. Prepared for Homestake Mining Company of California. February 29

Environmental Restoration Group, Inc. (ERG). 1998. Trucking Yard Buildings Radiological Surveys for Unrestricted Release. February 11

Homestake Mining Company of California (HMC). 2012. Grants Reclamation Project Evaluation of Years 2000 Through 2011 Irrigation with Alluvial Ground Water. Prepared for Homestake Mining Company of California by Environmental Restoration Group, Inc., RIMCON, and Hydro-Engineering, LLC. February.

5. Decommissioning Standards for Soil and Material

This section identifies the applicable decommissioning standards for soil and material for unconditional use at the Homestake Grants Reclamation Project. Soil decommissioning standards for the Grants Reclamation Project are presented in **Table 5.1-1**.

5.1 Unrestricted Release Criteria for Soil

The soil cleanup standards for source and byproduct material are established in 10 CFR 40 Appendix A (NRC 1999). Compliance with these standards allows for release of a licensed facility for unrestricted use.

5.2 Radium-226 Soil Standard

The soil standard for radium-226 is established in 10 CFR 40, Appendix A. Specifically, Criterion 6-(6) of Appendix A states:

> "The design requirements in this criterion for longevity and control of radon releases apply to any portion of a licensed and/or disposal site unless such portion contains a concentration of radium in land, averaged over areas of 100 square meters, which, as a result of byproduct material, does not exceed the background level by more than: (i) 5 picocuries per gram (pCi/g) of radium-226, or, in the case of thorium byproduct material, radium-228, averaged over the first 15 centimeters (cm) below the surface, and (ii) 15 pCi/g of radium-226, or, in the case of thorium byproduct material, radium-228, averaged over 15-cm thick layers more than 15 cm below the surface."

The radium-226 cleanup standards in Criterion6-(6) above apply to the Grants Reclamation Project. No thorium byproduct material exists at the site; therefore, the radium-228 soil cleanup standards do not apply.

The NRC-approved radium-226 background soil concentration for the site is 5.5 pCi/g; this is incorporated in the cleanup criteria in Amendment No. 15 of License SUA-1471 in 1993 (NRC 1993). Based on this approved background concentration of radium-226 in soil and Criterion 6-(6) above, the site soil cleanup standard for radium-226 is 10.5 pCi/g in the upper 15 cm of soil and 20.5 pCi/g below 15 cm of soil.

5.2.1 Other Radionuclide Soil Standards

On April 12, 1999, the NRC issued a Final Rule (64 FR 17506) that requires the use of the existing soil radium standard to derive a dose criterion for the cleanup of byproduct material. The amendment to Criterion 6(6) of 10 CFR Part 40, Appendix A was effective on June 11, 1999. This "benchmark approach" requires that NRC licensees model the site-specific dose from the existing radium standard and then use that dose to determine the allowable quantity of other radionuclides that would result in a similar dose to the average member of the critical group. These determinations must then be submitted to NRC with the site reclamation plan or included in license applications. This section documents the modeling and assumptions HMC made to derive a soil standard for natural uranium (U-nat). Mill-related radionuclides other than radium-226 and natural uranium are not expected to be present in significant concentrations above background, and a cleanup standard has not been developed.

Concurrent with publication of the Final Rule, NRC published draft guidance (64 FR 17690) for performing the benchmark dose modeling required to implement the final rule. Final guidance was published as Appendix E to NUREG-1569 Standard Review Plan for In Situ Leach License Applications (NRC 2003). Although the Grants Reclamation Project is not an in-situ leach facility, HMC believes the methods and assumptions used in NUREG-1569 to develop soil cleanup standards apply. NUREG-1569 discusses acceptable models and input parameters. This guidance, along with guidance from the RESRAD User's Manual (ANL 2001) and the Data Collection Handbook to Support Modeling Impacts of Radioactive Material in Soil (ANL 1993), and site-specific parameters were used in the modeling as discussed in the following sections.

5.2.1.1 Determination of Radium-226 Benchmark Dose

The hypothetical critical group for the Homestake Grants Reclamation Project would be a farmer establishing residence (resident farmer) on land that has been reclaimed. All potential exposure would apply except for radon-222 because the benchmark rule excludes radon-222, and the aquatic food pathway because there are no surface water bodies near the Grants Reclamation Project.

RESRAD Version 6.6 computer code was used to model the Grants Reclamation Project and calculate the annual dose from the current radium-226 cleanup standard. In all but one case, conservative default values within the RESRAD code were used. The site-specific parameter used in the model was precipitation of 0.27 meter per year.

The default values in RESRAD are conservative in nature, so limited site-specific parameters would result in a conservative estimate of dose.

The maximum RESRAD calculated dose from radium-226 contaminated soil is 31.9 mrem/yr for the residential farmer scenario. This dose is based on the 5 pCi/g surface (0 to 6-inch) Ra-226 standard and was noted at time, t = 0 years. The two pathways that contributed to over 90 percent of dose were external dose and plant ingestion (water independent). The external dose pathway accounts for 86 percent of the total dose. The results of the RESRAD data summary are provided in **Appendix E**. The 31.9 millirems per year (mrem/yr) dose from radium-226 is the level at which the natural uranium radiological end point soil standard will be based as described in the following section.

5.2.1.2 Site-Specific Natural Uranium Soil Standard-Radium Benchmark Approach

RESRAD was used to determine the concentration U-nat in soil distinguishable from background that would result in a maximum dose of 31.9 mrem/yr. The method involved modeling the dose from a set concentration of U-nat in soil. This dose was then compared to the radium benchmark dose and scaled to arrive at the maximum allowable natural uranium concentration in soil.

For ease of calculations, a preset concentration of 100 pCi/g U-nat was used for modeling the dose. The fractions used were 48.9 percent (or pCi/g) U-234, 48.9 percent (or pCi/g) U-238, and 2.2 percent (or pCi/g) U-235. The distribution coefficients selected for each radionuclide were RESRAD default values. All other input parameters were the same as those used in the radium-226 benchmark modeling. The RESRAD output showing the input parameters is provided in **Appendix E**.

Using a U-nat concentration in soil of 100 pCi/g, RESRAD predicts a maximum dose of 7.9 mrem/yr at time t = 0 years. The printout of the RESRAD data summary is provided in **Appendix E.**

The following formula was used to determine the site-specific U-nat soil standard:

$$Uranium\ Standard = \left(\frac{100\frac{pCi}{g}}{7.9\ mrem}\right) \times 31.9\ mrem/_y = 404\frac{pCi}{g}$$

The individual limits for radium-226 and U-nat are applied to soil cleanup using the unity rule. To determine whether an area exceeds the cleanup standards, the standards are applied according to Equation 5.2 below:

$$\left(\frac{Uranium\ Soil\ Concentration}{Uranium\ Standard}\right)+\left(\frac{Radium\ Concentration\ in\ Soil}{Radium\ Standard}\right)<1$$

(Equation 5.2)

This approach will be used for future cleanups at the Grants Reclamation Project to determine the radiological impact on the environment from releases of source and byproduct materials.

5.2.1.3 Natural Uranium Soils Standard-Toxicological End Point

Natural uranium, in addition to being radioactive, is also a naturally occurring heavy metal and consequently has chemical toxicity properties. Although radioactive, it has a very low specific activity, and in most cases the chemical toxicological end point is more limiting than the radiological end point, as determine in **Section 5.2.1.2** above. The NMED has adopted generic soil screening levels (SSLs) for a variety of compounds including soluble salts of uranium. The NMED SSLs are based on a 1 E-5 target risk for carcinogens, or a hazard quotient of 1 for non-carcinogens. Where an individual compound has the capacity to elicit both types of responses, such as with natural uranium, the SSLs preferentially report the screening value representative of the lowest compound concentration in environmental media. The generic SSL adopted by NMED for soluble uranium salts, based on a residential exposure scenario, is 235 mg/kg with the non-carcinogenic end point being the most restrictive. Based on a specific activity for natural uranium of 677 pCi/mg (NRC 2010), the natural uranium SSL is equal to 159 pCi/g of soil. This is considerably lower than the radiological end point of 404 pCi/g established using the radium benchmark approach. For this reason, HMC will adopt a tiered approach to the natural uranium soil cleanup level. The radiological end point soil concentration of 404 pCi/g will be the primary cleanup standard. The toxicologically based SSL of 159 pCi/g will be the soil cleanup goal, consistent with the application of the ALARA requirement. The equation in **Section 5.2.1.2** applies to the primary soil standards for radium-226 and U-nat, but does not apply to secondary standards.

5.2.1.4 Summary of Decommissioning Standards for Soil

The proposed decommissioning standards for soil for the Homestake Grants Reclamation Project are contained in **Table 5.1-1**.

5.3 Unrestricted Release Criteria for Material and Equipment

If material and equipment are to be salvaged, the material and equipment will be either transferred to another party licensed to accept it, or if surface contamination levels meet specific release criteria, transferred to another party for unconditional use. See **Section 7.3** for unrestricted release criteria. Uncontaminated material and equipment may be placed in a permitted onsite industrial WDC.

5.4 References

ANL. 1993. *"Data Collection Handbook to Support Modeling the Impacts of Radioactive Material in Soil"*, Argonne National Laboratory (for the U.S. Department of Energy), ANL/EAIS-8, 1993". Environmental Assessment Division, Argonne National Laboratory, 9700 South Cass Avenue, Argonne, Illinois 60439.

ANL. 2001. C. Yu, A.J. Zielen, J.J. Cheng, D.J. LePoire, E. Gnanapragasam, S. Kamboj, J. Arnish, A. Wallo III, W.A. Williams, and H. Peterson." *User's Manual for RESRAD Version 6.*" Environmental Assessment Division, Argonne National Laboratory, 9700 South Cass Avenue, Argonne, Illinois 60439.

U.S. Nuclear Regulatory Commission. (NRC). 1993. License Amendment No. 15 to Radioactive Materials License SUA-1471, August 25.

NRC. 1999. 10 CFR 40, Appendix A. *Code of Federal Regulations*: Office of Federal Register National Archives and Records Administration. Washington, D.C. 1 January.

NRC. 2003. *"Standard Review Plan for In situ Leach Uranium Extraction License Applications."* NUREG-1569. Division of Fuel Cycle Safety and Safeguards, Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission, Washington D.C. 20555-0001.

NRC. 2010. 10 CFR 20. "Standards for Protection Against Radiation." *Code of Federal Regulations*: Office of Federal Register National Archives and Records Administration. Washington, D.C. 1 January.

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6. Environmental Information

6.1 Environmental Report

HMC submitted an Environmental Report (ER) in support of a radioactive material license renewal application to the NMEID on April 1, 1982 (HMC 1982). This license amendment and ER were approved by the NMEID, and later transferred to the NRC following the transfer of regulatory authority from the state to the NRC. A supplement to this ER was submitted to the NRC by letter dated December 08, 1992 (HMC 1992), which was in support of a site reclamation plan submitted to the NRC by HMC by letter dated January 31, 1991 (HMC 1991). As per Licensee Amendment No. 15 dated August 25, 1993, License Condition 37H required that all reclamation plan requirements be incorporated into a single comprehensive document by October 31, 1993 (AKG and Jenkins 1993). This was accomplished by submittal of a revised reclamation plan in October 1993, which included appropriate revisions to the January 31, 1991 reclamation plan. The revised 1993 plan was supported by the revised ER previously submitted to the NRC.

The information documented in the ER is still valid for the activities addressed in the 1993 reclamation plan and majority of more recent license amendments. For activities not addressed in the 1993 reclamation plan or previous license amendments, updates to the ER may be required. For example, construction of EP-3 was not addressed in the 1993 reclamation plan, so the NRC required an ER specific to this activity. Some future updates to the existing ER may be needed to address specific revised/updated final reclamation and decommissioning activities not addressed in the 1993 reclamation plan or license amendments/conditions.

6.2 References

A.K. Geoconsult, Inc. and Jenkins Environmental, Inc. 1993. Reclamation Plan Revision 10/93, Homestake Mining Company of California Grants Operation, Volume I, text, Tables and Figures. October.

Homestake Mining Company of California. (HMC). 1982. Letter from Edward E. Kennedy, Director of Environmental Affairs, Homestake Mining Company, Grants, New Mexico to Al Topp, Chief, Radiation Protection Bureau, New Mexico Environmental Improvement Division, San Fe, New Mexico regarding submittal of Environmental Report in support a radioactive material license renewal application for the HMC Grants site. April 02.

HMC. 1991. Letter from Jerry W, Danni, Regional Manager, Environmental Affairs, Homestake Mining Company, Golden, Colorado to Ramon Hall, Director, Uranium Recovery Field Office, U.S. NRC Region IV, Denver, Colorado regarding the submittal of a final reclamation plan and interim surety for the HMC Grants site. January 31.

HMC. 1992. Letter from F.R. Craft, Resident Manager, Homestake Mining Company, Grants, New Mexico to Ramon Hall, Director, Uranium Recovery Field Office, U.S. NRC Region IV, Denver, Colorado regarding submittal of a supplement to the 1982 Environmental Report in support of an reclamation plan for the HMC Grants site submitted to the NRC on January 31, 1991. December 08.

7. ALARA Analysis

The intent of the ALARA Analysis, as described in NUREG-1757 Volume 2 (NRC 2006), is to provide the NRC sufficient information to determine that the DRP ensures that doses to the average member of a critical group meet ALARA requirements. The regulatory drivers for this determinations are 10 CFR 20.1402, 20.1403(a), 20.1404(e), and 20.1404 (a)(3), all of which are contained in 10 CFR 20, Subpart E—Radiological Criteria for License Termination (Subpart E) (NRC 2010). The general provisions and scope of Subpart E (10 CFR 20.1401) specifically excludes the criteria within Subpart E for uranium and thorium recovery facilities already subject to Appendix A to 10 CFR part 40. As discussed in **Section 5.1**, the soil cleanup standards for source and byproduct are established in 10 CFR 40 Appendix A (NRC 1999). Compliance with these standards allows for release of a licensed facility for unconditional use. Therefore, this ALARA analysis will be limited to the requirements of Appendix A, and will not necessarily precisely follow the guidance in NUREG-1756 Volume 2.

7.1 Radium-226 Soil Standard

The soil standard for radium-226 in 10 CFR 40, Appendix A Criterion 6-(6) does not consider an evaluation of ALARA. Presumably, if a site attains the radium-226 cleanup standard, the ALARA requirement has also been achieved. This presumption is supported in Section 6.3 of NUREG 1757 Volume 2, stating that an ALARA analysis for unrestricted release of soil need not be done.

The introduction to Appendix A allows for licensees to propose alternatives to the criteria, provided the proposed alternative will provide an equal level of protection. In this scenario, an ALARA analysis should be provided. HMC does not foresee the need to propose alternatives to Criterion 6-(6).

7.2 Other Radionuclide Soil Standards

The soil standard in Criterion 6-(6) for byproduct material containing radionuclides other than radium-226 must be at levels which meet ALARA requirements. As discussed in **Section 5.2.1**, U-nat is the only other mill-related radionuclide with the expected potential to occur at levels above background soil concentrations.

The primary standard for U-nat concentrations in soil is based on the radium-226 benchmark dose. This determination was detailed in **Section 5.0**. HMC is choosing to use the "Predetermined Compliance Measure" contained in NUREG 1757 Volume 2, to demonstrate ALARA for the U-nat soil standard. A deterministic U-nat soil standard for

unrestricted release has been established based on Criterion 6-(6). If the final status survey results meet the soil concentration criteria in **Section 5.2.2.2**, the licensee has met the ALARA requirements.

Additionally, the primary soil standard for U-nat is based on a radiation dose end point. The soil cleanup goal for U-nat, based on the chemical toxicity of U-nat, is much lower than the primary standard. Achieving the cleanup goal rather than the primary standard is also consistent with the ALARA requirement.

7.3 Unrestricted Release Criteria for Material and Equipment

It is uncertain whether any mill-related material and equipment will be salvaged. The fate of mill-related material and equipment will be determined at the time of decommissioning. For mill-related material and equipment slated for salvage, the acceptable surface contamination levels contained in NRC Regulatory Guide 1.86 "Termination of Operating Licenses for Nuclear Reactors" will be used as release criteria. The surface contamination levels have been used extensively in the past for uranium recovery and other decommissioning projects and are the only NRC-approved criteria for material and equipment from uranium recovery operations. Mill-related material not slated for salvage will either be appropriately sized and placed in the WDC or transferred to another licensee. No ALARA analysis is needed.

7.4 References

U.S. Nuclear Regulatory Commission (NRC). 1999. 10 CFR 40, Appendix A. "Criteria Relating to the Operation of Uranium Mills and the Disposition of Tailings or Wastes Produced by the Extraction or Concentration of Source Material From Ores Processed Primarily for Their Source Material Content." *Code of Federal Regulations*: Office of Federal Register National Archives and Records Administration. Washington, D.C. 1 January.

NRC. 2006. *"Consolidated Decommissioning Guidance, Characterization, Survey, and Determination of Radiological Criteria."* NUREG-1757 Vol.2, Rev1. Division of Waste Management and Environmental Protection, Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555-0001. September.

NRC. 2010. 10 CFR 20. "Standards for Protection Against Radiation." *Code of Federal Regulations*: Office of Federal Register National Archives and Records Administration. Washington, D.C. 1 January.

8. Decommissioning Alternatives

Decommissioning and closure alternatives have been evaluated historically for the HMC Grants Reclamation Project site. The NRC has agreed with HMC's preferred alternatives for both final tailings reclamation and the mill decommissioning. The site license has been amended and license conditions revised authorizing implementation of the preferred alternatives. This section briefly summarizes the historical evaluations, as this DRP does not propose to change the final overall tailings reclamation and mill decommissioning plan for onsite disposal from that previously approved.

HMC analyzed alternative sites for disposal of mill tailings and of alternative tailings disposal methods, and presented the results in the Environmental Report submitted by HMC in 1982 to the NMEID (today the NMED; HMC 1982). The alternative analyses consisted of an evaluation of alternative sites for disposal of mill tailings and of alternative tailings disposal methods.

A study was performed for HMC by AK Geoconsult, Inc. in July through November, 1989 to determine the feasibility of a designated alternative site for disposal of uranium mill tailings (AKG 1989). Further actions toward the development of an alternate tailings disposal site were terminated with mill operations ceasing in 1990 and the decision to permanently close the mill site. HMC was requested by the NRC to voluntarily submit a detailed tailings and reclamation plan by letter dated March 22, 1986 (Kuhn and Jenkins 1986). HMC submitted a tailings stabilization and site reclamation plan to the NRC in December 1986 (Kuhn and Jenkins 1986).

When mill operations ceased in 1990, HMC submitted a proposed final tailings reclamation and mill decommissioning plan to the NRC for its review in January 1991 (AKG et al. 1991). HMC submitted a supplement to the environmental report prepared in 1982 on December 8, 1992 (HMC 1992). The supplement describes the expected impacts associated with mill decommissioning and tailings reclamation, and evaluates alternatives for mitigating impacts. Additional information pertaining to the site environment and environmental impacts was submitted by HMC to the NRC in letters dated January 11, 1993 (HMC 1993a) and March 16, 1993 (HMC 1993b).

8.1 Tailings Piles and Mill Decommissioning Alternatives Considered

Alternatives for decommissioning the mill were evaluated in the March 16, 1993 letter submitted by HMC to the NRC (HMC 1993b). The three alternatives presented in this communication for mill decommissioning were as follows:

- Alternative 1: Removal of all mill facilities and burial of the debris in the tailings pond. The alternative was initially proposed by HMC in the original closure plan submitted to the NRC in 1986.
- Alternative 2: Demolition and disposal of all mill facilities in place.
- Alternative 3: Demolition and disposal of the majority of the mill facilities in place, with selected components buried in the tailings pile. This alternative was proposed in the reclamation plan submitted in 1991(AKG et al. 1991).

Alternative 3 was the alternative chosen by HMC. The NRC prepared the Environmental Assessment for the Decommissioning and Reclamation of the Grants Mill and Tailings Ponds in May 1993 (NRC 1993).

The environmental assessment prepared by NRC concluded that Alternative 3 was the preferred alternative for disposal of mill debris. This alternative minimizes costs while providing an increased assurance of long-term isolation of the more highly contaminated mill debris. The environmental assessment documented the NRC staff's evaluation of the alternatives for tailings reclamation and mill decommissioning. A Finding of No Significant Impact and Notice of Intent to Amend the license was published in the Federal Register on June 11, 1993 (50 FR 32734).

Alternative tailings disposal sites were evaluated in detail as part of the 1982 environmental report prepared by HMC and submitted to the NMEID. In the alternative sites analysis, sites within a 7-mile radius were evaluated to determine the most favorable sites for potential tailings disposal. A three-step process was used to evaluate potential disposal sites. Exclusionary criteria were first used to eliminate areas which contained major flaws. These criteria included being within a 100-year floodplain, proximity to active or potentially active faults, and proximity to residential or industrial areas. The highest ranking alternative site was then used to evaluate three alternative tailings disposal alternatives as follows:

1. Reclamation in place
2. Slurry relocation to the alternative offsite location
3. Conventional earthwork relocation to the alternative offsite location.

In the 1993 environmental assessment report, the NRC staff concluded, based on the costs and benefits associated with the above-mentioned three reclamation options, that the additional costs of relocation outweighed the minor benefits that would result from relocation. The NRC further stated that the reclamation plan proposed by the licensee will meet all applicable technical requirements of Section I of Appendix A to 10

CFR 40. The NRC staff therefore concluded that the preferred alternative for reclamation of the Homestake tailings piles was stabilization in place. A detailed discussion of the alternative tailings sites and methods is presented in the 1982 Environmental Report (HMC 1982).

The "no action" alternative was not considered by HMC or the NRC because Section I of Appendix A to 10 CFR 40 requires disposal of byproduct material in accordance with a design that meets specific technical criteria. The NRC required that all reclamation requirements be incorporated into a single comprehensive document by October 31, 1993. This was accomplished by HMC in providing appropriate revisions to the January 31, 1991 final reclamation plan (AKG et al. 1991). This requirement was addressed by License Amendment No. 14, which added this requirement to License Condition 37 H on July 23, 1993. HMC's License SUA-1471 was amended by Amendment 15 on August 25, 1993, to incorporate the preferred mill decommissioning plan by revising License Condition 29. The revisions provided for HMC to implement Alternative 3, subject to all associated and approved responses to the alternative by HMC and approved by the NRC. In addition, License Condition 29 provided for a soil verification survey and sampling program (see discussions in **Section 2.2.2.1**). Relevant portions of License Amendment No. 15 (August 23, 1993) were added to the 1993 updated plan, in accordance with the requirements of License Condition 37 H.

License Condition 37H was deleted per License Amendment No. 21 as of May 5, 1995 because the updated plan was submitted to the NRC on October 29, 1993 (AKG and Jenkins 1993). In addition, based on NRC acceptance of the 1993 updated plan, License Condition No. 35 A was revised to require HMC to reclaim the LTP and STP as stated in the October 29, 1993 updated plan (AKG and Jenkins 1993). HMC requested an amendment change by letter dated August 6, 1996, which proposed a redesign of the final radon barrier for the STP. The NRC determined that the proposed redesign of the final radon barrier was acceptable, as explained in NRC License Amendment No. 27 approval dated September 25, 1997 (NRC 1997). The final radon barrier design to be used for the STP is discussed in more detail in **Section 9**.

The mill decommissioning tasks identified in the 1993 reclamation and decommissioning plan were completed in 1995, and the NRC deemed that specified mill decommissioning tasks identified in the plan were complete and approved under License Amendment No. 32, dated January 28, 1999 (NRC 1999). See **Section 2.2.2** for detailed discussions of completed decommissioning activities. The remaining reclamation and decommissioning tasks required for final closure are discussed in **Section 9**.

As discussed in **Section 2.2.3**, the ACOE, on behalf of the EPA, reviewed the remediation efforts at the HMC Grants Reclamation Project site in 2009, with the final report issued in 2010 (ACOE 2010). The ACOE presented alternate strategies to the current groundwater restoration program. One of the alternatives evaluated was the relocation of tailings to an engineered landfill within 30 miles of the Grants site. The total estimated cost for such an effort was $2,700,000,000. ACOE's recommendation following their evaluation was as follows:

> *Relocation of the tailings should not be considered further by any means given the risks to the community and workers and the greenhouse gas emissions that would be generated during such work.*

The EPA (EPA 2011) and NRC (NRC 2011), as well as HMC, agreed with this recommendation. The NMED supported the EPA's recommendations by letter to the NRC dated April 20, 2011 (NMED 2011). HMC agrees with these positions and does not believe that the removal and disposal in a new offsite disposal cell is an appropriate or viable option.

At the request of the EPA on behalf of a local citizens group, HMC contracted with a third-party consulting firm to explore costs, efforts, and regulatory requirements to be met under the alternatives of continuing with the current remediation and reclamation strategy or a hypothetical move of the tailings pile to a location outside of the San Andres Aquifer basin and the Village of Milan (Tetra Tech 2012). Based on this study, the estimated total cost for implementing the offsite disposal alternative was projected to be $1.52 billion for the truck scenario, $1.52 billion for the rail scenario, and $1.86 billion for the slurry pipeline scenario. With a 15 percent contingency added to the total cost of each option (as per NRC guidance) plus $1.6 million for NRC long-term maintenance and surveillance fees, the estimated total cost totals were $1.75 billion for truck transportation, $2.01 billion for rail transportation, and $2.13 billion for slurry transportation (Tetra Tech 2012). These costs were consistent with the more recent cost-to-complete estimate from the Moab UMTRA project (DOE 2009). The cost estimates generated in this study, although based on limited information, support the positions taken by the EPA, ACOE, and NRC that offsite relocation of the tailings is not a viable option.

The most recent total closure cost estimate for the current onsite remediation and closure plan for years 2013 through 2022 is $80,797,033. This cost is composed of a total project cost of $69,527,206, the 15 percent NRC contingency fee of $10,429,081, and the NRC long-term maintenance/surveillance fee of $840,746 (HMC 2012).

ACOE also offered a number of other recommended alternatives to the groundwater restoration program, which are discussed in **Section 2.2.2.5**. HMC agreed to evaluate several of the ACOE's recommendations to determine if remedial process efficiencies could be gained (see **Section 9.10** for discussions of proposed revisions to the Updated CAP).

In summary, with the exception of groundwater restoration, HMC has completed an assessment of decommissioning alternatives, and the NRC has approved HMC's preferred alternatives discussed in **Section 9**. HMC has made a considerable effort to assess various groundwater treatment technology alternatives in seeking ways to clean up the contaminated groundwater at the site to levels that meet regulatory groundwater cleanup standards. In addition to the source control, plume control, and RO WTS optimization evaluations described in the 2012 Updated CAP, HMC is investigating several alternate treatment technologies. HMC may implement one or more of these technologies if proven feasible and will seek regulatory agency approval(s) as required. Current alternate treatment technologies being assessed are described in **Section 9**. As previously stated, groundwater restoration activities (e.g., alternatives) are only summarized in this DRP update, with detailed discussions provided in the HMC Updated CAP.

8.2 References

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surface of the recontoured LTP was compacted to not less than 95 percent of the maximum dry density (ASTM D-698-91), ±2 percent of optimum moisture content.

An average depth of 3.8 feet of radon barrier material was placed on the north, west, and south slopes of the LTP, with the average of 2 feet placed on the re-contoured eastern portion of the LTP. A 1-foot layer of radon barrier material was placed on top of the LTP as an interim cover. The total quantity of interim cover placed and compacted on the LTP was approximately 388,938 yd^3 (Knight Piesold 1996). The total quantity of radon barrier placed and compacted on the slopes of the LTP was 725,107 yd^3.

The remaining reclamation tasks required for the LTP include the following:

- Removal and plugging of all injection, recovery, and monitoring wells located on the top of the LTP. Work will be accomplished consistent with the NMED Monitoring Well Construction and Abandonment Guidelines and the Rules and Regulations Governing Well Driller Licensing; Construction, Repair and Plugging of Wells 19.27.4 NMAC. A plan for plugging wells shall be filed with - and approved by - the state engineer prior to plugging, in accordance with 19.27.4.30 C NMAC and as directed by the NMOSE. NMOSE only regulates those wells that penetrate the alluvial (uppermost aquifer) water table; wells completed in the tailings or perched zones are not permitted because these zones are not considered groundwater.
- Final backfill (as needed) and grading of LTP top surface.
- Placement of the final radon barrier on the top of the LTP.
- Placement of the final rock cover on the top of the LTP.

The interim radon barrier will be considered sufficiently stabilized when 90 percent of the primary settlement of the LTP has been achieved and groundwater restoration has been completed. At that time, the final radon barrier and rock cover material will be placed on top of the LTP.

HMC is required to reclaim the LTP as stated in the October 29, 1993 submittal (AKG and Jenkins 1993), including the revised radon barrier design approved by License Amendment 22, which is discussed in **Section 2.2.2.2**. The LTP final radon barrier will be completed as per material type, thickness, and placement criteria described in HMC's Final Radon Barrier Design for the Large Tailings Pile (HMC and ERG 1995), submitted to the NRC on June 16, 1995 (HMC 1995). The radon barrier will vary from 24 to 56 inches in thickness. The NRC's analysis of the proposed barrier thickness

indicated that the estimated radon flux from the side slopes, averaged with the flux from the top of the pile, meets the requirements in Criterion 6(1) of 10 CFR Part 40, Appendix A (NRC 1995a). A final erosion protection layer of rock of approximately 6 to 9 inches will be placed over the final radon barrier cover on the top of the LTP. The final radon barrier material will be obtained from the North Borrow Area or other NRC-approved borrow area(s). This borrow area has been well characterized and is known to contain a higher clay content than the existing interim barrier material. The final erosion (rock) cover will be obtained from the stockpile of rock material located approximately 1.5 miles west of the LTP.

Radon flux measurements on the interim radon barrier cover on top of the LTP began on August 18 and 19, 1995 following its placement. License Condition 36 E. requires annual radon flux measurements until the final radon barrier is placed on the pile and the project is accepted for final closure. Radon flux will be measured on the final radon barrier prior to placement of the rock cover. Radon flux measurements must not exceed a standard of 20 pCi/m^2. The ongoing radon flux monitoring program is discussed in **Section 12**.

As per License Condition 37 C., prior to placement of any of the final radon barrier material on the LTP, HMC shall submit a final radon barrier and rock cover placement construction quality control program for NRC review and approval. The construction quality control program will establish procedures to ensure that the specification is met which limits the activity of the radon barrier material to 5 pCi/g above background. The construction quality assurance and control program shall be as defined in the 1989 NRC Staff Technical Position on Testing and Inspection document. The acceptable correlation between ASTM D 2922 and ASTM D 1556 shall be as defined in the HMC's April 30, 1992 submittal (HMC 1992).

As stated in License Condition 37 I, HMC shall provide a Completion Report for the LTP within 6 months of the completion of construction. The report, including as-built drawings, shall verify the reclamation of the LTP was performed according to the approved plan. The report will include summaries of the results of the quality assurance and control testing to demonstrate that approved specifications were met.

LTP flushing will be terminated at the end of 2014 with LTP dewatering to continue to the end of 2016. As a precaution for potential additional settlement due to these actions, settlement monitor point elevations will continue to be monitored until primary settlement is not less than 90 percent complete as determined by the log time-

settlement curve approaching asymptotic ultimate values. It is expected that this settlement criterion will be achieved within 2 years after dewatering has ceased.

9.1.2 Small Tailings Pile

As discussed in **Section 2.2.2.2**, the STP was partially reclaimed during the time period from 1993 to 1995 as per approved closure plans by the NRC. The STP was only partially reclaimed due to the fact that EP-1 is constructed on top of the pile and EP-1 is used as part of the ongoing groundwater restoration program. The portion of the STP that does not include EP-1 is referred to as the South Triangle Area (**Figure 9.2-1**). Once final settlement of the fill material has occurred and groundwater restoration has been satisfactorily completed for the project site, final closure steps will be taken for the STP as per previous NRC approvals (e.g., License Conditions 36 and 37).

An average 1-foot depth of soil was placed as an interim cover on top of a portion of the STP that was not covered by EP-1. The uppermost 1 foot on the top surface of the re-contoured STP was compacted to not less than 95 percent of the maximum dry density (ASTM D-698-91), $\pm$ 2 percent of optimum moisture content. Approximately 33,082 yd^3 of interim cover material was placed and compacted on the portion of the top of the STP not covered by EP-1.

EP-1 and/or EP-2 will be converted to a WDC to be used for the burial of demolition and miscellaneous wastes once groundwater restoration has been completed. Completion of more detailed engineering will support a determination of whether one pond will be used or both.

The remaining reclamation tasks required for the STP is as follows:

- Final closure of EP-1. The method of closure will depend on whether EP-1 is used as a WDC. If determined to be a WDC, it will be used for disposal of remaining demolition wastes and contaminated soils. If not, it will be closed in-place with contaminated materials removed and disposed of in EP-2. Reclamation of EP-1 is discussed in **Section 9.3.1**.
- Removal and plugging of all recovery and monitor wells located on the top of the STP. Work will be accomplished consistent with the NMED Monitoring Well Construction and Abandonment Guidelines and the Rules and Regulations Governing Well Driller Licensing; Construction, Repair and Plugging of Wells 19.27.4 NMAC. A plan for plugging wells shall be filed with -

and approved by - the state engineer prior to plugging, in accordance with 19.27.4.30 C NMAC and as directed by the NMOSE.

- Placement of the final radon barrier on the top of the STP as described in Specification for Construction of Interim Soil Cover on the STP (**Appendix F**). The radon barrier cover for EP-2 is addressed in **Section 9.3.1**.
- Measuring radon flux.
- Placing of a final protective rock cover on the top surface of the STP.
- Placing the final protective rock cover on the side slopes, underlain by a layer of bedding material.

The interim soil cover will be allowed to stabilize until 90 percent of the primary settlement of the STP and groundwater restoration has been completed. At that time, the final radon barrier and rock cover material will be placed on top of the STP. The radon barrier **will be** as per the revised radon barrier design as approved by License Amendment 27, which is discussed in **Section 2.2.2.2**. The STP final radon barrier will be completed as per material type, thickness, and placement criteria described in HMC's Final Radon Barrier Design for the Small Tailings Pile (ERG 1996), submitted to the NRC on August 6, 1996 (HMC 1996).

The radon barrier for the STP will consist of two layers: (a) a lower layer of clay placed at 100 percent maximum Standard Proctor dry density, from 0.5 foot thick over the southern part of the pile to 1.7 feet over the EP-1 area and 3 feet over the outslopes; an upper layer with the same clay soil compacted to 95 percent maximum dry density and 1.5 feet thick over all pile areas (ERG 1996). The NRC's analysis of the proposed barrier thickness indicated that the cover meets the radon flux standard set forth in Criterion 6(1) of 10 CFR Part 40, Appendix A (NRC 1997). A final erosion protection layer of rock of approximately 6 to 9 inches thick will be placed on top of the STP final radon barrier

If feasible, the final radon barrier material will be obtained from the North Borrow Area. If deemed necessary, HMC will obtain borrow material from other areas that meet barrier cover specifications acceptable to the NRC. The final erosion (rock) cover will be obtained from the stockpile of rock material located approximately 1.5 miles west of the STP.

A bedding layer will be placed on all side slope surfaces on top of the radon barrier before placement of rock cover on those surfaces (**Figure 2.2-7**).. The bedding layer will be 90 to 125 percent of the design thickness of 0.5 foot. Bedding material may be

either crushed basalt fines or sand and gravel satisfying the flowing size and gradation criteria:

- d15 not larger than #10 sieve
- d50 not larger than #4 sieve

Radon flux was measured on the interim radon barrier cover on top of the South Triangle, and slopes of the entire STP, on August 18 and 19, 1995 following placement of the cover. License Condition 36 E requires annual radon flux measurements, until the final radon barrier is placed on the pile and the project is acceptable for final closure. Radon flux measurements must not exceed a standard of 20 pCi/m^2. The ongoing radon flux monitoring program is discussed in **Section 12**. As per License Condition 37 C, prior to placement of any of the final radon barrier material on the STP, HMC shall submit a construction quality control plan for NRC review and approval. The construction quality control program will establish procedures to ensure that the specification is met which limits the activity of the radon barrier material to 5 pCi/g above background.

License Condition 37.I requires that HMC provide a Completion Report for the STP within 6 months of the completion of final radon barrier and rock cover placement construction. The report, including as-built drawings, shall verify that reclamation of the STP was performed according to the approved plan. The report will include summaries of the results of the quality assurance and control testing to document that approved specifications were met.

As per License Condition 37 J., soil cleanup associated with the STP shall be as specified in HMC's submittal of September 15, 1994 (HMC 1994) and as modified by the submittal of December 13, 1995 (ERG 1995). A quality control program for the soil cleanup verification program shall be implemented to include at least 10 percent of the samples (randomly selected) to a vendor laboratory for radium-226 analysis (License Condition 37 K). If the vendor laboratory uses gamma spectroscopy, at least 30 percent of these QC samples shall also be analyzed by chemical separation and alpha spectroscopy.

No significant settlement is likely for the STP after reclamation (AKG and Jenkins 1993). Soft wet tailings encountered under the evaporation pond within the STP were reworked and compacted during evaporation pond construction. Slimes under the south dike and in the south quarter of the STP were surcharged with fill beginning in 1990. This surcharge material has imposed loads that cause consolidation during the period of pond operations. Therefore, after re-contouring of these surfaces, the

resulting surcharge loads on the slimes will be lower than those that had existed before re-contouring. Because no significant subsequent settlements should occur before barrier placement, no settlement monitoring will be performed.

9.2 Ponds

9.2.1 EP-1

EP-1 was constructed in 1990 on the STP to assist the dewatering of the LTP and to hold and evaporate water pumped from the collection wells of the groundwater restoration plan. The pond design was prepared by HMC's contractor (AKG 1990) and submitted to the NRC, NMEID, and the NMOSE in June 1990, with approval granted thereafter. License Amendment No. 7 revised License Conditions 35 of SUA-1471 and granted approval by the NRC for construction and operation of EP-1 (NRC 1990). Operation of the pond commenced in November 1990.

Construction and performance testing of the liner was completed in November 1990. HMC's contractor submitted a Certificate of Construction to the NMOSE on December 5, 1990 stating that the evaporation pond construction had been completed. A Completion Report (AKG 1991) for the construction of EP-1 was transmitted to the NRC, NMEID, and NMOSE by letters dated April 5, 1991.

EP-1, as well as the East and West Collection Ponds, is lined with a Deery Oil Liner/fabric liner system, which consists of a non-woven fabric that is impregnated and then overlain with a layer of No. 6 Deery Oil. No. 6 Deery Oil is a petroleum-based asphaltic blend that is applied after being heated to 370 to 400 °F, and is commonly used for sealing cracks in road asphalt (DBE 2011). EP-1 and the East and West Collection Ponds were part of an HMC Pond Liners Repair Project in 2011. Repairs were carried out where the Deery Oil Liner system was damaged or otherwise potentially not fully functioning, or where the underlying foundation material was deformed by wave or other actions that could lead to liner stretch and potential failure if not addressed. Repair procedures for EP-1 and the collection ponds are discussed in detail in a completion report for these ponds (DBE 2011).

EP-1 was located in the northern two thirds of the STP, where no tailings had been placed since 1961 and no standing water remained within the tailings pile (**Figure 9.2.2-5**). The total constructed area of the EP-1, including the bottom and side slopes, is 26.2 acres, with a capacity of approximately 285 acre-feet (92,867,656 gallons). The original specification for the pond required that the structural fill in the pond bottom be Type A material (sand tailings). However, because the tailings material was saturated

by rainfall during construction, much of this material was excavated and replaced with Type B dry fill material (natural soil borrowed from alluvial soils adjacent to the evaporation pond). This material, which usually ranged from a silty sand to clay (with gravel in some places), provided a base for the liner equal to or better than the Type A fill could have provided. The design engineer approved this variance.

The bottom of the pond and inside of the pond slopes of the dikes are covered with a double liner system consisting of: 1) Trevira spun-bound polyester with a minimum thickness of 60 mils laid in 10-foot wide strips with adjacent strips overlapping by at least 1 foot and 2) sprayed-on membrane (Deery #6) consisting of asphalts with resins and polymers applied to a minimum thickness of 90 mils. The liner extends onto the inside edge of the crest to an average width of 15 inches from the top of the pond slope. The liner is anchored in a backfilled trench in the crest of the pond. A pump station on the north dike was constructed at the mid-point of that dike to accommodate three pumps for an evaporation spray system. Only the pump foundations, conduit and station area rim, and liner are part of the design and construction of the pond. The spray system is a separate operational activity.

HMC plans to use EP-1 and/or EP-2 for final disposal of byproduct/byproduct-contaminated material. Whether or not both ponds will be used for disposal will not be determined until groundwater reclamation mitigation measures have been clearly defined (with regulatory agency approval), and detailed engineering of demolition and surface/subsurface reclamation has been completed.

Whichever pond is not used for long-term burial of wastes materials will be decommissioned as per NRC approval. The residues in the pond will be allowed to dry to manageable moisture content levels, or will be solidified with dry soil material, removed, and transported to the other pond (the WDC) designated for burial of byproduct/byproduct-contaminated materials. It may be necessary to mix dry contaminated soil with the pond sediments for ease of handling. The liners will then be cut to manageable size, rolled, and transported to the WDC. Any underlying contaminated soils will be removed and disposed of in the WDC. The banks of the pond that are not also part of the WDC will be removed by pushing the soil into the below-grade pond basin, and the area will be regraded to provide positive drainage away from the pond being closed.

Evaporation concentrates, pond liner, piping, and other related infrastructure associated with the pond not being used for waste burial will be disposed of in the WDC with other project demolition and decommissioning waste. EP-1, either as a

closed pond or as the WDC, will be reclaimed as part of the final reclamation of the STP that presently underlies EP-1.

A radiation survey will be performed to identify any portions of pond bottoms and berms of the pond being closed that require removal and disposal as byproduct material. After all contaminated material is removed, a final status survey for radium-226 and natural uranium will be performed in the area to assure compliance with the cleanup criteria contained in **Section 5**. After approval by the NRC, the areas will be restored by backfilling as needed, grading, and seeding.

9.2.2 EP-2

EP-2 was designed and constructed in 1995 to increase storage and treatment capacity for contaminated groundwater as part of HMC's ongoing groundwater restoration program under NMED DP-200 and DP-725 permits and NRC license conditions. Additional surface storage and evaporation capacity was required to increase contaminated groundwater pumping rates in order to shorten the overall time required for groundwater restoration. The pond and liner designs were prepared by HMC's contractor (AKG 1994a and 1994b) and submitted for approval to the NMOSE, NRC, and the NMEID, all of which had approval authority over the evaporation pond. The design was approved by the NMOSE on June 22, 1994. The NRC authorized construction and operation of the evaporation pond as per License Amendment 19 and the associated new License Condition 39 (NRC 1995b). Construction of EP-2 was completed on July 10, 1995. The pond is located between the STP on the east and the collection ponds on the west (**Figure 2.2-5**). The total constructed area of the evaporation pond, including bottom and side slopes, is approximately 17.48 acres, with a maximum storage capacity of approximately 317.43 acre-feet (103,427,836 gallons). A Completion Report (AKG 1996) for the evaporation pond was submitted to the NRC, NMOSE, and NMEID.

A three-part lining system was installed in the pond with a leak detection/drainage layer between two HDPE liners. The lining system consisted of an upper primary liner (60 mil thick), an intermediate layer (the detection or geogrid layer), and a secondary liner (bottom) that is 40 mil thickness. All seams were wedge-welded (hot-shoe welded) with the exception of the corner and west tie-in seams. In July 1995, after installation of the liner, performance testing (1 foot of water over the entire pond bottom) detected a leak between the liners. Identified leak points in the primary liner were repaired. Performance testing after the leak repairs indicated no further leakage.

EP-1 and/or EP-2 (i.e., WDC) will be used for the final disposal of contaminated reclamation and restoration waste materials. Waste materials will consist of radiologically contaminated building demolition debris, concrete structures and foundations, other structures debris, equipment, piping, synthetic liners and settled and solidified solids from EP-1 or EP-2 and EP-3, contaminated soils, and other miscellaneous contaminated materials.

Once the WDC is established, a Technical Specification will be developed by the designated Engineer of Record. The proposed work will adhere to the site's construction quality assurance and quality control procedures in order to ensure that the soil components are constructed and demolition debris and soil slurry are placed (mixture contents to be determined) in compliance with the Technical Specification(s) and meet the applicable regulatory requirements. The quality assurance and control procedures will ensure that proper materials, construction techniques, and procedures are followed by the contractor and that the intent of the design is met.

9.2.3 EP-3

HMC currently is carrying out an Updated CAP that consists of a groundwater pump and treat system primarily using a RO WTS. The goal of the Updated CAP is to restore groundwater to levels as close as practicable to upgradient groundwater background levels. This goal is being accomplished by pumping contaminated groundwater to either the RO WTS or one of the two existing evaporation ponds. The two existing evaporation ponds at the mill site are at or near capacity. Therefore, HMC requested approval from the NRC for the construction of EP-3 as an additional evaporation pond to allow HMC to run the RO WTS at its designed capacity. HMC submitted its request to the NRC for review and approval of the HMC Grants Reclamation Project engineering design package for the new proposed evaporation pond, and request for radioactive materials license amendment by letter dated October 25, 2006 (HMC 2006). Follow-up information was submitted to the NRC by HMC via letters dated February 7, 2007, July 18, 2007, and March 17, 2008. NRC reviewed HMC's submittals and approved construction of the proposed EP-3 via letter dated August 7, 2008 (License Amendment No. 41; NRC 2008). In addition to the NRC, the pond was constructed in accordance with the requirements of the NMED (modification of DP-725) and the NMOSE Dam permit #D-671.

Construction was completed for EP-3 in November 2010, and it was placed into operation in January 2011. The Completion Report (Kleinfelder 2011) for the construction of EP-3 was completed in February with copies submitted to the NRC (Kuhn 2011), NMED, and NMOSE.

The evaporation pond consists of two cells of equal sizem each with approximately 13.3 acres (total of 26.6 acres) of water surface at maximum pool level. The two cells will provide storage capacity of approximately 286 acre-feet (93,193,508 gallons) for temporary retention and evaporation of contaminated groundwater. The pond is lined with a three-part liner system consisting of two HDPE membranes (primary and secondary liners) and an HDPE geonet leak detection/drainage layer between the two membranes. The primary liner membrane is 60 mil thick, the secondary liner is 40 mil thick, and the geonet is a minimum of 0.20 inch thick at the standard intersection.

Once groundwater restoration has been completed at the Grants site, EP-3 will be decommissioned. The residues in the pond will be allowed to dry to manageable moisture content levels, removed, and transported to the WDC. It may be necessary to mix dry contaminated or clean soil with the pond sediments for ease of handling. The liners will then be cut to manageable size, rolled, and transported to the WDC for either disposal or reuse as an additional barrier underlying the earthen radon barrier. Any underlying contaminated soils will be removed and disposed of in the WDC. Evaporation concentrates, pond liner, piping, and other related infrastructure associated with EP-3 will be disposed of in the WDC with other project demolition and decommissioning waste, with final reclamation completed as part of the final reclamation of the WDC. The relatively new EP-3 liners are candidates for optional reuse in the WDC (i.e., cover of buried wastes) to act as a supplement to the final cap cover in preventing infiltration of rainfall/snowmelt through the overlying cover. Such an action would require a modification to the current approved STP design and License Condition 37.B.

A radiation survey will be performed to identify any portions of EP-3 pond bottoms and berms that require removal and disposal as byproduct material. After all contaminated material is removed, a final status survey for radium-226 and natural uranium will be performed to assure compliance with the cleanup criteria contained in **Section 5**. After approval by the NRC, the area occupied by EP-3, along with the access corridor, piping, and utility corridors will be graded, seeded, and revegetated. The security fence will be removed to allow agricultural grazing land use. If contaminated, the fence will be disposed of in the WDC. Upon completion of the reclamation and decommissioning, the permitted license boundary associated with the EP-3 location will be adjusted back to the previous project site boundary.

The decommissioning work for the evaporation pond will be performed in accordance with the Technical Specifications (**Appendix F**) and Construction Drawings.

The Completion Report (Kleinfelder 2011) for the construction of EP-3 was completed in February 2011 with copies submitted to the NRC (Kuhn 2011), NMED, and NMOSE.

9.2.4 Collection Ponds

Two collection ponds (East Collection Pond and West Collection Pond) are located between the RO WTS and EP-2 (**Figure 2.2-5**). These ponds were constructed in 1985 and commenced operations in October 1986 to reduce the salt load going to the tailings facility. Water discharged to the collection ponds initially originated from three sources: backwash from the ion exchange facility (approximately 5 gpm); spent brine and backwash from the main water softeners (approximately 2 gpm); and barren solution from the low sodium extraction (6 gpm; HMC 1984). The estimated continuous discharge rate was approximately 13 gpm.

The two collection ponds have been used as part of the groundwater restoration program since the installation of the RO WTS in 1999. The RO WTS uses a pretreatment system where the pH is increased in order to precipitate solids. The precipitated solids are removed through settling in a reactor/clarifier and by filtration in sand beds. The process produces solid wastes during flocculation and high-TDS brine from the RO process. Collection ponds are used to store miscellaneous RO WTS overflows and plant process water (blowdown), which can be recycled to the RO WTS influent streams for treatment or, alternatively, pumped to the evaporation ponds. Brine solutions are discharged to EP-2.

The East and West Collection Ponds, as well as EP-1, are lined with a Deery Oil Liner/fabric liner system, which consists of a non-woven fabric that is impregnated and then overlain with a layer of No. 6 Deery Oil. See previous discussions in **Section 9.2.1** for liner details.

Once groundwater restoration has been completed on the mill site, the two collection ponds will be decommissioned. Pond concentrates, pond liner, piping, and other related infrastructure associated with the Collection Ponds will be disposed of in the WDC along with other project demolition and decommissioning waste.

Decommissioning of the ponds will commence with pumping as much water as possible from the ponds, along with evaporation enhancement with spray systems. The residues in the collection ponds will be allowed to dry to manageable moisture content levels, removed, and transported to the designated WDC. It may be necessary to mix dry contaminated or clean soil with the pond sediments for ease of handling. The liners will then be cut to a manageable size, rolled, and transported to the WDC for

disposal. A radiation survey will then be performed to identify any portions of the collection ponds bottoms and berms that require removal and disposal as byproduct material. Any underlying contaminated soils will be removed and disposed of in the WDC. The banks of the collection ponds that are determined not to be regulated as a byproduct material will be removed by pushing the soil into the below-grade pond bases, and the area will be regraded to provide positive drainage. NRC approval will be obtained before the banks are pushed into the pond basins.

After all contaminated material is removed and the ponds are filled in, a final status survey for radium-226 and natural uranium will be performed in the area to assure compliance with the cleanup criteria contained in **Section 5**. After approval by the NRC, the areas will be restored by grading and seeding.

9.3 Borrow Areas

All of the borrow areas used in the past have been regraded and revegetated. The locations of Borrow Areas owned by HMC and subject to use are shown on **Figure 2.2-3**. Soils required for the final radon barrier of the LTP, STP, and WDC will be obtained from the North Borrow Area (which has been extensively characterized) or other sites with similar characterizations that are acceptable to the NRC. For other soil needs, such as backfill needs, soils from other borrow areas may be used as long as they are acceptable for the intended usage and approved by the NRC.

The estimated quantity of borrow material and excavated soils/gravel material to be used during final site reclamation and decommissioning are shown in **Table 9.3-1** (HMC 2012a).

The North Borrow Area and other borrow areas designated prior to excavation of borrow soil for coverage construction shall be prepared as follows:

- Vegetation will be cleared and grubbed.
- Vegetation, trash, and other foreign material will be removed to an approved temporary storage or disposal area.
- Wells, water lines, and power lines needed for water supply or for the onsite groundwater restoration program will be preserved and protected.
- Power lines, telephone lines, and other utilities along rights-of-way within the borrow areas will be preserved and protected.
- Any identified cultural resource sites that have been previously identified for each of the borrow areas will be preserved and protected.

In general, borrow soils will be excavated from the uppermost 5 feet of soil. No borrow material shall be used in the soil cover that has contaminated material (concentrations of byproduct-derived radium-226 in excess of 5.0 pCi/g). With a background radium concentration of 5.5 pCi/g, the maximum radium content of borrow material will not be more than 10.5 pCi/g unless excess concentrations have been demonstrated by soil tests to be naturally occurring radium.

HMC will maintain a Quality Assurance Program (QAP), and its contractors will maintain a QCP, as discussed in **Section 14**. These programs will be used for the proper management of the removal and placement of borrow materials, and to ensure that the final cover material meets specifications identified in the final closure plans.

It is currently estimated that approximately 400 acres of current borrow areas will be evaluated for final tailings reclamation; approximately 240 acres may ultimately need to be cleared and grubbed prior to soil removal for use as borrow material for the LTP and 105 acres for the STP. It is currently estimated that approximately 777,000 yd^3 of radon barrier borrow material will be removed from the North Borrow Area (or an acceptable alternate site) and hauled to and placed on the top of the LTP as radon barrier cover. Approximately 87,000 yd^3 of rock cover material will be required for placement on the LTP.

Approximately 170,000 yd^3 of borrow material will be required for preparation and grading of the STP surface, followed by approximately 340,000 yd^3 of borrow material for placement on top of the STP as final radon barrier cover. Approximately 32,000 and 28,000 yd^3 of rock cover material will be required for placement on top of the STP and side slopes, respectively.

With NRC approval, and as needed, HMC may identify and use other regional soil borrow areas with material acceptable as final radon barrier cover or other fill uses.

The Contractor shall employ those measures necessary to minimize dust from its operations, including excavation activities and transportation from the borrow area to the point of placement. Acceptable measures include spraying or other method of applying water or approved dust control chemical mixtures to ground surfaces.

Once soils are no longer needed from the soil borrow areas, these areas will be reclaimed. The disturbed borrow areas will be regraded in accordance with I Specification for Site Regrading and Revegetation to provide drainage similar to

original conditions. As needed, regrading will provide for positive sheet flow drainage, smooth contours, and minimum surface gradients.

Any area within or around the borrow areas that has been compacted through the use of heavy equipment during soil excavation will be ripped with a bulldozer or equivalent equipment with ripple shanks which will make parallel cuts on the contour. The area will then be disked or harrowed to provide a surface for drill or broadcast seeding.

The soils from the borrow areas have been demonstrated to sustain vegetative cover. All seeding activities will follow the procedures found in HMC's 1993 Reclamation Plan. The natural seed mixture compatible with the area vegetation will be as presented in Table 5 of HMC's 1993 Reclamation Plan.

9.4 Contaminated Structures

Decommissioning tasks that currently remain include addressing structures and equipment associated with the LTP dewatering and groundwater restoration activities and management support facilities. The final demolition and decommissioning of HMC's Grants Operations remaining facilities will be performed by a demolition contractor working directly under contract to HMC and in compliance with all NRC regulations and applicable county and state regulations. The demolition contractor shall be directly responsible to HMC's site Project Manager, who may designate a representative from his staff to observe the contract work. The contractor shall perform its duties in accordance with the requirements of HMC's Specifications (**Appendix F**). Demolition work will include dismantling and onsite disposal of all designated project site facilities components. Onsite disposal will be in the designated WDC (EP-1 and/or EP-2).

It is currently planned to dispose of contaminated demolition debris, pond liners, contaminated equipment, piping, and other items in the WDC. Non-contaminated equipment and buildings, including water towers, may be disposed of or sold offsite once screening determines them acceptable for unrestricted use. Any offsite disposal of uncontaminated equipment, debris, and miscellaneous items in an approved offsite landfill will be implemented only if deemed more acceptable for final onsite closure activities. Appropriate agency approval will be obtained before any such action.

The contractor may request the right to purchase from HMC, for salvage purposes, site facility components or equipment. In the event HMC accepts such an offer from the contractor, the contractor will clean and decontaminate all items to be purchased in accordance with applicable NRC regulations and guidelines and that part of HMC

standard operating procedure (SOP) HP-4 entitled HMC Procedure for the Survey of Equipment Prior to Release for Unrestricted Release to HMC's satisfaction (**Table 11.2-1**).

Prior to demolition of remaining buildings and other assets, characterization radiological surveys will be performed to determine what equipment and structures are considered contaminated. Survey methods will include the following procedures:

- Alpha, beta contamination surveys
- Beta and/or gamma exposure rate surveys
- Release of equipment for unrestricted use surveys

These procedures are located in HMC's SOP HP-4.

9.4.1 Buildings within Administration Compound (Previous Trucking Yard)

Between 1993 and 1995, the major mill facilities and all mill buildings were demolished and disposed of onsite. There were a few buildings left intact to be used in support of the ongoing groundwater remediation program. The remaining site buildings are located in the Administration Compound (previous Trucking Yard during site operations) and are used to house maintenance equipment, supplies, and personnel including administrative personnel. These facilities are northeast of the LTP and evaporation ponds (**Figure 2.1-1**) and include:

- Main Office/Warehouse (includes offices, four bays, and a loft)
- Warehouse Building 1
- Warehouse Building 2

Radiological surveys for unrestricted use were conducted on these buildings in March 1997 and January 1998 (ERG 1998). The suspected contaminant in the surveyed buildings was uranium decay chain radionuclides in disequilibrium (i.e., radium-226 enhanced tailings or thorium-230 enhanced solvents). None of the buildings remaining onsite were suspected to contain other enhanced tailings or thorium-230 enhanced solvents. The surface contamination release criteria for uranium ore is specified in HMC's SOP HP-4 (**Table 11.2-1**) as 5,000 dpm/100 centimeters square (cm^2) total, 1,000 dpm/100 cm^2 removable, and 15,000 dpm/100 cm^2 maximum. For any surface exceeding HMC's SOP HP-4's (HMC 1997) administrative limit of 250 dpm/100 cm^2 total alpha, it will be decontaminated and resurveyed. The combined beta and gamma exposure rates may not exceed 40 microRad (µR)/hr for any surface to be acceptable for unrestricted release. Site data have demonstrated that for aged (equilibrium)

yellowcake, the gamma and beta exposure rates are approximately equal. Survey procedures required that the gamma exposure rate be doubled, with the background then subtracted to calculate the combined beta and gamma exposure rates (ERG 1998).

Radiological survey frequencies and locations, radiological equipment detection sensitivities, and data review were performed to the specifications of NUREG/CR-5849, Manual for Conducting Surveys in Support of License Termination (NRC 1992). Areas to be surveyed were classified as affected (containing radiological contamination and requiring comprehensive survey) or unknown (requiring an "inclusion" survey as defined in NRC 1992). Classification of areas and survey methods are presented in the report summarizing the radiological surveys of the abovementioned buildings (ERG 1998).

The conclusions of the radiological survey were as follows (ERG 1998):

- Based on the radiological survey data within the three subject buildings at the HMC site, the buildings met the requirements for unrestricted use. All of the area classifications were demonstrated to be reasonably accurate in predicting low levels of surface contamination in affected areas and little or no surface contamination in the "unknown" areas.
- No total alpha measurements exceeded the release criterion of 5,000 dpm/100 cm^2, with more than 95 percent of the measurements being less than 1,000 dpm/100 cm^2. None of the removable contamination measurements exceeded 150 dpm/100 cm^2 or 15 percent of the unrestricted release criterion of 1,000 dpm/100 cm^2.
- Due to the low surface contamination levels, the gamma and beta exposures are predictably low and assumed to be representative of background. All survey values are less than 40 µR/hr criterion specified in HMC SOP HP-4.

The remaining buildings in the truck yard are scheduled for demolition in the year 2022, when they will no longer be needed to support remaining decommissioning and groundwater reclamation activities. These buildings will be razed and the rubble disposed of in the WDC or taken to an appropriate offsite landfill for disposal.

9.4.2 Reverse Osmosis Facility

The current 600 gpm RO WTS is an important and integral component of the overall groundwater remediation/cleanup strategy at the Grants site. The RO WTS is a water treatment facility that uses lime softening for pH control and two RO membrane

treatment systems to treat contaminated water pumped from the alluvial aquifer. The treated water is used as injection water in some areas of the HMC groundwater restoration program. The RO facility was constructed in 1999 and began full operation in January 2000. A second RO unit was added in 2002. The RO facility will continue to be used until the groundwater restoration program for the HMC site is completed. It is anticipated that the RO facility will be operated as part of the site groundwater remediation program through 2020 and then kept on standby in 2021 until final decommissioning and demolition/disposal of the plant and equipment can be accomplished.

An expanded RO water treatment system is presently scheduled for construction in 2016. It will augment the 600 gpm RO WTS, if required, and will provide a total RO WTS treatment capacity of approximately 900 gpm on a continuous basis. The expanded RO WTS will be operated from 2016 through 2020.

With the exception of the floors and sumps, the RO buildings themselves are expected to be free of contamination. A surface contamination survey will be conducted and the buildings released for unconditional use if they meet the criteria contained in NRC Regulatory Guide 1.86. If contaminated, the buildings will be decontaminated and re-surveyed to determine if they meet unconditional release criteria, managed as byproduct material, or transferred to a company with an appropriate radioactive materials license.

HMC shall employ a qualified contractor for the demolition or dismantling of the RO facilities. The RO facilities will be decontaminated as necessary to facilitate safe handling and will be demolished or dismantled using primarily mechanical means. The specific equipment used for demolition or dismantling will be selected by the contractor and HMC based on considerations of applicability, cost-effectiveness, worker safety, and protection measures against release of contaminants using ALARA principles. Surface contamination may be removed using scaling and high-pressure washing. Specific equipment and other materials in the RO WTS may be removed from the site if decontamination sampling can meet regulatory release requirements. Otherwise, all contaminated debris, equipment, piping, and other materials will be disposed of in the WDC. The floors and sumps will be removed and managed as byproduct material in the WDC.

9.5 Contaminated Systems and Equipment

All pumps, well casings, piping and valves, and evaporation-pond spray systems associated with the onsite groundwater restoration program will be removed, sized,

and disposed of in the WDC as byproduct material. The RO WTS may be transferred to another licensee or sized and managed as byproduct material. Radiation surveys will be conducted on tanks, pumps, and piping associated with pretreatment of water for the RO circuits. Some of these items are expected to be suitable for unrestricted release.

Irrigation piping, pumps, and central pivot spray systems; flood irrigation piping and equipment; and possibly pilot plants for groundwater restoration studies that are currently underway or planned are expected to meet release criteria for unconditional use detailed in NRC Regulatory Guide 1.86. Characterization radiation surveys will be conducted on this equipment. Equipment that does not meet the above criteria will be sized and disposed of as byproduct material in the WDC.

9.6 Sequence of Removal of Structures, Equipment, and Systems

It will be several years before groundwater restoration is complete and final decommissioning and reclamation activities can be developed with reasonable certainty. Therefore, attempting to present the sequence of removal of structures, equipment, and systems at the current time is not productive and could lead to unnecessary scrutiny and future confusion for the stakeholders.

Once final demolition and reclamation tasks can be identified and scheduled, Technical Specifications will be developed by the designated Engineer of Record. The proposed work will adhere to the site's construction QA/QC procedures in order to ensure that the remaining demolition, earthwork, and other reclamation activities comply with the Technical Specification(s), are consistent with current industry practices, and meet applicable regulatory requirements. The QA/QC procedures will ensure that proper materials, construction techniques, and procedures are followed by the contractor and that the intent of the designs is met.

9.7 Soil

Contaminated surface soils were removed from the site during the mill decommissioning and windblown contamination cleanup completed in 1995 (AKG 1996, ERG 1995). Some areas have potentially been contaminated by small water releases from the groundwater restoration program activities. In addition, the final decommissioning of the groundwater restoration facilities is expected to create or identify additional potentially contaminated areas.

9.7.1 Surface Soil Contamination

The only surface soils known to exhibit elevated mill-related radionuclide concentrations are the soils near the evaporation pond spray systems. Radiation surveys will be performed in the area near the spray systems as well as all potentially contaminated areas created from decommissioning the groundwater restoration facilities. These areas include the underlying soils of evaporation pond and collection pond liners, foundations, and disturbed areas as a result of demolishing buildings; and waste transport routes.

9.7.2 Subsurface Soil Contamination

Currently, the only known subsurface soils that potentially may exceed cleanup criteria are soils near EP-1 and EP-2, which were impacted from over-spray. These surface and subsurface soils will be investigated by performing radiation surveys and soil sampling and analysis.

Operation of EP-3 could also possibly result in similar subsurface contamination. Therefore, the pond will also be investigated by performing radiation surveys and soil sampling and analysis.

9.7.3 Outlying Land Areas

The only known offsite activity having the potential for contaminating the environment is associated with the irrigation program. This program has been carefully monitored over the last 11 years. The 2010 Irrigation Report (HMC et al. 2012) presents all of the data collected to date. A slight buildup of uranium has occurred in the soils. However, these concentrations are a very small fraction of the applicable cleanup levels for uranium.

A Class 2 Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) survey will be conducted across each irrigation field to document the concentrations in the soil and verify that the levels are below cleanup criteria.

9.8 Regrading and Vegetation

With the exception of the LTP, STP, mill area, and the Levee, each portion of the site disturbed by reclamation activities, including the borrow areas, shall be final graded after all other construction activities have been completed before revegetation activities on each portion of the affected site.

Final site grading shall be performed to establish those gradients that will assure positive drainage of surface water runoff in directions away from the LTP, STP, and the reclaimed mill area. To the extent feasible, the final regraded contours will reestablish or maintain the directions and slope gradients of ground surfaces that existed prior to development of the HMC mill site.

Final status survey design for the verification of radiological contamination of the disturbed areas is discussed in **Section 15.3**. A Final Survey Status (FSS) Report will be prepared within 90 days following the completion of soil cleanup and disposal activities in accordance with License Conditions 29F. The format and content of the report will be as described in **Section 15.4**.

The Specification for Site Regrading and Revegetation for site grading and restoration is presented in **Appendix F**.

9.9 Surface Water

AS discussed in **Section 3.6**, the only features containing water within HMC's license boundary are the manmade collection ponds and evaporation ponds, which will be reclaimed as part of final closure of the site. There are no significant streams or surface water bodies downgradient of the site that would be subject to impacts of surface runoff from the site. No streams exist near the radiologically controlled area of the site, which is relatively flat with a slight slope to the south. Ponding in the area can occur after a few days following large precipitation events, but generally evaporates or infiltrates the alluvium. Surface water flow near the HMC site only occurs after extreme precipitation events and generally only within some reaches of the nearby San Mateo and Lobo Creeks (HMC and Hydro-Engineering 2011). Therefore, impacts from surface runoff from the site to surface water bodies or streams downgradient of the site are expected to be minimal.

Surface Water Runoff Control Onsite

The main issue with stormwater as far as final site decommissioning and reclamation is the potential for large precipitation events and surface runoff and erosion of the berms of the LTP, STP, and reclaimed mill site. As discussed in **Section 3.6**, the Grants Reclamation Project site lies partially within the broad floodplain of San Mateo Creek with 291 square miles of upstream watershed (**Figures 3.1-2** and **3.6-1**).

Figure 2.2-10 shows an overlay of the 2010 FEMA Floodplain boundaries in relation to the HMC Grants Site. The FEMA 100-Year Floodplain Boundary encompasses much

of the HMC Grants Site and extends southwest into the Murray Acres, Broadview Acres, and Felice Acres subdivisions. This map demonstrates the lack of channeled flow of water in established drainages in this area.

The representation of the FEMA map does not reflect the presence of the site features including the LTP, collection ponds, EP-1 and EP-2, and the existing dike, which will change the flow of water in the immediate area of these features. The existing dike, located on the southeast toe of the LTP (**Figure 2.2-9**), was constructed in order to direct the flow of flood water to the north and west of the LTP and to protect the LTP toe, reclaimed mill area, and disposal pits and evaporation ponds to the south. This levee also will serve to divert both offsite flows from the San Mateo and Lobo Canyon flood flows to the north and west of the mill area and the reclaimed LTP and STP areas.

HMC has assessed storm water runoff at the site (AKG and Jenkins 1993) with the objective of determining: 1) the estimated peak flood flows produced from within the project boundary as a result of the 100-year 24-hour rainfall event and 2) the total runoff volume during the storm event. The study provides information needed for the preparation of a conceptual drainage channel design to control the flood waters generated from the project site and to route flood waters to the agricultural fields either west or south of the property. This drainage channel will assist in controlling the flood waters originating onsite and limit the impact to the residential neighborhoods to the south and west of the property. As part of the final closure plan, specific design details will be developed for this diversion/drainage channel.

HMC will develop a surface water control plan for the surface water generated onsite during flood conditions which considers the location and extent of the FEMA 100-Year Floodplain. Detailed survey data will be collected to support the plan development so that onsite HMC Grants runoff will be controlled with the intent of preventing exacerbation of offsite flooding. The construction engineering of the final reclamation activities (e.g., ponds and site surface areas) will need to be factored into the development of the surface water control plan.

9.10 Groundwater

The Updated CAP is detailed in the Grants Reclamation Project Updated Correction Program, which was submitted to the NRC by letter dated March 15, 2012 (HMC 2012b). The purpose of this section is to only briefly summarize the major components of the Updated CAP.

The purpose of the update to the CAP is to document the status of the current restoration effort and the adaptations necessary for source control and plume remediation. The CAP is designed to accomplish the following objectives:

- To fulfill the relevant acceptance criteria for groundwater CAPs for the NRC, as detailed in NUREG-1620, Section 4.4.3;
- To communicate effectively with all stakeholders about the progress being made in restoring groundwater to established site standards and the anticipated path forward;
- To address future modifications to the Updated CAP and predict the required duration for each component;
- To compile relevant information available in the annual monitoring reports and NRC license amendments into a single document;
- To address the RAIs from the NRC after their recent review of the 2006 draft CAP revision; and
- To address specific comments from the Environmental Protection Agency (EPA) and NMED in letters to the NRC dated December 13, 2011 and November 27, 2011, respectively, to assure that completion of the Updated CAP will satisfy EPA and NMED requirements necessary to delete the site from the NPL.

HMC is proactively incorporating multi-agency input into its evaluation and operation of the groundwater restoration program. HMC is committed to successfully restoring groundwater to the site standards, and input from all of the stakeholders is valued in achieving this goal.

At the time of preparation of this Updated DRP, additional comments on the Updated CAP by the NRC, EPA, and NMED are pending. It is anticipated that the Updated CAP will be revised following the receipt of RAIs from the NRC, which will include comments received from other regulatory agencies and the public.

Active restoration efforts are currently expected to continue through 2020, with final evaporation and closure and decommissioning continuing through 2022. This represents a 3-year extension of the schedule; the restoration effort was previously expected to be completed by 2017. Two of the primary reasons for the revised schedule were the delay in the issuance of approvals for construction of EP-3 and the NMED's decision to limit land treatment as a means of managing groundwater generated by the plume control program.

The Updated CAP includes five major operational components: (1) source control, (2) plume control, (3) RO treatment, (4) evaporation, and (5) land treatment. Source control currently involves flushing the soluble contaminant mass in the tailings pore water with un-impacted to slightly impacted low contaminant concentration water to expedite the reduction of contaminant flux coming out of the LTP. The plume control program involves the creation and maintenance of a hydraulic barrier downgradient of the LTP to inhibit the flow of contaminated groundwater and allow collection for treatment.

Crop irrigation, or land treatment, has been conducted since 2000 to manage large volumes of groundwater containing relatively low levels of COCs. Beginning in 2010, however, NMED began to limit HMC's use of land treatment as part of its remediation strategy. If these land treatment limitations continue, additional delays should be expected, as this strategy is a critical component of the Updated CAP.

Within the groundwater collection area established by the hydraulic barrier, groundwater that contains COCs at concentrations in excess of the approved cleanup standards is extracted from the aquifer and sent to the RO WTS. The RO WTS removes COCs from the water, thereby allowing the treated product water to be used as a source of un-impacted water at the site. Evaporation (which is conducted in three lined evaporation ponds) and land treatment are water management strategies that allow HMC to handle inflows and outflows from the other restoration programs to achieve a site-wide water balance. Evaporation and land treatment are essential to the operation of the Updated CAP.

HMC has completed and is currently conducting numerous evaluations to determine if the performance and/or operation of the five existing components of the Updated CAP has been effective or can be further optimized.

HMC conducted a mass removal analysis of dissolved uranium to demonstrate the effectiveness of the plume control program. During this analysis, the total mass of dissolved uranium in the alluvial aquifer plume was calculated for each year from 2001 to 2009. In 2001, the total mass of dissolved uranium in the alluvial plume was estimated to be 80,000 kg and in 2009, the total mass was estimated to be 30,000 kg. These results are consistent with reductions in COC concentrations and plume size observed over the past decade. Furthermore, the results of this analysis directly address EPA and NMED concerns by conclusively demonstrating that the decrease in dissolved uranium concentrations observed in the plume is due to mass removal, not dilution from injected water.

HMC is also evaluating the condition and performance of the RO WTS and identifying strategies to maximize production and treatment efficiency. Preliminary results from this investigation indicate that the RO WTS is in generally good condition and can be operated reliably for the next 10 years with some investment in rehabilitation and replacement of equipment as it reaches the end of its useful life. Pretreatment can be optimized to maximize treatment capability and minimize produced waste. Potential improvements include equalization and characterization of influent feed water, physical modifications to address hydraulic capacity constraints, adjusting the locations of chemical feeds, and increasing process water quality monitoring. These improvements will increase the reliability of the plant and increase treatment capacity.

HMC is conducting an investigation in the LTP to evaluate the current source control program. This investigation includes a rebound evaluation to provide a defensible, technically sound prediction of long-term COC leaching behavior in and downgradient of the LTP after flushing ends. The rebound evaluation has three elements: (1) bench-scale tests to evaluate the leaching behavior of uranium, molybdenum, and selenium from tailings solids; (2) a tracer study in a 1.3-acre portion of the LTP to characterize the flow regime and evaluate the connectivity of the well network before discontinuing flushing; and (3) a monitoring program of relevant geochemical parameters after flushing was discontinued in May 2011 in this highly localized area. Continued post-flushing monitoring is planned for at least 1 year in this area of the LTP to further understand rebound potential.

In addition to the source control, plume control, and RO WTS optimization evaluations, HMC is investigating several alternative treatment technologies. If bench- and pilot-scale tests are successful, HMC may implement one or more of these technologies upon receiving appropriate agency approval to enhance groundwater restoration. HMC is currently evaluating three different alternative treatment technologies: *in situ* phosphate treatment, *ex situ* zeolite treatment, and EC. Phosphate treatment would be used in a variety of implementation approaches to address dissolved uranium in groundwater *in situ*.

Both zeolite and EC treatment are pump-and-treat technologies that may be feasible for use as additional water treatment strategies to supplement the RO WTS. HMC is currently operating an *ex situ* zeolite pad on top of the LTP and is conducting bench-scale EC testing to determine the feasibility of using either or both of these treatment technologies at the site.

The five current components of the Updated CAP work in combination as a proven strategy to achieve source control and plume remediation. The source control program limits future contamination potential from the LTP. The plume control program inhibits the movement of contaminated groundwater and sends highly contaminated groundwater to the RO WTS for treatment. Evaporation and land treatment are essential water management practices that allow HMC to achieve target injection, extraction, and treatment rates. Without land treatment, the performance of the source control, plume control, and RO WTS programs is limited, and groundwater restoration will not be achieved on schedule. HMC will continue to evaluate conditions and alternative treatment technologies with the aim of identifying opportunities to enhance the effectiveness and timing of the restoration efforts.

HMC's estimate that active groundwater restoration efforts under the Updated CAP will continue through 2020 is based upon groundwater modeling, observed results from present operating conditions, and predicted future operating conditions. The Updated CAP will be subject to further revisions depending upon operational changes in the five current components of the Updated CAP and/or the implementation of alternative restoration technologies as applicable. However, the current schedule cannot not be met if the operation of one or more of the Updated CAP components is impeded.

9.11 Decommissioning Schedule

The revised schedule for completion of the remaining decommissioning and reclamation at the Grants Reclamation Project is presented on **Figure 9.11-1**.

The overall schedule is currently estimated to be completed by the year 2022. Completion of the major tasks is scheduled as follows:

1. Water Treatment
   - Tailings Water Management — 2013 through 2019
   - Aquifer Remediation — 2013 through 2022
   - Groundwater Treatment and Evaporation — 2013 through 2022
   - Physical Reclamation/Closure — 2021 through 2022
2. Tailings Facility Closure/Reclamation — 2021
3. Onsite Demolition — 2022
4. Monitoring/Regulatory — 2013 through 2022

9.11.1 Water Treatment

This project activity program category includes many of the ongoing activities related to continuation of the groundwater remediation program at the Grants site. The following are brief discussions of each of the program subcategories involved with maintaining the groundwater cleanup program at the site until final site closure. Refer to the Updated CAP for further detail.

Tailings Water Management

Tailings water management consists of flushing of the LTP with freshwater injection into the tailings in order to drive contaminated waters to dewatering wells. The toe drains and dewatering wells collect the water from the tailings with high concentrations of contaminants and divert these waters to the treatment facilities (i.e., RO WTS and evaporation ponds). The tailings injection program is planned through 2014, while the tailings collection is scheduled to stop after 2016. Abandonment of the majority of the tailings wells in the LTP is planned in 2019.

Tailings Collection

Activities include maintenance and operation of the LTP tailings water collection wells and piping systems used to extract tailings water out of the pile during flushing and final well extraction activities prior to final closure of the LTP. Outside contractors; technical consulting support; and parts, supplies, and pumps will be used to maintain the extractions systems through the end of 2016, with some additional costs anticipated in 2017.

Toe Drains and Sump Collection

Activities associated with the toe drains and sump water collection in and around the LTP are scheduled to occur through 2016 with minor additional activities in 2017. Outside contractors, technical consulting support, and parts and supplies and sump pump repair/replacement to maintain the LTP seepage collection systems will be required throughout this time period.

Tailings Flushing System

Water conveyance and injection systems in place on the LTP to complete the tailings flushing program are scheduled to operate through 2014. Pumps required for water supply delivery to the injection systems and outside contractor support for electrical systems, pump repair, and technical consulting support will be needed to maintain the system for the LTP flushing program.

Groundwater Management

Activities related to groundwater management pertain to water quality monitoring, well maintenance, and drilling/abandonment of wells in the alluvial and Chinle aquifers that are necessary to evaluate the status and progress in remediation of water contamination in these aquifers downgradient of the Grants site. As such, the groundwater remediation program activity will be maintained for the remainder of site closure from 2013 through 2022 when final site closure is planned.

Groundwater Collection

The groundwater collection program involves the groundwater well system used to collect aquifer water for continued containment removal and subsequent cleanup of the affected aquifer systems beneath and downgradient of the Grants site. Groundwater collection is ongoing and will continue through 2020, with the water either treated through the RO WTS operations or used for tailings pile flushing or other groundwater cleanup program activities, depending on the quality of the water. This program involves outside contractor and technical consulting support services, parts, supplies, pump repair/replacement, and electrical costs for operation of pumping systems.

Groundwater Injection

This aspect of the groundwater remediation program at the Grants site involves the groundwater well and infiltration line systems used to inject fresh water or treated RO water in the aquifer system to assist in containment removal and subsequent cleanup of the affected aquifer systems beneath and downgradient of the Grants site. The groundwater injection system is currently in operation and will continue through 2020 in areas where aquifer remediation requires supplemental freshwater injection. This program includes outside contractor and technical consulting support services, parts, supplies, pump repair/replacement, and electrical costs for operations on injection systems.

RO WTS Operations

The 600 gpm RO WTS is an important and integral component of the overall groundwater remediation/cleanup strategy at the Grants site. The RO WTS is used to provide a source of clean treated water for injection into the aquifer system downgradient of the Grants tailings piles and also concentrates contaminants for subsequent disposal in the project evaporation pond complex. Plant feed is primarily composed of contaminated groundwater beneath or immediately downgradient of the LTP and is an important component for aquifer cleanup and to assure hydraulic containment of contaminants within close proximity of the LTP and mill site area. The

Grants site groundwater remediation program has been scheduled to operate the RO WTS through 2020 and then to keep the plant on standby in 2021 until final decommissioning and demolition/disposal of the plant and equipment. This program includes outside contractor and technical consulting services, electrical power and natural gas for operation, parts, supplies, pump repair/replacement, minor water analysis cost for operation, and chemical consumables and RO membranes related to the water treatment process.

Expanded RO WTS

An expansion to the RO WTS is scheduled for construction in 2015, which will augment the 600 gpm RO WTS and will provide a total RO treatment capacity of approximately 900 gpm on a continuous basis. The plant feed water and operation will be essentially the same as those for the existing RO WTS, and the projected operating costs are an extension of the operating costs for the existing RO WTS. The system is scheduled to operate from 2016 through 2020.

Alternate Remediation Testing

R&D test work is underway to ascertain whether an *in situ* chemical treatment or other *ex situ* pump-and-treat technologies are feasible to assist in groundwater remediation and/or tailings pile closure at the Grants site. A positive feasibility determination may support additional costs or implementation of the technology based on results. Continued testing of alternate remediation technologies is included in years 2013 and 2014.

Evaporation System Management

Forced evaporation spray systems are used to enhance evaporative loss in the pond systems that are in place to contain contaminated wastewater at the site. Spray systems are operated on the East and West Collection Ponds and the EP-1, EP -2, and EP-3 evaporation ponds. This program includes the use of outside contractor support for the electrical, pump maintenance, parts, and supplies including odor control chemicals (copper sulfate). It is anticipated that all three ponds will be used for passive or forced-spray evaporation through 2022.

Irrigation System Management

This program component for the Grants site groundwater remediation program involves use of a land treatment/crop irrigation program to accomplish final "polish" remediation of the affected aquifer systems downgradient of the tailings piles and milling complex area. Approximately 400 acres of land are under a center pivot and

flood irrigation system. Operation of this system was initiated in 1999/2000. This crop irrigation program involves outside contractor and technical consulting support, program monitoring and analysis of soils, vegetation and water quality, well maintenance, installation and abandonment of groundwater wells, parts, supplies, pump repair/replacement, and electrical power consumption costs to operate pumps and center pivot equipment.

9.11.2 Tailings Facility Closure/Reclamation

Activities in this closure activity category are associated with final decommissioning and physical/closure of the site. Major activities involve outside contractor construction work and technical consulting support for designs, planning, and follow-up environmental monitoring and include:

- Final physical reclamation and closure of the LTP in 2021 after completion of the ongoing pile flushing program and completion of residual extractive pumping of water remaining in the pile prior to final natural draindown. The operation of alluvial collection and injection systems within the footprint of the LTP will continue through 2020.
- Final closure and physical reclamation of the STP in 2022 subsequent to closure of the evaporation ponds, which is scheduled in 2022. RO WTS decommissioning activities and associated costs with removal and disposal of contaminated plant, equipment, and piping systems are also planned in 2022.

9.11.3 Onsite Demolition

Activities in this category include outside consulting technical support to provide design details and plans for reclamation work involved with final demolition and onsite quality control. Also included are activities related to preparation of final as-built drawings for final reclamation activities planned at project end in 2022.

9.11.4 Monitoring/Regulatory

The monitoring and regulatory permit maintenance programs at the Grants site provide support to a comprehensive surveillance and reporting system necessary to monitor progress in accomplishing groundwater cleanup, identify issue/concern areas in the program, and to provide required reporting and information sharing with the regulatory agencies that have oversight and permit requirement authorities/responsibilities. These activities include permit applications preparation, regulatory agency oversight, and technical support related to preparation of project reports required for permit or regulatory authority; parts, supplies, and power requirements for air/meteorological

monitoring; and radiation program monitoring and personnel training. Also included are surveying and reporting tasks associated with monitoring of physical settlement of the LTP, a condition of existing permits in place for the site. These activities will continue through the end of the project in 2022.

9.11.5 Aquifer Remediation

The aquifer remediation program consists of collecting contaminated groundwater, treating some of the collected water through the RO WTS, disposing of some water in the evaporation ponds, furnishing some of the water to irrigate nearby cropland, and injecting fresh and contaminated groundwater and RO product water to help in the containment and cleanup activities. HMC uses several separate groundwater collection systems to collect groundwater as part of the overall groundwater remediation system. The groundwater injection activities will cease in 2020, with the injection of RO treated water occurring until the end of 2020. The irrigation program is projected to continue through 2020. Alternative aquifer restoration, if determined successful, is expected to occur from 2013 through 2020.

9.11.6 Groundwater Treatment and Evaporation

The groundwater restoration program is currently projected to extend through 2020. Operation of the irrigation and alternative restoration systems are planned through 2020 as well. The groundwater treatment and evaporation system consists of the operations of the RO WTS (through 2020), alternative testing and remediation testing, collection ponds, and evaporation ponds for evaporative dewatering. The collection and evaporation ponds will be operated with treatment water input until 2020, with evaporative dewatering to continue until 2022. The collection and evaporation ponds will be reclaimed by the end of 2022. EP-1 and/or EP-2 will be used for disposal of remaining soils, sediments, demolition debris, and other materials.

9.11.7 Physical Reclamation/Closure

The reclamation and closure of the remaining physical assets (i.e., tailings piles, RO WTS, office/shop buildings, miscellaneous and ancillary facilities) will occur from 2021 through 2022. The majority if the final site grading and the final radiological survey will occur in the first half of 2022. The cleanup criteria for groundwater are projected to be met by 2022.

Alternate groundwater treatment options under consideration are discussed in **Section 9.10**.

The closure cost estimate for the years 2013 through 2022 (HMC 2012a) was developed with the assumption that the groundwater restoration program is to follow the schedule outlined in the HMC Updated CAP developed in 2011 through early 2012 (HMC 2012b). The reclamation activities associated with the program schedule shown on **Figure 9.11-1** are summarized as follows:

- The Tailings Flushing program is to continue through 2014.
- The Toe Dam Collection program is to continue through 2016.
- The Collection for Reinjection program is to continue through 2015.
- The Tailings Dewatering program is to continue through 2016.
- The Upper Chinle Injection program is to continue through 2018.
- The Middle Chinle Injection program is to continue through 2018.
- The Freshwater Injection program is to continue through 2020.
- The placement of the Radon Barrier and the Rock Cover for the LTP is to occur in 2021.
- The existing RO WTS is to be operated from 2013 through 2020.
- The practically achievable continuous feed rate is estimated at 540 gpm.
- The expanded RO WTS is to be operated from 2016 through 2020.
- The Groundwater Restoration program is to continue through 2020.
- The Alluvial Collection program is to continue through 2020.
- The operation of EP-1 is to continue through 2021.
- The operation of EP-2 and EP-3 and the East and West Collection ponds is to continue through 2021.
- The reclamation of EP-2 and EP-3 and the East and West Collection ponds is to occur in 2022.
- The placement of the Radon Barrier and the Rock Cover for the STP is to occur in 2022.
- The RO WTS demolition is to occur in 2022.
- Demolition of the office and other onsite features is to occur in 2022.
- The Irrigation program is to continue through 2020.

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10. Project Management and Organization

10.1 Decommissioning Management Organization

The HMC currently operates with a site staff of ten individuals for carrying out the groundwater remediation program and is expected to continue with a similar staffing through the remaining reclamation and decommissioning activities. Additional staffing, or a change in staffing, could occur once final reclamation and decommissioning tasks are better identified and scheduled. HMC will employ a variety of contractors in carrying out the remaining groundwater restoration activities and final site demolition and decommissioning tasks.

The HMC Grants site organization is led by the Project Manager (PM), supported by a staff of functional area personnel (**Figure 10.1-1**). For each major task identified and implemented, the site PM will assign an employee to serve as the Task Manager (TM). The TM will oversee all of the activities required to complete a specific task, including oversight of the work by the contractor. Each TM will have experience in performing the work required in a task, with the level of experience depending on the task. If necessary, a TM will receive training for a specific role. An individual may serve as a TM for more than one task, as long as that individual is able to complete tasks in an acceptable manner. If needed, individuals may be contracted on a part time basis for job assignments that do not require full-time site involvement.

For all tasks involving potential or expected radiological exposures, work activities will be performed as per the radiation safety program discussed in **Section 11.2**.

As groundwater reclamation and decommissioning of the mill site moves forward, the final tasks are better understood, and contractors are selected, it is expected that the PM will change the organization to integrate responsibilities with the organizational structure of the specific contractors (e.g., demolition). It will be the responsibility of the PM to assign or reassign responsibilities as necessary to ensure satisfactory safety performance, environmental protection, and regulatory compliance with applicable federal state and local laws and regulations.

Any major changes in the organization structure will be conducted in accordance with the requirements of License SUA-1471.

10.2 Decommissioning Task Management

Reclamation and decommissioning activities are managed in compliance with company policies, environmental management systems (Barrick 2010), and SOPs (HMC 2010). The SOPs are consistent with regulatory requirements and License SUA-1471 conditions. Once final reclamation and decommissioning tasks are better defined (as needed) and scheduled, the SOPs will be reviewed by the Radiation Safety Officer (RSO) for potential revisions and additions based on the identified actions and need for protection and monitoring measures. See **Section 11.2** for additional discussions of SOPs.

The organizational structure during final reclamation and decommissioning will identify the following functional responsibilities:

- Licensing and Permitting
- Project Controls
- Project Engineering
- Operations
- Waste Management
- Security
- Radiation Protection
- Environmental Health and Safety
- Security
- Quality Assurance (demolition, reclamation, personnel, and environmental monitoring)

Staff responsibilities are summarized in **Table 10.3-1**. A summary of the HMC staff positions, responsibilities, and educational requirements for support of the site radiation safety, health, and environmental program for decommissioning and reclamation tasks is shown in **Table 10.3-2**.

Manager of Closure Properties

The position of Manager of Closure Properties is a management position of the HMC parent company, Barrick Gold of North America. The Manager of Closure Properties is responsible for the budget, staffing, and operations of the HMC Grants Reclamation Project.

HMC Project Manager

The HMC Grants Reclamation PM reports directly to the Manager of Closure Properties. The site PM will have the primary responsibility for preparing the final reclamation and decommissioning plans and for managing the reclamation and decommissioning activities. The PM will have training and experience in radiological facility operations and/or decommissioning of such or similar assets. The PM will have overall responsibility to ensure safety and compliance during the reclamation and decommissioning of the Grants site while complying with applicable laws and regulations. This position is responsible for hiring personnel who meet minimum qualifications for positions described in this section. The PM will serve as the site RPA as per License Condition 21 of License SUA-1471.

The PM, at a minimum, will have the following qualifications:

- Bachelor's degree in an appropriate discipline
- Previous experience in project management of industrial sites
- Radiation safety training as the RSO that meets NRC requirements (NRC 2002)

Task Manager

Each TM will have experience and training in the activity of the assigned task. The TM, in consultation with the PM, will have the responsibility for preparation and implementation of the work plan, and, as needed, a Radiation Work Permit (RWP), for an assigned task. The TM will also be responsible for the execution of the task and will report directly to the PM.

Senior Environmental Engineer

The Senior Environmental Engineer reports directly to the Grants site PM, and responsibilities include assisting the PM with the following tasks:

- Acts as PM when the PM is absent from the site. Under the direction of the PM, this position supervises and coordinates reclamation and decommissioning operational and maintenance activities.
- Assists in the preparation of letters and reports to federal and state agencies and ensures that all required training of staff and contractors is completed.
- Provides regulatory oversight and support in regard to remediation activities at the Grants site, in order to ensure compliance with applicable environmental and safety regulatory requirements.

- Negotiates and interacts with regulatory agencies and stakeholders in order to ensure regulatory compliance with the development and implementation of effective remediation and site closure strategies.
- Oversees and manages regulatory and permit compliance requirements of environmental consulting support parties employed by HMC in support of remediation and closure activities.

Senior Project Engineer

The Senior Project Engineer will have the primary responsibility of providing technical and engineering assistance and guidance to the PM and other staff members in completing reclamation and decommissioning tasks. The Senior Project Engineer manages all stages of reclamation and decommissioning activities onsite and ensures that all contractors comply with regulatory guidelines; company policy; and applicable federal, state, and local laws. This position provides safety training to staff members and contractors, conducts incident/accident investigations, and prepares and submits necessary applications to the state for various aspects of well permitting. The Senior Project Engineer coordinates with the Senior Environmental Engineer in carrying out related and shared roles.

The Senior Project Engineer, at a minimum, will have the following qualifications:

- Bachelor's degree in engineering
- Previous engineering and managerial experience at industrial sites
- Radiation and industrial safety training

Site Supervisor (Senior Environmental Technician)

The Site Supervisor's primary responsibility is the supervision and coordination of all onsite reclamation and decommissioning operational and maintenance activities under the direction of the PM and Senior Environmental and Project Engineer. The position supervises all utility operators and ensures that all duties performed comply with regulatory guidelines; company policies; and all applicable county, state, and federal laws. One of the position's main tasks is to ensure continual safe and efficient operation of the groundwater restoration system. The Site Supervisor also serves as the site Senior Environmental Technician (SET).

The Site Supervisor, at a minimum, will have the following qualifications:

- High school diploma or equivalent
- Previous experience in similar supervisory tasks for a large industrial facility

- Radiation safety and industrial safety training

Senior Health Physics Technician

The primary responsibility of the Senior Health Physics Technician (SHPT) is to maintain all radiation monitoring and ALARA programs. The SHPT performs all duties required to conduct field water sampling, high-volume sampling, and environmental radiation monitoring (e.g., radon and gamma measures). This position also performs scans for radiation (people and equipment) and manages personnel badges. The SHPT monitors and assists with the operation of the RO WTS and conducts monthly and weekly groundwater management system inspections. This position acts as the Site Supervisor when the Site Supervisor is absent.

The SHPT, at a minimum, will have the following qualifications:

- High school diploma or equivalent
- Supervisory experience that enables acting as Site Supervisor when the latter is absent from the site
- Training in radiation safety and radiation monitoring equipment

Environmental Technician

The Environmental Technician will, at a minimum, hold a high school diploma or equivalent training and/or experience. The position is required to have an understanding and ability to use and maintain a groundwater database management system and ability to prepare groundwater status reports. The qualifications and general responsibilities for other Grants staff positions are presented in **Table 10.3-2**. The education and experience of these staff members meet or exceed the requirements of NRC Regulatory Guide 8.31 (NRC 2002).

10.3 Radiation Safety and Health Training

All personnel who enter the license area to participate in final reclamation and decommissioning tasks will be given training in health and safety radiation procedures in accordance with the requirements of the HMC Radiation Protection Training (SOP No. HP-14; HMC 2010). All prime contractor and subcontractor personnel will be subject to this training. All training will be conducted under the direction of the PM (serves as site RPA) and Utility Operator/SHPT. All training will be consistent with applicable license conditions of License SUA-1471. HMC employees and contractors who have received the Radiation Orientation are required to receive Refresher

Radiation Protection Training every year that they work with radioactive materials. This training has an outline, reference material, and test.

10.4 Contractor Support

HMC final reclamation and decommissioning activities will be managed by a combination of HMC staff and qualified contractors. HMC currently employs specialized contractors in ongoing groundwater reclamation activities and will employ additional contractors for specific purposes such as demolition, well closure, drilling, excavation, tailings and pond(s) closures, surface grading, reseeding, and other activities. An experienced and qualified radiation health physicist is currently employed in support of the site radiation safety program (e.g., annual ALARA audit and annual tailings piles radon flux survey), and that entity will continue to be employed until final reclamation and decommissioning tasks are completed. In addition, a third-party licensed engineer conducts annual inspections of the tailings piles and ponds to confirm the stability and functionality of these assets.

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11. Health and Safety Program during Decommissioning

11.1 Barrick Gold Safety and Health Policy and Commitments

Barrick, parent company of HMC, maintains a Safety and Health Policy (S&HP) which describes the commitments for the protection of project personnel and the general public at the HMC Grants site (Barrick 2012a). Barrick maintains a Safety and Health Management System (S&HMS; Barrick 2012b) that applies to all of its operations. The S&HP and S&HMS are the basis for compliance with the Occupational Safety & Health Administration (OSHA) CFR Title 29, Parts 1904, 1910 and 1926, and NRC 10 CFR Parts 19 and 20, as well as HMC's S&HMS commitments and requirements.

11.1.1 Barrick Safety and Health Policy

We Believe

- Nothing is more important to Barrick than the safety, health, and well-being of our workers and their families.
- All injuries and occupational illnesses are preventable, and there is no job worth doing in an unsafe way. None!
- We are a team treating everyone with respect, building trust, and listening to understand safety and health issues while supporting each other to work in a safe and healthy manner and in compliance with all applicable rules and regulations.
- We are courageous safety leaders who act with a sense of urgency to eliminate or effectively control safety and health hazards.

We Promise

- To continuously identify and implement safe and healthy ways to do the job.
- To maintain a high degree of emergency preparedness.
- To keep safety and health as a value that drives overall performance.
- To hold each other accountable for superior safety and health practices and to provide the leadership and resources needed to achieve our vision.
- To encourage each other to be champions of safety and health both on and off the job.

The elements of the S&HMS consist of the following:

- Leadership and Personal Commitment

- Training and Competence
- Risk Management
- Operational Controls and Procedures
- Health and Wellness
- Contractor Controls
- Incident Investigation
- Emergency Preparedness
- Performance Measurement and Assessment

HMC's Grants site SOPs include health procedures that ensure work tasks are carried out safely (HMC 2010). These SOPs address physical safety and industrial hygiene procedures as well as radiation safety and health procedures (the latter are discussed below).

11.2 Radiation Safety and Health Program during Decommissioning

The objectives of a radiation safety program for workers is to establish appropriate health and safety measures to control and monitor the impacts of ionizing radiation on workers and to demonstrate compliance with the NRC regulations in 10 CFR Parts 19 and 20.

Currently, the licensed radioactive materials at the site are primarily contained within the existing tailings cells, which minimally have a clean interim cover, burial pits, or are within or under existing evaporation ponds. Consequently, the potential for worker exposure to ionizing radiation is minimal. Amendment No. 21 of SUA-1471 reduced the required occupational monitoring programs to be consistent with the reduced potential for worker exposure (NRC 1995). Currently, most of the existing worker monitoring and scanning is triggered by requirements contained in RWPs used to control exposures in non-routine activities which have the potential for bringing workers in direct contact with the licensed radioactive materials.

The potential for exposure to radioactive material during decommissioning activities will increase because radioactive material will be exposed during excavation and placement into the disposal cells. The following sections present the current major occupational monitoring conducted at the Homestake Grants Reclamation Project and the additional monitoring needed once decommissioning commences. These procedures are included in HMC's SOPs for environmental monitoring and health

procedures, which are outlined in **Table 11.2-1**. These procedures are reviewed annually by the HMC PM, who also serves as the site RSO.

Existing SOPs specific to demolition activities will be reviewed following completion of the contractor selection process. This will allow HMC site management time to develop more specific and effective SOPs because pertinent information will be available including knowledge of the type of specific equipment that will be used, number of contractor and subcontractor employees, revised demolition schedule, and anticipated health and safety considerations. The SOPs will address the tasks required to perform a specific activity plus any radiation protection and/or contamination control practices that should be followed while carrying out the task. SOPS will be developed in accordance with License Condition No. 23.

An RWP will be developed and implemented as per License Condition No. 24 in the event that an SOP is not developed. As per License Condition No. 24, a RWP will contain, at a minimum, the following:

- The scope of work to be performed
- Any precautions necessary to reduce exposure to uranium and its daughters
- The supplemental radiological monitoring and sampling necessary prior to, during, and following completion of the work.

RWPs will be issued for short-term or non-routine projects and/or specific scopes of work that have a radiological hazard element and are not captured by other radiological authorizations (e.g., SOPs). The RWPs may supplement or be independent of other authorizations and are valid only for the duration and scope of the project.

11.2.1 Radiation Safety and Controls for Monitoring Workers

11.2.1.1 Workplace Air Sampling Program

The existing workplace monitoring program for long-lived radionuclides consists of personnel lapel sampling with low-volume pumps. The location and frequency of this monitoring is driven by requirements contained in RWPs. No routine monitoring is currently conducted.

Occupational monitoring for radon-222 currently consists of track-etch detectors in the RO building. The detectors are exchanged quarterly.

Prior to decommissioning, a workplace monitoring program consistent with Regulatory Guide 8.25 Air Sampling in the Workplace (NRC 1992a) will be developed and implemented for long-lived radionuclides and radon-222.

11.2.1.2 Respiratory Protection Program

Currently, the Homestake Grants Reclamation Project does not have a respiratory protection program in place nor do existing site activities warrant one due to the low potential for inhalation of licensed radionuclides.

While airborne emission from decommissioning activities for uranium recovery facilities have been shown to be effectively controlled using engineering controls such as dust suppression, there is an increased potential for higher airborne radionuclide concentrations which may require respiratory protection for some tasks. Prior to decommissioning, a respiratory protection program consistent with Regulatory Guide 8.15 Acceptable Programs for Respiratory Protection (NRC 1999) and in compliance 10 CFR 20 Subpart H (NRC 2010) will be developed and implemented if needed.

11.2.1.3 Internal Exposure Determination

Currently, internal exposure to workers has been shown to be less than 10 percent of the applicable Annual Limit on Intake (ALI). No minors are allowed to perform work with licensed material and there have been no declared pregnancies. Collectively, these conditions are below the 10 CFR 20.1502 (b) threshold requiring individual monitoring of internal occupational dose. Baseline, exit, and semi-annual urine bioassay samples are collected from all HMC employees. Baseline and exit urine bioassay samples are collected from contractors working on short-term projects as required by an RWP. All bioassay samples are analyzed for natural uranium concentrations at an offsite laboratory. Typically, bioassay results are all below the laboratory's lower limit of detection (LLD) of 5 µg/L.

Inhalation of airborne radionuclides is the most important pathway for internal exposure during decommissioning activities. As discussed above, the potential for increased concentrations of airborne radionuclides is higher for decommissioning activities when compared to current site activities and conditions. Prior to decommissioning, procedures will be developed consistent with methods described in Regulatory Guide 8.34 Monitoring Criteria and Methods to Calculate Occupational Radiation Doses (NRC 1992b) to calculate internal doses. If air monitoring results collected during decommissioning activities indicate that intakes greater than 0.1 ALI are likely, internal doses will be evaluated.

The existing bioassay program is appropriate for decommissioning activities.

11.2.1.4 External Exposure Determination

Currently, all workers at the HMC Grants Reclamation Project site are issued personal dosimeters to monitor external radiation doses from site activities. External doses are evaluated every year and have been below 10 percent of applicable limits; therefore, the dose recording requirements in 10 CFR 20, Subpart L do not apply.

The current practice of issuing personal dosimeters to all workers at the site is appropriate for decommissioning activities as well. External dose reporting requirements may change as discussed below.

11.2.1.5 Summation of Internal and External Exposure

As briefly discussed in previous sections, currently, the external and internal exposure at the site are below 10 percent of applicable limits; thus, the requirements to sum internal and external exposure and report doses on appropriate forms are not applicable.

Prior to decommissioning, dose determination and reporting procedures will be developed consistent with methods described in Regulatory Guide 8.34 Monitoring Criteria and Methods to Calculate Occupational Radiation Doses (NRC 1992b) to calculate internal and external doses. If monitoring results collected during decommissioning activities indicate that doses are higher than 10 percent of applicable limits, internal and external doses will be evaluated using the procedure, including summation of the internal and external component, and reported in compliance with 10 CFR 20, Subpart L.

11.2.1.6 Contamination Control Program

The existing contamination control program is predominantly composed of administrative controls such as site rules and best practices regarding use of radioactive material. Spot check alpha surveys of workers and equipment required by RWPs are being conducted as needed. The requirement for routine contamination surveys was eliminated with License Amendment No. 21. Recently, alpha surveys of clean areas, such as lunchrooms and desks, have been implemented annually for ALARA purposes but are not required in the license or site procedures. Additionally, leak testing of check sources has been implemented as an ALARA action.

Decommissioning activities will expose radioactive materials and increase the potential for contamination of personnel and equipment. Prior to decommissioning, a contamination control program will be developed and implemented consistent with recommendations and methods contained in Regulatory Guide 8.30 Health Physics Surveys in Uranium Recovery Facilities (NRC 2002a). Equipment release surveys will be conducted as required in License Condition 14 of SUA 1471, Amendment 41 (NRC 2008).

11.2.2 Instrumentation Program

The Homestake Grants Reclamation Project currently has an instrumentation program that complies with 10 CFR 20.1501 (b) and (c). Decommissioning may increase the number of instruments needed to support site activities, but the type of instruments used should be similar to what the site currently has in its inventory. No changes to the existing instrumentation program requirements are needed to support future decommissioning activities.

11.2.3 Health Physics Audits, Inspections, and Recordkeeping

The existing radiation protection program and procedures specify the requirements for health physics audits, inspections, and recordkeeping requirements for the site. These procedures comply with conditions of SUA-1471 (NRC 2006), Amendment 41 and are appropriate to support site decommissioning activities. No changes to the existing program are needed.

11.3 References

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12. Environmental Monitoring and Control Program

12.1 Environmental ALARA Evaluation

HMC currently employs a health physicist and engineering contractor to conduct annual ALARA audits for the HMC Grants Reclamation Project site. The audits are conducted in accordance with NRC Regulatory Guide 8.31. Included in these audits is an evaluation of the effectiveness of the data generated from the site's environmental monitoring program in evaluating radiation doses to members of the public and trends in important environmental media. The annual ALARA audit conducted and reported to the NRC at the time of preparation of this document occurred on December 4 and 5, 2012 (ERG 2012). The environmental monitoring program was found to be adequate to evaluate public dose and trends. Radiation doses to members of the public continue to be below regulatory limits and are at ALARA levels. The audit did not result in any suggestions for improving the radiation protection program.

An ALARA audit in 2012 reported that HMC had satisfactorily responded to these two recommendations.

12.2 Environmental Monitoring

HMC operates an environmental monitoring program for the Grants mill site, with data being reported to the NRC and NMED semi-annually. This monitoring assesses the impact of operations on the nearby residents and environment. Monitoring locations were established on the perimeter of the milling operations and an additional location which was considered representative of background. A semi-annual report is submitted to the NRC Regional Office and NMED within 60 days after January 1 and July 1 for each year of operation pursuant to 10 CFR Part 40.65. The monitoring data and the report format have been selected by HMC representatives to satisfy the requirements of 10 CFR Part 40.65.

HMC's monitoring and surveillance program for radioactive effluent releases have been designed to ensure project compliance with 10 CFR Part 40 and Part 20 (NRC Standards for Protection Against Radiation) and closely approximates programs as described in NRC Regulatory Guide 4.1.4 (Radioactive Effluent and Environmental Monitoring at Uranium Mills). Some monitoring activities differ from those presented in Regulatory Guide 4.14 as required by Homestake's Radioactive Material License (SUA-1471) and the fact that the site is not operational and is in the final reclamation and decommissioning stage. Risk of exposure to employees and the public has been significantly minimized by the completion of decommissioning of the mill process area,

interim stabilization of the LTP and STP, and soil cleanup of windblown contamination in areas within and immediately outside of the license boundary.

12.2.1 Baseline Information

Baseline information is required in order to estimate the concentrations of site-related constituents in environmental media or direct gamma exposure rates should the facility have never existed. For new facilities, all or most of the information is obtained prior to construction. For the older HMC mill site, there is no evidence that pre-operational data were collected because such data collection was not required. Therefore, baseline data from sampling locations that are considered unaffected by operations have been used and approved by the NRC.

12.2.2 Ra-226 in Soils

The current NRC-approved background concentration of radium-226 in surface soils for the Grants site is 5.5 pCi/g. This value was based on samples taken in 1980, 1987, and 1988 reported to the NRC on August 16, 1988 (Kennedy 1988). This correspondence successfully defended the use of a radium-226 background concentration in the range of 5.5 to 6.5 pCi/g. SUA-1471 License Condition 37.J reconfirms the use of 5.5 pCi/g as a radium-226 background soil concentration for completing the off-pile soil cleanup associated with the groundwater restoration facilities and reclamation of the STP.

The above-referenced Kennedy letter correctly describes the alluvium near the HMC site as primarily sands with lenses of clay (Kennedy 1988). An example is cited where radium-226, presumably mobilized via water transport over the millennia, had adsorbed onto a clay lens producing very high radium-226 background concentrations. While most of the verification sample results from the cleanup of the windblown areas were significantly below 5.5 pCi/g, the method for cleanup was to remove all surface soils down to a depth where the gross gamma emissions indicated near background levels. Therefore, clay lenses with high natural background radium-226 concentrations, along with other gamma-ray-emitting contaminated material, would have been removed prior to sampling. These data therefore could not be used as an argument to supporting a change in the natural background radium-226 concentrations.

12.2.3 Airborne Particulate, Radon, and Direct Gamma Background Monitoring Stations

The ambient air radiological monitoring program is summarized in **Tables 12.2-1** and **12.2-2**. The monitoring program for occupational exposures is discussed in **Section 11.2**.

There are nine air monitoring stations on the site, as shown on **Figure 12.2-1**. HMC-1 through HMC-6 have been operational since the beginning of mill operations and are equipped with high-volume particulate air samplers, radon track-etch detectors, and optically stimulated luminescent dosimeters (OSLs). HMC-7 has only radon track-etch detectors, while HMC-16 has radon track-etch and OSL dosimeters. HMC-1A was added in the first quarter of 2010 and is located to monitor airborne particulate, radon, and direct radiation in the vicinity of the newly constructed evaporation pond (EP-3).

The wind rose for the site is presented in **Section 3.5.8** and is based on data from the meteorological station located approximately 1,000 ft south of EP-2. The wind rose indicates that the high-speed winds generally come from the southwest. Therefore, the location of the westernmost air monitoring station HMC-6 is a satisfactory background location for airborne particulate.

HMC-16 is the NRC-approved background monitoring station for radon and direct gamma dose rate, whereas HMC-6 serves as the location for monitoring background concentrations for air particulates.

12.2.3.1 Radioactive Air Particulate Monitoring and Resulting Dose at the Nearest Resident Locations

HMC continuously samples total suspended particulate at seven locations around the Grants mill site (**Figure 12.2-1; Table 12.2-1**). Sampling locations identified as HMC-1, HMC-1A, HMC-2, and HMC-3 are areas at the property boundary expected to have the highest predictable concentrations of airborne radioactive particulate. The predominant wind direction is from the southwest; accordingly HMC-1, HMC-2, and HMC-3 are generally located downwind from HMC's reclamation activities. HMC-1A is a more recent high-volume sampling station located to the northeast of EP-3 (**Figure 12.2-1**). This sampler was added in the first quarter of 2010. It is located downwind of the pond based on a prevailing wind direction from the southwest. The location identified as HMC-6 represents background conditions, and is located due west of the LTP at the westernmost side of the property boundary. Locations HMC-4 and HMC-5 are proximal to the nearest residences. HMC-7 is a blank Whatman filter that is analyzed as a lab and filter manufacturer quality check sample.

HMC uses Sierra Instruments Model #305-200 High-Volume Air Samplers (or equivalent) to continuously sample the ambient air at the locations shown on **Figure 12.2-1**. The samples are collected on 8-inch by 10-inch Whatman glass fiber filters (or equivalent), which are changed weekly or more frequently as required by dust loading. Energy Laboratories, Inc. analyzes the collected samples quarterly for natural uranium, radium-226, thorium-230, and vanadium.

Continuous high-volume air samplers exist at the air monitoring stations with the radiological results reported in the Semi-Annual Monitoring Reports submitted to the NRC. Data from earlier years can be obtained from the Semi-Annual Monitoring Reports, with more recent reports available on NRC ADAMS. The air filters are composited quarterly and analyzed for uranium-238, thorium-230, radium-226, and vanadium. The quarterly data for the high-volume air samples for the years 2009 through 2012 are summarized in **Table 12.2-3**. The concentrations of all radionuclides at HMC-1 through HMC-5 are near background levels (HMC-6).

The net committed effective dose equivalent (CEDE) from inhalation of particulate is calculated for the four principal long-lived radionuclides (uranium-238, uranium-234, thorium-230, and radium-226) using the quarterly monitoring data given in the Semi-Annual Environmental Monitoring Reports. The annual effective dose equivalent is calculated for HMC-4, HMC-5, and HMC-6 and is reported each year as Attachment 4 to the second half Semi-Annual Environmental Monitoring Report. The monitoring stations HMC-4 and HMC-5 are considered Nearest Resident locations and the points of compliance for public dose limits. These stations are located on the southwestern perimeter of the site near existing residences. The use of these data to predict the dose to the nearest resident is conservative in that the exposure at the residences should be lower than that at the site perimeter. The dose at HMC-4 and HMC-5 locations from site emissions is estimated by subtracting the dose from background concentrations measured at HMC-6 using methods described in Attachment 4. Concentrations at or below the detection limits are considered equal to the detection limits for these calculations. The results for the years 2009 through 2012 are given in **Table 12.2-4**. As expected, the effective dose equivalent at all stations is near that at the background station because there is little exposed contaminated material at the site. Doses for earlier years are documented in the second half Semi-Annual Environmental Monitoring Reports as mentioned above.

12.2.3.2 Ambient Radon Concentrations at the Nearest and Background Monitoring Locations

The outdoor radon levels in the Grants Uranium Belt are known to be high and variable, depending on the location relative to mine vents, surface ore deposits, and

topographical features. The natural background radon concentrations, arising from the calm winds during the evenings and at times from temperature inversions, generally follow the drainage path of the air. The HMC site is situated in the lowest point of the drainage path for radon generated over a very large area to the north, northwest, and Lobo Canyon to the east. Therefore, the natural background levels at the site are expected to be very high and variable over short periods of time due to being in this drainage path.

Track-etch radon detectors are placed at the monitoring stations to assess the impact from onsite releases of radon. Single detectors are deployed at a height of approximately 1 meter. Radon gas concentrations are monitored continuously at the nine locations identified in **Table 12.2-1** and **12.2-2,** and on **Figure 12.2-1**. The NRC-approved background station for radon gas is HMC-16, located northwest of the site. Landauer Corporation Track-Etch passive radon monitors (PRMs), or the equivalent, are used to continuously monitor radon gas at each sampling location. The detectors are changed out semi-annually and processed by the vendor.

Beginning with sampling in 2010, HMC personnel are retrieving exposed detectors quarterly rather than semi-annually as was done previously, and returning them to the vendor for analysis. The technique by which the PRM detectors measure radon gas concentrations consists of exposing an alpha-particle sensitive plastic detector, which is mounted in a filtered container, to ambient air. The alpha decay of radon gas contained in the ambient air causes damage tracks on the detector that can be counted after chemically etching. The radon gas concentration can subsequently be calculated by determining the number of tracks per unit area of the detector. The filter over the detector opening inhibits the entrance of any alpha-emitting dust particles.

The first quarter of 2010 results from the vendor indicated that two of the detectors could not be processed due to scratches. Because the detectors are sealed within the filter container, HMC has no control over this and can only report the results as such.

Due to HMC's concern with the reliance on a single track-etch detector at each location, three detectors were deployed at each location during the second quarter 2010. Data for all detectors for the second quarter of 2010 were reported by the vendor, and there were no apparent outliers. Arithmetic averages of the values for the three detectors are reported along with the standard error for each monitoring location in the sampling results discussed below.

Data for the period 2009 through 2012 are presented in **Table 12.2-5**. HMC-16 has been accepted as the radon background location for the site. Because the radon releases from the site would not be expected to differ significantly during this period, most of the variation from year to year results from measurement errors and possibly meteorological conditions such as precipitation levels and snow cover. Data for earlier years can be obtained from the Semi-Annual Monitoring Reports.

The CEDE at the nearest neighbor locations is calculated annually by subtracting the concentration at the background location (HMC-16) from the annual average at HMC-4 and HMC-5. A 20-percent radon progeny equilibrium is assumed at HMC-4 and HMC-5, along with an occupancy factor of 0.75. NRC uses continuous exposure to 0.1 pCi/1 radon-222 in full equilibrium with the daughter products as being equivalent to a CEDE of 50 mrem/y (10 CFR Part 20, Appendix B). With 20 percent equilibrium, the CEDE conversion factor would be 100 mrem/pCi/L. The annual results are presented in Attachment 4 to the second half Semi-Annual Environmental Monitoring Reports filed with the NRC. The results for the last 4 years are presented in **Table 12.2-6**.

12.2.3.3 Direct Gamma Dose Rate at the Nearest Neighbor Monitoring Locations

Up until 2003, gamma exposure rates at the mill site were continuously monitored through the use of thermo luminescent dosimeters (TLDs) at each of the seven locations identified in **Table 12.2-2** and on **Figure 12.2-1**. Starting in 2004, HMC replaced the TLDs with OSL dosimeter badges. The OSL provides a level of flexibility and accuracy unmatched by the TLDs and film dosimeter technology.

Since 2004, gamma exposure rates at the mill site are continuously monitoring through the use of the OSL dosimeter badges placed at each of the seven locations identified in **Table 12.2-2** and on **Figure 12.2-1**. HMC-16 is considered the background location for direct radiation. Each OSL badge consists of an aluminum oxide detector with a plastic holder. The plastic provides adequate protection from weather for these badges to be used outdoors. The OSLs are exchanged semi-annually and analyzed by an approved independent laboratory. The levels of direct environmental radiation are recorded for each of the seven locations.

The net annual gamma-ray exposure rate is calculated for the nearest neighbor locations (HMC-4 and HMC-5) and reported in Attachment 4 of the Semi-Annual Environmental Monitoring Reports for the last half of each year. The net values for HMC-1 through HMC-5 for years 2009 through 2012 are presented in **Table 12.2-7,** multiplied by a 75 percent occupancy factor.

Lower Limit of Detection

Homestake representatives have calculated the LLD for each measurement system, where applicable, to more accurately evaluate concentrations of radioactive material measured in the environment surrounding the mill site. The LLD is defined in Appendix B of NRC Regulatory Guide 8.30 as the smallest concentration of radioactive material that has a 95 percent probability of being detected. Radioactive material is "detected" if the value measured on an instrument is high enough to conclude that activity above the system background is probably present. Because the LLD is a function of sample volume, counting efficiency, radiochemical yield, and other parameters, it varies for different sampling and analyses procedures.

For the individual measurement system for which HMC calculates LLDs, the following formula is employed:

$$LLD = \frac{3+4.66\ S_b}{3.7\ E\ 4\ Ev\ Y \exp(-\lambda t)}$$

Where:

LLD	is the lower limit of detection (microCuries per milliliters)
S_b	is the standard deviation of the instrument background counting rate (counts per second)
3.7 E 4	is the number of disintegrations per second per microCurie
E	is the counting efficiency (counts per disintegration)
v	is the sample volume (milliliters)
Y	is the fractional radiochemical yield (when applicable)
λ	is the radioactive decay constant for the particular radionuclide
t	is the elapsed time between sample collection and counting

The value of S_b used in the calculation of the LLD for a particular measurement system will be based on the actual observed variance of the instrument background counting rate. The laboratory has been instructed to report the LLD for each measurement considering all of the parameters associated with the measurement system and the sample size.

The vendor laboratory that performs the analyses herein has documented that the LLD for air and water samples will meet or exceed the requirements established in NRC Regulatory Guide 4.14. This assumes a minimum water sample size of 1 liter and an

air sample volume of 2 E09 ml. Landauer, Inc. (vendor laboratory) reports the LLD for radon-222. The LLD for the constituents are:

Radium-226, Th-230 in air	1 E-16 µCi/ml
Radon-222 in air	30 Ci(d/L)
Natural uranium in air	1 E-16 µCi/ml
U-rad in water	2 E-10 µCi/ml
Radium-226, thorium-230 in water	2 E-10 µCi/m

Uranium is analyzed by inductively coupled plasma-mass spectrometry (ICP-MS) methods by the current vendor laboratory. The laboratory has analyzed a blank sample many times and uses the standard deviation of these background measurements to calculate the LLD. The LLD is specified for all analyses as long as the sample size or volume meets the minimum value.

12.2.4 Water Quality Monitoring

Table 12.2-8 (8-99, as modified by License Amendment No. 34), outlines the water quality sampling frequency and parameters monitored. In addition, the volumes of water injected and recovered as part of the groundwater cleanup program are monitored weekly and the rates documented. A performance review report is submitted by March 31 of each year according to License Condition No. 35E. The groundwater monitoring data for the Point of Compliance (POC) wells and background well P, as required to comply with 10 CFR 40.65, are included in the semi-annual environmental monitoring reports.

The groundwater monitoring data for the POC wells and background well P, as required to comply with 10 CFR 40.65, are reported for the years 2001 through 2012 in **Tables 12.2-9** through **12.2-12.** A summary of the 12-year period for these analytical results is provided in **Table 12.2-13.** The water quality of the POC wells is currently being restored, and therefore the reported levels are not representative of steady-state aquifer conditions at the present time. The concentration levels are therefore not compared to 10 CFR 20 effluent limits. The POC wells will eventually be used to demonstrate groundwater restoration, but they are currently not representative of offsite groundwater quality conditions. The ultimate goal of the groundwater restoration program is to restore the concentration of each COC to levels that meet the accepted groundwater site standards for each constituent in designated aquifers at the Grants site.

The NRC, EPA, and NMED have agreed upon the groundwater site standards for each COC for each aquifer at the site (Meyer 2010). The site standards were finalized in 2006 after back groundwater quality was evaluated, and set at either background or appropriate drinking water standards. These standards were incorporated into the NRC license through License Amendment No. 39 as groundwater protection standards (GWPSs). The site standards are summarized in **Table 12.2-14.** The Chinle Mixing Zone refers to the area adjacent to the subcrop locations where the alluvial water has had an impact on water quality. These site standards must eventually be met at POC wells D1, X, and S4 in the alluvial aquifer and at two additional proposed POC wells (CE2 and CE8) in the Upper Chinle Non-Mixing Zone. The locations of the POC wells are identified on **Figure 12.2-2**. The POC wells and site standards are discussed in more detail in HMC's Updated CAP for groundwater.

A hydraulic barrier forces the water in the aquifer near these POC wells to move in the direction of the collection wells where the water is withdrawn and treated. Consequently, water level data on these wells are also not reflective of steady-state conditions, and therefore are not reported here.

12.2.5 Radon Flux Measurements on the STP and LTP

Reclamation activities to date associated with the LTP were completed in phases. The pile was contoured in 1994, at which time an interim cover was placed on the top of the pile to control the dispersal of tailings by wind and water erosion. Radon barrier was applied to the north, west, and south side slopes, with completion of the work in 1994. Radon flux was measured on these side slopes on October 24 and 25, 1994. Radon barrier was placed on the east side slope and aprons just prior to making the radon flux measurements on July 24 and 25, 1995. An erosion protection layer was then applied to the side slopes and aprons.

An evaporation pond was constructed on the STP and an interim cover placed on the remainder of the pile. Radon flux was measured on the top of the LTP and the interim cover of the STP on August 18 and 19, 1995. The interim cover areas of the LTP and STP have been maintained to date by grading the side slopes of the STP and adding interim cover on the top of the LTP.

As part of a request for a license amendment extending the milestones in the NRC license, radon flux measurements were repeated in the areas with interim cover on October 21 and 22, 2003. The resulting license amendment required HMC to repeat these measurements annually. Annual measurements have been made since 2003,

with the results submitted to the NRC as part of the Annual Performance Review Report.

Method

The purpose of the measurements is to demonstrate compliance with National Emission Standards for Hazardous Air Pollutants (NESHAP) Subpart W: Standards for Radon Emissions from Operating Uranium Mill Tailings (40 CFR Part 61, Subpart W). Subpart W limits the average radon flux from a mill tailings pile to 20 pCi/m^2s and indicates that an average of 100 measurements made on each distinctly different region of a pile is adequate for compliance purposes. Because the area of the STP with interim cover is small, the NRC has accepted distributing a total of 100 radon flux canisters over the interim covers of the STP and LTP. **Figure 12.2-3** shows canister placement locations on the LTP and STP.

Radon flux canisters are deployed annually by a contractor in accordance with EPA Method 115, which is included in Appendix B to part 61. The average radon flux from the LTP is calculated using the area-weighted average of the flux measured annually from the top of the LTP and the flux measured on the side slopes and aprons in 1994 and 1995. The area of the aprons and side slopes constitutes 65 percent of the total area with the top of the pile being 35 percent. The average flux for the side slopes and the aprons was 3.27 pCi/m^2. There is a thick rock erosion protection cover on the aprons and side slopes; thus, annual measurements are not practical.

The average radon flux for the STP is also calculated by taking an area-weighted average. The areas for the side slopes, southern portion of pile (top of pile), and Evaporation Pond are 137,000, 874,000, and 1,331,000 square feet, respectively. Method 115 specifies that the radon flux from water covered areas should be assumed to be zero.

Results

The average radon flux for the LTP and STP for the years 2003 through 2012 are reported in **Table 12.2-15**. Measured average flux values for the LTP slightly exceeded the 20 pCi/m^2s standard for the years 2004, 2006, 2010, and 2011. Additional interim cover was placed on the top of the pile and new measurements made at previous canister locations affected by the new cover. A new average was calculated for the LTP which brought the pile in compliance for 2004, 2010, 2011, and 2012. For the year 2006, the measurements could not be made until September. Because of inclement weather, interim cover could not be added until early 2007 where the new measurements indicated an average flux of 18.1 pCi/m^2 (Cox 2007).

In 2011, the measurements for the LTP resulted in an average flux of 20.96 pCi/m^{2}s, above the desired 20 pCi/m^{2}s goal. The interim cover was increased in areas containing three flux monitoring locations where the measurements were higher than others of similar size. Follow-up measurements at the three locations resulted in an average flux for the LTP of 18.8 pCi/m^{2}s.

2012 Radon Flux Results

Annual 2012 measurements were made on September 19 and 20, 2012. One hundred sample locations were established on the piles. At flux measurement location 21 on the LTP, the data were void due to the canister getting wet as a result of nearby construction. One duplicate field measurement was made on the STP at location 72. The two results were within 3.0 percent of each other. The distribution of canisters was allocated so that each canister represented an equal area of the total pile surface. Measurements are reported for 63 locations on the LTP and 36 locations on the STP. The average measured flux was 15.67 pCi/m2s and 4.12 pCi/m2s for the LTP and STP, respectively, which are below the desired 20 pCi/m^{2}s goal. When calculating average measured flux for analysis duplicates (same canister analyzed twice), the results were averaged.

2012 Average Pile Flux

The average measured radon flux levels for 2003 through 2012 ranged from 14.1 to 20.6 pCi/m^{2}s for the LTP and 4.12 to 12.05 pCi/m^{2}s for the STP. Eight of the ten measurements (2003 through 2012) for the LTP, and all ten of the measurements for the STP, were below the 20 pCi/m2s standard. Interim cover was added to reduce the average radon flux to less than 20 pCi/m^{2}s.

Exposure measurements at each canister location began in 2006, using a Ludlum Gamma Model 19 microR survey meter. Measurements are made with the survey meter held approximately 1 meter above the ground surface. The average and range of measured values for the LTP and STP from 2006 through 2011 are presented in **Table 12.2-15.** The measured values have been relatively consistent, with annual average values ranging from 25.1 to 29.6 i/ µR/hr.

12.3 QA/QC for Environmental Monitoring Program

QA/QC for the existing Environmental Monitoring Program includes the following:

- Procedures describing how environmental media are to be sampled and what parameters to evaluate at the analytical laboratory. Included in the procedures

are requirements for duplicate analysis where appropriate and the proper use of chain-of-custody procedures.

- HMC employs a laboratory certified by the State of New Mexico to analyze the parameters of concern.

The data resulting from the Environmental Monitoring Program and the procedures used to collect the data are audited periodically for completeness and effectiveness by the following organizations:

- Period internal audits conducted by the site's Radiation Protection Administrator or his or her designee
- Annual audits by independent third-party consultants
- Regulatory agencies including the NRC and EPA

Deficiencies found during these periodic audits are documented, and corrective action plans are developed if needed to correct the deficiencies.

HMC will review the existing QA/QC procedures for the Environmental Monitoring Program prior to implementation of such monitoring in association with final reclamation and decommissioning activities. Procedures will be updated as needed.

12.4 Effluent Control Program

This section describes effluent controls used at the HMC Grants Reclamation Project site, and as needed, actions necessary to ensure that site air and liquid effluents are within applicable regulatory limits. Because a major portion of decommissioning and reclamation has already been completed and approved by the NRC, and there are only a limited amount of structures and activities (e.g., groundwater restoration), there are only a few areas where effluent controls are needed (e.g., wash water). Effluents will be reduced by minimizing waste generation, disturbances (e.g., soils and contaminated waters), and reuse/recycling of materials when possible. The waste management program in effect at the site during decommissioning and reclamation are discussed in **Section 13**. Site activities during decommissioning and reclamation where controls are used to minimize releases of radioactive and non-radioactive material to the environment are as follows:

1. Gaseous Emissions and Airborne Particulate

a) Non-radioactive Emissions

Non-radioactive gaseous emissions will result primarily from the operation of internal combustion engines. This includes exhaust of company and contractor diesel or gasoline-fueled vehicles such as pickups, sport utility vehicles, road grader(s), dozer(s), front-end loaders, and diesel drilling rigs. In addition, other miscellaneous equipment (such as water pumps, generators, and air compressors) would be expected to generate temporary emissions. These types of diesel- or gasoline-fueled vehicles and equipment would be expected to emit small amounts of carbon monoxide, sulfur dioxide, particulates, and other types of internal combustion engine emissions. Such emissions will be reduced by regular maintenance, adherence to SOPS, and use of pollution prevention equipment associated with the vehicles and equipment. Contractors will be required to minimize emissions from their vehicles and equipment.

The majority of the airborne particulates will be dust from traffic on unpaved roads on and adjacent to the project site, and wind erosion of disturbed areas and surrounding terrain (natural erosion). Onsite dust emissions would be generated by company and contractor vehicles moving around the site and adjoining lands owned by HMC, drilling of wells, periodic truck deliveries of materials (e.g., lime, acid, and other materials to the RO building), maintenance activities, monitoring of wells, and other activities.

Construction activities associated with final reclamation of the LTP and STP, two collection ponds, three evaporation ponds, demolition of remaining structures (e.g., dirt work involving movement of contaminated pond sediments and movement of soils from borrow areas to the area being reclaimed) will result in dust emissions. In addition, any required soil cleanup (soils removal and backfilling with clean borrow material) would involve surface disturbance activities that would create dust emissions. Contractors will be required to carry out efficient construction practices to minimize generation of particulates.

Onsite unpaved roads will be sprayed with water (as needed) using a water truck during times of active road use, such as during transport of soils for backfill and waste materials for disposal. Water sprays will also be used in borrow areas when heavy equipment is in use. Dust suppressants will be used as needed.

b) Radioactive Emissions

The primary radioactive airborne effluent of concern is radon gas. When considering the entire Grants Reclamation Project and site activities, the RO building presents a potential source of concern for radon exposure (ERG 2012). Water from the collection wells is exposed to the atmosphere in the RO building, and dissolved radon will emanate into the building atmosphere. Ventilation fans in the building are operated daily prior to shift entry to exhaust this radiation source, and an additional exhaust fan operating continuously was added to the building sump in 2003 to reduce radon concentrations further. Two track-etch detectors were placed in the work areas and read monthly during 2003, where monthly averages ranged from 4.5 to 14.5 pCi/L. This was a significant decrease from the levels measured in 2001 and 2002 prior to full installation of the existing building exhaust system. Detectors are changed out quarterly at this time. The readings for the first three quarters of 2012 were 8.0 and 7.7 pCi/l for the first quarter, 4.9 and 4.8 pCi/l for the second quarter, and 5.0 and 5.1 pCi/l for the third quarter. These concentrations are generally below the 2003 values and significantly lower than that measured during the first half of 2002 (21 pCi/L) and the year 2001 (47 pCi/L). This reduction in concentration is likely due to the aforementioned increased ventilation in the RO building.

HMC records the occupancy time during which employees are in the RO building. Working Level (WL) measurements from prior years showed very low radon daughter concentrations compared to the radon concentrations. In addition, occupancy times for workers are normally a few hours per week. Thus radiation exposures under these occupancy periods are very low.

A track-etch detector was placed in the office of the Main Office/Warehouse building during the second and third quarters of 2012 in the area proximal to the desks of the two non-radiation workers (ERG 2012). The results were 1.5 and 1.4 pCi/L. These concentrations are also representative of what one would expect of the entire office area because the doors are kept open between the areas. The detectors were deployed primarily to assure that the non-radiation workers were not receiving a radiation exposure above normal background levels. The detectors will be deployed for a full calendar year, and a decision made as to whether the monitoring will be continued. Due to the lack of a viable source, the potential for radon exposure from other structures (i.e., Warehouse

Building 1 and Warehouse Building 2 in the Administration Compound) is very limited.

HMC employee and contractor monitoring protocol and results are discussed in the annual ALARA audit reports. The annual ALARA audits are conducted as per NUREG-8.31. The most recent audit was conducted on December 4 and 5, 2012 by Environmental Restoration Group, Inc.

Potential impacts associated with radon gas on the environment and public are monitored via continuous monitoring using track-etch cups discussed in **Section 12.2.3.2**.

2. Groundwater and Wastewater Discharges

Discharge Permit DP-200 issued by the NMED regulates the injection of groundwater consisting of water extracted from the San Andres and Chinle Formations and RO-treated groundwater from the San Mateo Alluvium. The water is injected into a series of injection wells downgradient from the edge of the contaminant plume beneath HMC's facility. The permit requires specific monitoring of groundwater monitor wells and reporting to ensure compliance with the discharges.

HMC also maintains a discharge permit via NMED Discharge Permit DP-725, which regulates the discharge of wastewater to three evaporation ponds and two existing collection ponds. Water is collected from the RO WTS (blow down, brine wastewater, and miscellaneous overflow), the LTP, and sump collection system and discharged to two synthetically lined collection ponds (West and East Collection Ponds) and three synthetically lined evaporation ponds (EP-1, EP-2, and EP-3). Water from the well collection system and some water from the LTP and toe drains are pumped to the RO WTS as feed water. A major portion of the extracted water from the LTP is discharged directly to the East Collection Pond for evaporation. Blow down sludge is discharged to the West Collection Pond and then into EP-1 while brine wastewater and miscellaneous overflow from the RO WTS is discharged to the East Collection Pond. Excess water is transferred from the East Collection Pond to EP-2, EP-1, or EP-3. HMC is required to sample designated monitor wells and report findings to the NMED to ensure compliance with the discharge permit.

EP-2 and EP-3 have a double HDPE liner system that allows for routine leak detection monitoring between the primary and secondary liners. EP-1 is lined with a single Deery Oil Liner/fabric liner system. The West and East Collection Ponds also have single synthetic liners. HMC uses designated downgradient

monitor wells to detect any releases from the East Collection Pond, West Collection Pond, EP-1, and EP-2. Monitoring for EP-3 includes the leak detection monitoring between the double liners and monitoring of downgradient monitor wells. Leak detection systems between the primary and secondary liners are tied into a series of sump systems. The sumps are routinely monitored to detect any leaks.

HMC is also required to visually inspect all of the ponds and surrounding berms weekly. HMC maintains spill reporting procedures required by the discharge permit.

The HMC Grants Reclamation Project site has one sewage system that services the Main Office/Warehouse Building located in the Administration Compound. The sewage system consist of a septic tank with a drain field and receives waste from restrooms (sinks/commodes), shower facilities, the clothes washer, the sink in the eating area, and a small laboratory. The building has been historically operated as a site maintenance facility, and the potential for radiological contamination of any significance to the septic system is considered low. Additional discussions of the sewage system are provided in **Section 13.2.2**.

12.5 References

Cox, A. 2007. Letter from A. Cox, Project Manager/RSO, Homestake Mining Company of California to R.C. Linton, Senior Groundwater Hydrologist/Project Manager, Office of Federal and State Materials and Environmental Management Programs, NRC Regarding License SUA-1471 Grants Reclamation Project 2006 Tailings Piles Radon Flux Survey. ML07065005. February 23.

Duran Bokich Enterprises, LLC (DBE). 2011. Homestake Mining Company Grants Project Collection Ponds and Evaporation Pond No. 1 Liner Repair Project – Completion Report. September.

Environmental Restoration Group, Inc. (ERG). 2012. Annual ALARA Audit. Grants Operations, Homestake Mining Company. December.

Kennedy, E.E. 1988. Letter to H.J. Pettengill, Chief, Licensing Branch 2, Uranium Recovery Field Office, NRC Regarding License No. SUA-1471 Soil Background Concentrations. August 16.

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13. Waste Management Program

Waste management activities include the minimization, treatment, storage, and/or disposal of radioactive, hazardous, and non-hazardous wastes associated with decommissioning and reclamation activities at the HMC Grants Reclamation Project site. The primary goal of HMC's waste management activities is the protection of workers, the public, and the environment. The waste management program will safely control the handling, packaging, transport, and disposal of solid, liquid, and any mixed wastes generated during final reclamation and decommissioning activities. A vital aspect of protection is compliance with all applicable federal, state, and county requirements. Regulatory guidelines covering these activities are provisions of the RCRA, the State of New Mexico environmental laws and regulations, and applicable county requirements. The NMED has been delegated authority from the EPA for enforcement of the federal hazardous and non-hazardous waste requirements. The NMED has adopted most of the EPA regulations into the state Administrative Code for the SWDA and RCRA. The NRC regulates wastes containing radioactive constituents including mill tailings and other byproduct waste generated by HMC at its Grants site (see discussions in **Section 13.1**).

Waste management was an integral part of the operations of the mill site from 1958 until milling operations ceased in 1990. During operations, mill effluents and wastes were minimized to the extent reasonable achievable through the use of process and engineering controls. Post-1990 waste management activities using this approach have continued as an active component of site reclamation and decommissioning operations. This process will continue through the final decommissioning and reclamation phase at the Grants site.

Wastes generated and disposed of during decommissioning activities completed in 1995 are discussed in the Mill Completion Report submitted to the NRC in 1996 (AKG 1996).

13.1 Radioactive Waste

Radioactive material license SUA-1471 (NRC 2012) authorizes the possession of residual uranium and byproduct material in the form of uranium waste tailings and other byproduct waste generated by the licensee's past milling operations. Byproduct material, as defined in 10 CFR 40.4 means:

> "...the tailings or wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content..."

Byproduct material is not defined by the radioactive component of the wastes; rather, it is described as a tailings or wastes from a process. As such, the non-radiological and radiological components of the tailings or waste do not have to be handled differently.

License SUA-1471 also authorizes the onsite disposal of residual uranium and byproduct material provided the disposal is consistent with criteria contained in 10 CFR 40, Appendix A (NRC 1999).

Prior to termination of License SUA-1471, HMC will transfer title to byproduct material and land, including any interest therein, which is used for the disposal of byproduct material or is essential to ensure the long-term stability of such disposal site, to the DOE. The DOE will be responsible for the long-term care and maintenance of the HMC site.

Reclamation and decommissioning activities that occurred from 1993 until 1995 resulted in the handling and disposal of the majority of 11(e)(2) byproduct materials to be generated onsite. The largest volume of wastes generated onsite was associated with the cleanup of windblown tailings, resulting in large volumes of contaminated soils. The contaminated soils were disposed of in either the LTP or STP, with the majority being placed in the LTP. Because the mill tailings and majority of remaining reclaimed and demolition wastes are contained within the LTP, the LTP is the largest source of radioactive waste remaining onsite. The LTP has been re-contoured and partially reclaimed with the placement of an interim radon barrier. Additional work will not involve the handling of the buried tailings, but only the removal of injection, monitor, and test wells and placement of a final radon barrier and overlying rock cover over the interim cover. The area around EP-1 of the STP has been partially reclaimed with an interim cover, and the pond will be closed in place. Therefore, there will be minimal exposure to previously buried tailings materials in the STP.

The mill site process equipment and structures, liquids, and other solid wastes were decontaminated for safe handling and disposed onsite, as described in the October 1993 Reclamation Plan (AKG and Jenkins 1993) and the Mill Completion Report (AKG 1996).

With the exception of the LTP and STP (which will require placement of a final radon barrier and rock cover), the remaining assets consist primarily of ancillary office, maintenance shop, storage buildings, RO water treatment plant complex, two lined collection (brine) ponds, three lined evaporation ponds, piping, and miscellaneous equipment and materials. These assets will be demolished and buried onsite, as described in **Section 9**.

Discussions of the management of radioactive waste material during decommissioning activities from 1993 through 1995 are also presented in **Section 2.2.2.1**. This section (**Section 13**) discusses planned waste management activities during the remaining reclamation and decommissioning activities.

With the existing interim covers over LTP and STP, and completed decommissioning of the mill processing area, the potential for exposure to 11(e)(2) byproduct materials onsite has been greatly reduced.

13.1.1 Solid Byproduct Material

The majority of the "solid" byproduct material consists of tailings from the uranium recovery operations and is contained in either the LTP or the STP. Solid byproduct material resulting from future site remediation will include but is not limited to the following:

- Soil which exceeds the cleanup criteria in **Section 5**
- Evaporation pond residues and sediments
- Evaporation pond liners
- Contaminated building material (structural and component metal, concrete, and other materials) resulting from razing of existing Main Office/Warehouse Building, Warehouse Building 1, and Warehouse Building 2, and RO WTS
- Contaminated equipment which will not be salvaged
- Groundwater treatment infrastructure such as piping and pumps
- Investigation-derived waste such as personal protective equipment, sampling supplies, and other items.

Solid byproduct material will be sized if needed and consolidated in the WDC (EP-1 and/or EP-2) in accordance with NRC-approved plans and specifications consistent with the criteria contained in 10 CFR 40, Appendix A.

Currently, solid waste materials are generated as part of the ongoing groundwater treatment activities. These wastes are disposed of in onsite disposal pits located on the west top-side of the STP. Two types of wastes disposed of consist of the following:

- Materials that have been in contact with groundwater from HMC's system of collection wells, tailings wells, and tailings sumps including but not limited to the following materials: pipes, fittings, valves, meters, pumps, and pump parts.

- Materials that have been in contact with water in the process of being treated at either the pretreatment stage or the RO stage at HMC's RO WTS including but not limited to the following materials: cartridge filters, solid filter media, RO membranes, pipes, fittings, valves, meters, pumps, and pump parts.

Materials described above will be stored in a location designated by the Site Supervisor until they are air-dried and enough volume has accumulated to warrant disposal. At that time, a pit will be excavated adjacent to the southwest corner of EP-1 in an area designated for groundwater contaminated solid wastes. The materials will be placed in the pit and covered with 2 feet of clean soil as soon as practical. This disposal area will be included in the final reclamation plan for the STP, and will be covered with a radon barrier and overlying rock cover.

13.1.2 Liquid Byproduct Material

Liquids containing byproduct material are currently being stored in three evaporation ponds onsite. Once groundwater pumping into the evaporation ponds is complete, the water will be evaporated and the remaining solids disposed of as described in **Section 13.1.1**. A small volume of liquid waste may remain following evaporation. This material will be absorbed with solid byproduct material such as soil with radionuclide concentrations above the cleanup level and then disposed of as described in **Section 13.1.1**.

Liquids containing byproduct material may also be generated during decommissioning activities. Wastewater from equipment and vehicle decontamination is an example of a potential liquid waste stream. Wastewater from equipment and vehicle decontamination or any other liquid waste stream will be transferred to one of three existing evaporation ponds and evaporated, used as dust control during placement of solid byproduct material within the disposal cell, or absorbed with solid byproduct material such as contaminated soil and then disposed of as described in **Section 13.1.1**.

13.2 Non-Radioactive Wastes

13.2.1 Hazardous Wastes

All hazardous wastes generated at the HMC mill site during operations and reclamation and decommissioning activities from 1958 to present were disposed of either onsite in acceptable and approved facilities or offsite at permitted commercial facilities approved by the NRC and EPA. All hazardous wastes transported offsite were stored, packaged, and manifested in compliance with applicable and federal regulations.

Activities included:

- Contracting for all offsite hazardous waste disposal
- Removal and disposal of PCB capacitors, transformers, and fluids
- Disposal of RCRA regulated chemicals
- Disposal of used oils and greases
- Storage and disposal of mercury
- Removal and disposal of asbestos

Used oil, which is not considered a hazardous waste when recycled or mixed with other materials, was shipped by approved transporters to approved oil-recycling facilities (i.e. Safety Kleen Corporation and Mesa Oil Inc. of Albuquerque, New Mexico). HMC continues to dispose of used oil in this manner.

The HMC Grants Reclamation Project site is currently registered with the NMED, Identification Number NMD007860935 as a Conditionally Exempt Small Quantity Generator (CESQG).).) CESQGs generate 220 lbs (100 kilograms [kgs]) or less per month of hazardous waste, or 2.2 lbs (1 kg) or less of acutely hazardous waste. CESQGs may not accumulate more than 2,200 lbs (1,000 kgs) of hazardous waste at any one time. HMC generates less than 220 pounds of hazardous waste and less than 2.2 lbs of acute hazardous waste per month of acutely hazardous waste, and less than 220 lbs per month of acute spill residue or soil. In addition, the site does not accumulate, at any time, more than 2,200 lbs of RCRA hazardous waste. In the event HMC becomes aware during decommissioning that the site will generate quantities of hazardous waste greater than allowed for a CESQG, HMC will submit the proper notification and forms to the NMED for a change in generator status. It is anticipated that some asbestos materials (e.g., ceiling tiles and floor tiles) may be present in the office building. Prior to demolition of this building, applicable building materials will be

sampled and tested for asbestos. Any asbestos material will be transported to an offsite permitted and approved disposal site.

The majority of hazardous waste generated and disposed of occurred during post-1993 site reclamation and decommissioning activities when the mill site was being demolished. All hazardous wastes shipped offsite to an approved disposal site were handled under the regulatory approved manifest system. Copies of manifests/associated communications and disposal certificates are maintained onsite.

In 1995 and 1996, as part of the program to dispose of used solvents, used solvents were sampled and analyzed for total uranium and total radium. All sampling results were below levels of 10 CFR Part 20, Appendix B, Table 3 (sewer disposal; HMC 1996). Solvents were released to owners of the solvents.

The HMC Grants Reclamation site maintains a number of chemicals onsite that may need to be disposed of as hazardous waste prior to completion of final reclamation and decommissioning tasks. In May 2006, a private environmental and engineering company conducted a site inventory of onsite chemicals in order to assure that Material Safety Data Sheets were up-to-date (Kleinfelder 2006). This list also serves as an inventory of chemicals that may eventually become a hazardous waste if disposal is required. There were more than 200 chemicals identified onsite, with the name of the chemical, quantity, and storage location identified. Once these chemicals/containers are empty, expired, or no longer in use by the facility, they will be disposed of as hazardous waste if determined to meet the criteria of a hazardous waste. Any unused chemicals (not considered a waste) will be returned to the originator or manufacturer if feasible. This is expected to occur near the completion of groundwater restoration and final decommissioning tasks. Any additional chemicals brought onsite for use following the 2006 inventory will be subject to the same management and disposal protocols as noted above.

Hazardous wastes generated will be clearly labeled and stored in sealed containers above ground in accordance with requirements of the NMED. Such wastes may be temporarily stored onsite (< 90 days) subject to RCRA requirements prior to transport for offsite disposal. Such hazardous wastes will be collected by an approved commercial hazardous waste transporter and transported to an approved commercial hazardous waste disposal facility.

13.2.2 Petroleum Waste

Used oil and wastes consist primarily of:

- Used oil (typically includes gasoline and diesel engine crankcase oils piston-engine oils for trucks and heavy equipment, used brake fluid, used power steering fluid, transmission fluid, bearing oil, gear oil, and grease), used industrial hydraulic fluid, used compressor oils, and used electrical insulation oil (non-PCBs). Used oils cannot contain chlorinated or halogenated solvents or gasoline.
- Solvent waste (including thinners, cleaners, degreasers, fuel additives, adhesive removers, and other chemicals).
- Used antifreeze/water mixtures, which are a non-RCRA hazardous waste, unless testing indicates that a mixture is hazardous due to a specific RCRA listed characteristic.

Used and waste oil items are recycled through the use of permitting transporters and recycling facilities. Any used oil items not recycled will be disposed of as hazardous waste, using properly permitted and approved transports and disposal facilities. Wastes such as antifreeze/water mixtures and other oils/water mixtures are assumed to be hazardous and are transported and disposed of in the same manner. Used oil filters are drained of oil and disposed of as non-hazardous wastes. Used solvents and petroleum-based paints are disposed of as a hazardous wastes. Paint cans that once contained latex and non-latex paints must meet the definition of empty before they can be placed in the domestic trash.

13.2.3 Solid Non-hazardous Wastes

During final reclamation and decommissioning activities, non-hazardous wastes (e.g., paper, rags, wood products, plastic materials, office wastes, steel, food wastes, sewage sludge, and other non-hazardous wastes) will be generated. With the exception of sewage sludge, these types of wastes will be collected and temporarily stored onsite in commercial waste containers and periodically removed for disposal at a state-approved local landfill. Sewage sludge is periodically collected by an approved septic cleaning company and disposed at a municipal sewage facility approved to receive such wastes. Demolition debris and other items determined to not be contaminated with radiological material may be disposed of or reused offsite, subject to survey documentation and NRC approval.

Domestic Sewage

Domestic sewage generated at the office/maintenance shop building is disposed of in a conventional septic/leach field system. Third-party portable chemical toilets are periodically used at various locations on the site, especially where contractors are working in the field. During final reclamation and decommissioning activities, domestic sewage will continue to be handled in the same manner. Additional discussions of the sewage system are provided in **Section 12.4**.

Once decommissioning is completed, the liquids and solids will be removed from the septic tank(s), the bottom of the tank will be broken out so that liquids cannot be retained, and the tank will then be filled with rubble and/or soil. The piping feeding the leach field will be removed or plugged to prevent liquids from entering the well field.

Demolition Debris

The handling and disposal of demolition waste during decommissioning activities from 1993 through 1995 are discussed in **Section 2.2.2.1** (Mill Reclamation and Decommissioning Activities) and the Mill Completion Report (AKG 1996).

The remaining structures onsite will be demolished in a fashion similar to that described in **Section 2.2.2.1** and the Mill Completion Report (AKG 1996). The planned demolition activities for the remaining structures are discussed in **Section 9**.

13.3 Estimated Quantities of Demolition and Reclamation Wastes

Estimated quantities of demolition and reclamation wastes are presented in **Table 9.1-1**. The majority of the total estimated waste volumes that will be generated and managed are associated with the reclamation and demolition of the three evaporation ponds and two collection ponds.

13.4 References

AK Geoconsult, Inc. (AKG). 1996. Completion Report Mill, Decommissioning, Homestake Mining Company, Grants Uranium Mill. February 29.

AK Geoconsult, Inc. and Jenkins Environmental, Inc. (AKG and Jenkins). 1993. Homestake Reclamation Plan Revision 10/93, Volume I. October.

Homestake Mining Company (HMC). 1996. Interoffice Communication for Adrian and Joe to Roy Cellan and Mike Regarding Release of used Solvent. November 21, 1996.

Kleinfelder, Inc. 2006. Letter from Jennifer Meyer, Regional Environmental Manager, Kleinfelder, Inc. to Dan Kump, Homestake Mining Operation, Grants, New Mexico Regarding Chemical Inventory and MSDS Update for Homestake Mining Operation. June 5.

U.S. Nuclear Regulatory Commission (NRC). 1999. 10 CFR 40, Appendix A. "Criteria Relating to the Operation of Uranium Mills and the Disposition of Tailings or Wastes Produced by the Extraction or Concentration of Source Material From Ores Processed Primarily for Their Source Material Content." *Code of Federal Regulations*: Office of Federal Register National Archives and Records Administration. Washington, D.C. 1 January, 1999.

NRC. 2012. License Amendment No. 45 to Radioactive Materials License SUA-1471, September 27. U.S. Nuclear Regulatory Commission, Washington D.C.

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14. Construction Quality Assurance and Quality Control Program

14.1 Quality Assurance and Quality Control

Conditions C 37 C and D of License SUA-1471 require HMC to have a construction QA/QC program as follows:

- Submittal of a construction control program for NRC review and approval prior to placing any portion of the radon barrier that will ensure compliance with the specification which limits the activity of the radon barrier material to 5 pCi/g above background.
- The construction QA/QC program shall be as defined in the Staff Technical Position on Testing and Inspection (NRC 1989). The acceptable correlation between ASTM D-2922 and ASTM D-1556 shall be defined in the licensee's April 30, 1992 submittal.

14.1.1 Construction Quality Assurance Plan

HMC continues to carry out applicable site activities using the approved QA/QC procedures. Because the majority of the Phase 1 reclamation work has been completed, the need and use for these procedures have been minimal. Once groundwater restoration has been completed to the satisfaction of the NRC, and final decommissioning and reclamation activities are ready to proceed, these procedures will be updated to be consistent with planned activities. HMC will prepare a Construction Quality Assurance (CQA) Plan that will consist of CQA procedures for: demolition of support structures (e.g., buildings); closure of LTP, STP, RO Facilities, collection ponds, and evaporation ponds; and dismantling of remaining groundwater restoration support facilities (e.g., piping, and injection, collection and monitor wells) and earthwork (e.g., soil cleanup, backfill, site grading and drainage, and other features). This program will help to ensure adherence to proper materials/equipment, construction techniques and procedures and designs are adhered to by the contractor. This program will help to identify any problems that may occur during construction. Demolition and closure activities shall be conducted in accordance with current industry practices and applicable regulatory (e.g., NRC and OSHA) safety requirements. Implementation of the CQA procedures will be as per the CQA Plan.

HMC's CQA Plan will address quality assurance, but not quality control (QC). QC is conducted by the contractor. The intent of the CQA is to provide verification and testing in order to demonstrate that the contractor has met its obligations in the work carried out according to the design, specifications, current industry practices,

contractual agreements, and regulatory requirements. The QC function involves the actions carried out by the contractor in order to ensure that materials and quality of work meet the requirements of the drawings and specifications. The contractor will be required to obtain approval of a QC program prior to implementation of any work onsite.

The HMC PM is responsible for the overall quality of reclamation work at the Grants Reclamation Project by ensuring that required requirements and processes are in place. All construction activities will be performed primarily by contractors working under the direction of HMC. To ascertain and document that all decommissioning and reclamation tasks are in accordance with construction specifications, HMC employs the services of an Engineer of Record.

The Engineer of Record is responsible for review and updates to Technical Specifications in order to incorporate the most recent information and site conditions and confirm that construction was performed in compliance with the applicable drawings and specifications. The Engineering of Record and PM are responsible for the resolution of all quality assurance issues. The Engineer of Record will be a third-party licensed PE with experience in the decommissioning and reclamation activities that will occur at the site.

The Engineer of Record will assist the HMC PM and staff with the development of the CQA Plan. This plan will consist of the following:

- Purpose and Scope of the Plan
- QA Organization and Responsibilities, Management Procedures, Lines of Communication
- Schedule with a summary of planned construction activities, sequence, interrelationships, durations, and terminations
- Written procedures for the maintenance and storage of the CQA program records, including, but not limited to, plans and Technical Specifications; as-built drawings; field sampling and laboratory tests performed by HMC or the contractor; work completion; variances from the specification (e.g., Change Orders); photographic and video tape records of the work; and chronological record notifications to the contractor of variances of specifications, unacceptable work performance, and stop-work orders
- Quality Control Testing (QCT) that includes type of testing, frequency, and who will perform the tests to ensure that equipment used to support decommissioning activities is properly controlled, calibrated, and maintained

- Corrective action procedures that will allow for prompt identification and correction of activities adversely affecting quality of the work
- Audits and inspections performed as part of the CQA program in order to verify compliance with and effectiveness of the CQA program

14.2 Quality Control

During Phase 1 of the decommissioning and reclamation activities, a specification for QCT and inspection services was used for reclamation of earthwork and rock quarry at the Grants site (HMC 1994b). HMC entered into a contractual agreement with a Quality Control Testing Services (QCTS) contractor (Knight Piesold and Company) to ascertain and document that all earthwork and quarried rock was in accordance with construction specifications (HMC and Knight Piesold 1994). The QCTS contractor provided monthly inspections (with daily inspection reports) of testing equipment, procedures, and QCTS field personnel by a qualified, licensed PE in responsible charge of the field personnel. The contractor was also responsible for documenting and maintaining records of all testing activities, testing equipment, identification numbers, and calibrations. All testing was done in accordance with the HMC Specifications for Quality Control Testing Services (HMC 1994b; as per guidance from NRC 1989), HMC's Quality Control Procedures (HMC 1994a), and conformed with relevant ASTM and other current most appropriate engineering standards. HMC was responsible for clearly identifying what tests were required.

Work related to the activities of the QCTS contractor but performed by others included:

- Daily supervision and direction of the earthwork contractor activities by HMC's Project Management Contractor
- Review, revision, and evaluation of the earthwork with respect to requirements of the design and specifications to be performed by HMC's consultant/design engineer
- Electrical power, water, and sanitary facilities to be provided by HMC
- Security of equipment and working areas to be provided by HMC.

QC tasks to be carried out during Phase 2 of decommissioning and reclamation are expected to be similar to the Quality Control Program carried out under Phase 1. The existing specification for QCT and inspection services will be reviewed and updated (in consultation with an experienced PE) as needed prior to entering into a contractual agreement with the QCTS Contractor and prior to commencement of the work.

The proposed construction Quality Assurance and Quality Control Programs will be submitted to the NRC for approval prior to commencement of applicable work.

14.3 References

Golder Associates, Inc. (Golder). 2008. Technical Specifications Pinon Ridge Project Montrose County, Colorado. Prepared for Energy Fuels Resources Corporation. September.

Homestaking Mining Company and Knight Piesold and Company. (HMC and Knight Piesold). 1994. Consulting Services Agreement. January 13.

HMC. 1994a. Quality Control Procedures for Homestake Grants Site Reclamation.

HMC. 1994b. Specification for Quality Control Testing Services of Reclamation Earthwork and Quarried Rock, Homestake Grants Operations. Included as Attachment A to HMC and Knight and Piesold 1994.

U.S. Nuclear Regulatory Commission. (NRC). 1989. Staff Technical Position on Testing and Inspection Plans During Construction of DOE's Remedial Action at Inactive Uranium Mill Tailing Sites. January. NRC. 1993. Letter from Ramon E. Hall, Director, Uranium Recovery Field Office, NRC to Harold Barnes, Homestake Mining Company, San Francisco, CA Regarding License SUA-1471 License Amendment No. 14. July 23.

15. Facility Radiation Surveys

The off-pile contaminated soil cleanup (areas other than the LTP and the STP) was completed in 1995 and approved by the NRC in 1999 as License Amendment 32. Contaminated soils were consolidated with the tailings in the LTP and STP, and verification surveys were completed to demonstrate compliance with the cleanup criteria. Additional soils will be potentially contaminated from activities associated with the decommissioning of the groundwater restoration facilities. Radiation surveys will be performed in these areas and the contaminated soils removed and placed in the WDC as part of final closure.

15.1 Release Criteria

Release criteria for unconditional use of land areas are described in **Section 5.1**. Release criteria for unconditional use of equipment and material are contained in NRC's Policy and Guidance Directive FF 03-23 (NRC 1983), which are similar to those in NRC Regulatory Guide 1.86 Termination of Operating Licenses for Nuclear Reactors (NRC 1974).

15.2 Characterization Surveys

GPS-based gamma surveys will be conducted in areas potentially contaminated with mill-related uranium and radium-226. Two different surveys will be conducted in areas proximal to the evaporation and holding ponds or areas where spills may have occurred. The area will be gamma surveyed using 2-inch by 2-inch sodium iodide detectors mounted on a vehicle or trailer. The count rates will be mapped using ArcGIS or equivalent software, similar to that which was done in the 1994/95 cleanup of windblown tailings. Terrain that prohibits the use of a vehicle or trailer will be walked by personnel carrying the GPS and radiometric equipment in a backpack. The survey will be repeated using Field Instrument for the Detection of Low Energy Radiation (FIDLER) detectors. These detectors were selected due to their sensitivity to the low-energy gamma rays from uranium. This survey will use a transect spacing of less than 1 meter and a speed of less than 1 meter/second. All data will be tagged with GPS coordinates and downloaded in ArcGIS or equivalent for analysis and presentation.

Gamma count rate/radium-226 soil concentration will be correlated using the currently approved procedures (HMC License Amendment 15). This correlation will be used to estimate the concentrations of radium-226 in soil based on gamma count rate data collected in the field. An additional correlation will be made using the FIDLER detectors for surface soils contaminated with dispersed uranium-containing material.

Conservative action levels (95% probability of detection) will be established that correspond to the respective cleanup limits for radium-226 and natural uranium.

15.3 Final Status Survey Design

Verification of the remaining off-pile areas will likely be limited to areas within the "inner zone" as discussed in **Section 2.2.2.1** and defined in the NRC-approved plan (see Appendix A to Soil Cleanup Report which includes License Amendment 15 and accompanying Technical Evaluation Report (ERG 1995; **Figure 2.2-4**). In that plan, the 100 m^2 area grid block within each 500 ft by 500 ft grid block having the highest average measured gamma count rate was sampled using a five-point compositing method. If the sample passed, it was assumed that all others would pass, considering the extensive effort to investigate areas with anomalously high gamma count rates during excavation. If the grid block failed, the next highest grid block was sampled and so on until one reached a level where the grid blocks passed. If necessary, the grid blocks and grid blocks with similar gamma emission rates would be decontaminated and resampled. All evidence contained in the Soil Cleanup Report (ERG 1995) indicates that this approach was effective in verifying that the soil standards were met on this site as well as other mill sites, including the Lucky Mac and Shirley Basin sites in Wyoming.

Recently, the NRC has encouraged the use of a MARSSIM-based approach while still employing the cleanup criteria in 10 CFR Part 40, Appendix A. Appendix A requires the radium-226 concentration in a 6-inch layer be averaged over 100 m^2. The MARSSIM strategy is to determine whether the average concentration in a survey unit meets the cleanup criteria by taking samples at a number of points and performing statistical tests on the data set. MARSSIM's elevated measurement comparison (EMC) method allows higher concentrations within a survey unit. MARSSIM recommends a 100 percent scan of a survey unit. MARSSIM also recommends that efforts be made to remediate all areas with elevated gamma exposure rates. The maximum size for the most restrictive Class 1 survey unit is 1000 m^2.

While arguments might be made that the current NRC-approved plan for HMC may have a higher probability of assuring that the parcel meets the cleanup criteria, it is a stratified sampling approach as opposed to the MARSSIM approach, which is statistically based. The most recent uranium mill site that has an NRC-approved plan is the Moab Mill Site. This plan required that the site be divided into 100 m^2 grids and that 5 percent of the grids be selected randomly and sampled using a nine-point compositing technique. For the Homestake Grants Reclamation Project, this would result in an average of one randomly chosen composite sample for each 2,000 m^2

area. MARSSIM recommends that, for areas that have been scanned, samples should be taken on a regular grid while if nothing is known about an area, random sampling is preferable. The Moab and currently NRC-approved plan for the HMC site require that all grids sampled meet the cleanup criteria; a pure MARSSIM approach allows some data points to be higher than the cleanup criteria as long as the statistical tests show that the average concentrations in the entire survey unit are below the cleanup criteria levels.

There is an additional consideration regarding the EMC. One might argue that, for a radium-226 contaminated site or a uranium-contaminated site, the EMC concentrations might be based on averaging over the size of a house for radium-226 and the size of a garden for natural uranium. In both cases, a size of approximately 100 m^2 might be appropriately chosen as a size of interest for the EMC in a residential scenario. Therefore, we believe that the Moab plan is consistent with the intent of MARSSIM with the possible exception of random sampling rather than sampling on a regular grid.

HMC proposes an FSS with survey units of 2,322 m^2 size (500 ft x 500 ft) or less. A rectangular or triangular grid will be established that includes two sampling points within the grid (roughly 10 percent sampling of 100 m^2 areas). Each sampling point will serve as the center of a regular 100 m^2 grid block with the sides oriented approximately with the compass directions. A nine-point composite sample will be prepared for each of the 12 locations. Any 100 m^2 grid block that does not pass will be remediated and sampled along with other areas of similar scanning levels. No statistical analysis of the data for the entire survey unit will be necessary because all data will meet the cleanup levels.

15.4 Final Status Survey Report

A FSS report will be prepared within 90 days following the completion of soil cleanup and disposal activities in accordance with License Condition 29F. The format and content will be similar to the November 1995 Completion Report for Reclamation of Off-Pile Areas at the Homestake Mining Company of California Uranium Mill (ERG 1995).

15.5 References

Environmental Restoration Group, Inc. (ERG). 1995. Completion Report for Reclamation of Off-Pile Area at the Homestake Mining Company of California Uranium Mill, Grants Operation, License SUA-1471. Prepared for Homestake Mining Company of California. November 1995.

U.S. Nuclear Regulatory Commission. (NRC). 1974. Regulatory Guide 1.86. Termination of Operating Licenses for Nuclear Reactors. June.

NRC. 1983. Memorandum from R.E. Cunningham to Regional Administrators, November 4, 1983. Policy and Guidance Directive FC 03-23: Termination of Byproduct, Source and Special Nuclear Material Licenses. U.S. Nuclear Regulatory Commission, Washington, D.C.

16. Restricted Use

The decommissioning of the Grants Reclamation Project site will result in the permanent stabilization of the LTP, STP, WDC, and demolished contaminated mill structures and equipment buried in cells within in the previous mill processing area. These features are located within a license boundary. The area within the license boundary (excluding a 185-acre block containing EP-3 that is discussed in **Section 17**), once final reclamation and decommissioning has been completed to the satisfaction of the NRC, will be designated as a restricted area. The radioactive material license will be transferred to the DOE in accordance with Criterion 11 of Appendix A to CFR Part 40, which will maintain the site under a general radioactive material license. It is expected that the area within the license boundary will be restricted from future use other than protection of the LTP, STP, WDC, burial cells within the previous mill site area, and compliance monitor wells. The restricted area (less the 185 acres containing EP-3) to be transferred to the DOE is shown on **Figure 16.1-1**.

In order to restrict access, the area within the license boundary will be enclosed by a security fence with warning signs. Until title transfer to the DOE, HMC will maintain institutional controls (site entry controls, scheduled inspections and repairs, maintenance of air monitoring stations and groundwater compliance monitor wells). Upon title transfer from HMC to the DOE, the DOE will assume custody and responsibility in perpetuity for the licensed area. HMC will establish a financial assurance arrangement to cover the cost of long-term care and monitoring according to Criterion 10 of Appendix A to CFR Part 40.

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17. Unrestricted Use

The current license boundary includes 185 acres added as of August 7, 2008 to allow for the construction of EP-3, used as part of the groundwater restoration program (**Figure 2.1-1**; NRC 2008). The use of the evaporation pond will terminate when groundwater restoration has been completed. Decommissioning of EP-3 will result in removal of the evaporation pond and associated assets safely from service and reduce residual radioactivity to a level that will permit release of the 185-acre property for unrestricted use. A request will then be made to the NRC for the removal of the 185 acres from the source material license as part of the license boundary. This is the only part of the current license boundary that will be changed to unrestricted use and removed as part of the license boundary. The decommissioning steps are described in **Section 9.2.3**.

Areas outside of the license boundary where groundwater restoration activities have occurred (i.e., areas around groundwater injection and collection wells and irrigation areas) will be cleaned up, as needed, to meet conditions consistent with unrestricted access requirements. Irrigation/land treatment areas and assessments associated with constituent concentrations of soils in the irrigated areas are discussed in the HMC report for the evaluation of years 2000 through 2010 irrigation with alluvial groundwater (HMC et al. 2012). Actions to be taken to address potential offsite impacts and cleanup of groundwater are addressed in **Section 9.9** and the 2012 Revised Groundwater CAP (HMC 2012).

17.1 References

Homestake Mining Company of California (HMC), Hydro-Engineering, LLC, and Environmental Restoration Group (ERG) (HMC et al.). 2012. Evaluation of Years 2000 through 2011 Irrigation with Alluvial Ground Water. February.

Homestake Mining Company of California (HMC). 2012. Grants Reclamation Project, Groundwater Corrective Action Program. March.

U.S. Nuclear Regulatory Commission (NRC). 2008. Letter from K. McConnell, Deputy Director, Decommissioning and Uranium Recovery Licensing Directorate, NRC to Al Cox, Project Director, Homestake Mining Company. Regarding License Amendment No. 41 approving construction of Evaporation Pond No. 3. August 7.

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18. Decommissioning Cost Estimate and Surety Fund

License Condition 28 of License SUA-1471 requires that HMC maintain an NRC-approved financial surety arrangement consistent with 10 CFR 40, Appendix A, Criteria 9 and 10, which is adequate to cover estimated decommissioning and decontamination costs. The surety is required to be updated annually and submitted to the NRC for approval. The 2011 surety was approved by the NRC via License Amendment No. 44 (License Condition 28) by letter dated December 20, 2011 for a total amount of $41,093,194 (NRC 2011). The revised cost estimate reflects a total project closure cost for years 2011 through 2017. The NRC used guidance provided in NUREG-1629, Rev 1, "Standard Review Plan for the Review of a Reclamation Plan for Mill Tailings Sites Under Title II of the Uranium Mill Tailings Radiation Control Act of 1978," June 2003. The estimated costs include having experienced and qualified third parties prepare project design and contracting documents and completion of the demolition and reclamation work.

The 2011 surety for the Grants Reclamation Project (2011 through 2017) is composed of total project reclamation project costs of $36,645,670, a contingency fee of $5,496,850 estimated at 10 percent of the aforementioned total project costs, and an estimated long-term surveillance fee of $803,935 (HMC 2011; NRC ADAMS ML111010153).

A summary of the 2011 closure cost estimates is presented in **Table 18.1-1**. A summary of the 2011 physical reclamation cost estimates is presented in **Table 18.1-2.** These cost estimates are based on 2010 dollars.

HMC submitted the revised 2012 project cost estimate for the Grants Reclamation project by letter dated March 29, 2012 (HMC 2012; NRC ADAMS ML12096A074). The submittal is under NRC review. The new cost estimate reflects a total closure cost for the years 2013 through 2022 of $80,797,033. This total is composed of the following: total project cost of $69,527,206; the 15 percent NRC contingency fee per NUREG-1620 Appendix C of $10,429,081; and the NRC Long-Term Maintenance/Surveillance Fee of $840,746 (using January 2012 index basis). A summary of the 2012 closure cost estimates is presented in **Table 18.1-3**. A summary of the 2012 physical reclamation cost estimates is presented in **Table 18.1-4.** NRC approval is pending.

Ongoing reclamation activities are evaluating, and in some cases planning, additional equipment to be used for groundwater restoration (e.g., expanded RO WTS). The costs and associated expenses with operating such equipment will not be included in

the surety estimate until a final decision has been made for implementation of such systems.

18.1 Long-term Surveillance Site Plan

Federal regulations at 10 CFR 40.28 provide for the licensing, custody, and long-term care of uranium mill tailings closed under Title II of the UMTRCA. After closure, the NRC issues a General License to the DOE for the custody and long-term care of the site, including monitoring, maintenance, and emergency measures necessary to protect the public health and safety and any other actions necessary to comply with the regulations. The General License (long-term custody) becomes effective when HMC's current site-specific license (SUA-1471) is terminated by the NRC and when a site-specific Long-Term Surveillance Plan (LTSP) prepared by the DOE is accepted by the NRC. The DOE is responsible for preparing the LTSP.

As per Criterion 10 of 10 CFR Part 40, HMC is required to provide funds for the long-term surveillance of the site once the license has been transferred to the DOE. The funds are to be paid to the general treasury of the United States prior to termination of the license. The current estimate of this fund, as provided in the 2012 annual surety estimate, is $840,746. It is assumed that, with a 1 percent annual real interest rate, the collected funds will yield interest in an amount sufficient to cover the annual costs of site surveillance. This cost estimate is updated annually as part of HMC's annual financial surety estimate for final decommissioning and reclamation.

18.2 References

Homestake Mining Company of California. (HMC). 2011. Letter from A.D. Cox, Project Manager, Homestake Mining Company of California, Grants Reclamation Project to John T. Buckley, Project Manager, Office of Federal and State Materials and Environmental Management Programs, U.S. Nuclear Regulatory Commission regarding Grants Reclamation Project – 2012 Closure Cost Estimate. March 31.

HMC. 2012. Letter from A.D. Cox, Project Manager, Homestake Mining Company of California, Grants Reclamation Project to John T. Buckley, Project Manager, Office of Federal and State Materials and Environmental Management Programs, U.S. Nuclear Regulatory Commission regarding Grants Reclamation Project – 2012 Closure Cost Estimate. March 29.

U.S. Nuclear Regulatory Commission (NRC). 2011. Letter from K. McConnell, Deputy Director, Decommissioning and Uranium Recovery Licensing Directorate, NRC to Al Cox, Project Director, Homestake Mining Company. Regarding *2010 Surety Update for the Homestake Mining Company Grants Reclamation Project, Amendment No. 43 to Source Material License SUA-1471.* February 28, 2011.

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Tables

Table 1.0-1 Cross Reference Checklist of NUREG-1620 and NUREG-1757 to Decommissioning and Reclamation Plan Update 2011

Location of Information in License Submittal		NUREG-1620	NUREG-1757
			Part II: Decommissioning Plans
			16 Decommissioning Plans: Site Description
1.	**Executive Summary**		16.1 Executive Summary
1.1	Site and Licensee Information	Appendix B Appendix E	16.1.2 Acceptance Criteria
1.2	Summary of Licensed Activities	4.1 3 Acceptance Criteria Appendix B	16.1.2 Acceptance Criteria
1.3	Nature and Extent of Site Radiological Contamination	Appendix B Appendix H	16.1.2 Acceptance Criteria
1.4	Decommissioning Objective	Appendix E	16.1.2 Acceptance Criteria
1.5	Radiological Criteria for Unrestricted Use	Appendix C	6.0 Radiological Criteria for Decommissioning 16.4 Radiological Status of Facility
1.6	ALARA Analysis	4.4.3 Acceptance Criteria	16.1.2 Acceptance Criteria
1.7	License Termination Restricted Conditions	Appendix E	16.1.2 Acceptance Criteria
1.8	Financial Assurance		
1.9	Institutional Controls	4.3.3 Acceptance Criteria 4.4.4 Evaluation Findings	17.7 Institutional Controls and Engineered Barriers
1.10	Final Decommissioning and Reclamation Schedule	Appendix E	16.1.2 Acceptance Criteria
1.11	Post-Remediation Activities	Appendix D	16.1.2 Acceptance Criteria
1.12	Request for License Amendment to Incorporate Decommissioning Plan	Appendix E	16.1.2 Acceptance Criteria
1.13	References	--	--
2.	**Facility Operating History**	4.1.3 Acceptance Criteria 4.4.3 Acceptance Criteria Appendix B	16.2 Facility Operating History
2.1	License Number, Status and Authorized Activities	"	16.2.1 License No./Status/Authorized Activities
2.1.1	Facility Ownership	"	16.2.1 License No./Status/Authorized Activities
2.1.2	Facility Status	"	16.2.1 License No./Status/Authorized Activities
2.1.3	NRC SUA-1471 Authorized Activities	"	16.2.1 License No./Status/Authorized Activities
2.2	License History	"	16.2.2 License History
2.2.1	Operational History	"	16.2.3 Previous Decommissioning Activities
2.2.2	Completed Reclamation/Decommissioning Activities	"	16.2.3 Previous Decommissioning Activities
2.2.2.2	Tailing Piles Reclamation	"	16.2.3 Previous Decommissioning Activities
2.2.2.3	Remaining Structures and Groundwater Restoration Support Structures and Associated Byproduct (11e(2) Material	"	16.4 Radiological Status of Facility
2.2.2.4	Groundwater Restoration History	Updated CAP (Table 1.0-2)	16.2.3 Previous Decommissioning Activities
2.2.3	EPA CERCLA (Superfund) Activities	Appendix B Appendix E	16.2.3 Previous Decommissioning Activities
2.2.4	New Mexico Environmental Department Discharge Permits	Appendix B Appendix E	16.2.3 Previous Decommissioning Activities
2.2.5	Spills	5.2.2 Review Procedures	16.2.4 Spills

Table 1.0-1 Cross Reference Checklist of NUREG-1620 and NUREG-1757 to Decommissioning and Reclamation Plan Update 2011

Location of Information in License Submittal		NUREG-1620	NUREG-1757
		Appendix B	
2.2.5.1	Non-Hydrocarbon Spills/Releases	5.2.2 Review Procedures Appendix B	16.2.4 Spills
2.2.6	Fires	3.5.1 Area of review 3.5.2 Review Procedures Appendix B	16.2.4 Spills
3.	**Site Description**	4.1.1 Areas of Review 4.1.3 Acceptance review Appendix B	16.3.1 Site Location and Description
3.1	Site Location and Description	"	16.3.1 Site Location and Description
3.2	Population Description	"	16.3.2 Population Distribution
3.2.1	Cibola County	"	16.3.2 Population Distribution
3.2.2	City of Grants	"	16.3.2 Population Distribution
3.2.3	Village of Milan	"	16.3.2 Population Distribution
3.3	Current and Future Land Use	"	16.3.3 Current/Future Land Use
3.3.1	Current Land Use	"	16.3.3 Current/Future Land Use
3.3.2	Future Land Use	"	16.3.3 Current/Future Land Use
			16 Decommissioning Plans: Site Description
3.4	Meteorology, Climatology and Air Quality	4.1.1 Areas of Review 4.1.3 Acceptance review Appendix B	16.3.4 Meteorology and Climatology
3.4.1	Regional Climate Summary	"	16.3.4 Meteorology and Climatology
3.4.2	Local Climate Summary	"	16.3.4 Meteorology and Climatology
3.4.3	Temperature	"	16.3.4 Meteorology and Climatology
3.4.4	Precipitation	"	16.3.4 Meteorology and Climatology
3.4.5	Relative Humidity	"	16.3.4 Meteorology and Climatology
3.4.6	Barometric Pressure	"	16.3.4 Meteorology and Climatology
3.4.7	Solar Radiation	"	16.3.4 Meteorology and Climatology
3.4.8	Wind	"	16.3.4 Meteorology and Climatology
3.4.9	Air Quality	"	16.3.4 Meteorology and Climatology
3.5	Geology and Seismology	1.0 Geology and Seismology	16.3.5 Geology and Seismology
3.5.1	Surface Geology	1.1 Stratigraphic Features	16.3.5 Geology and Seismology
3.5.2	Bedrock Geology	1.1 Stratigraphic Features	16.3.5 Geology and Seismology
3.5.3	Structural Setting	1.2 Structural and Tectonic Features	16.3.5 Geology and Seismology
3.5.4	Seismology	1.4 Seismicity and Groundwater Motion estimates	16.3.5 Geology and Seismology
3.6	Surface Water Hydrology	3.0 Surface Water Hydrology and Erosion Protection Updated CAP (Table 1.0-2)	16.3.6 Surface Water Hydrology

Table 1.0-1 Cross Reference Checklist of NUREG-1620 and NUREG-1757 to Decommissioning and Reclamation Plan Update 2011

Location of Information in License Submittal		NUREG-1620	NUREG-1757
3.7	Groundwater Hydrology	4.0 Protecting Water Resources Updated CAP (Table 1.0-2)	16.3.7 Groundwater Hydrology Acceptance Criteria (See Updated CAP (Table 1.0-2)
3.7.1	Alluvial Aquifer	Updated CAP (Table 1.0-2)	"
3.7.2	Chinle Formation Aquifers	Updated CAP (Table 1.0-2)	"
3.7.2.1	Upper Chinle Aquifer	Updated CAP (Table 1.0-2)	"
3.7.2.2	Middle Chinle Aquifer	Updated CAP (Table 1.0-2)	"
3.7.2.3	Lower Chinle Aquifer	Updated CAP (Table 1.0-2)	"
3.7.3	San Andres-Glorietta Aquifer	Updated CAP (Table 1.0-2)	"
3.8	Natural Resources	Appendix B	16.3.8 Natural Resources
3.9	Ecology/Endangered Species	Appendix B	15.7.2 Environmental Assessment 16.3 Facility Description
3.9.1	Regional Setting	4.4.3 Acceptance Criteria	"
3.9.2	Baseline Data	4.1.3 Acceptance Criteria	"
3.9.2.1	Vegetation	Appendix B	"
3.9.2.2	Wildlife	Appendix B	"
3.9.3	Aquatic Ecology	Appendix B	"
3.9.4	Threatened and Endangered Species and Species of Concern	Appendix G	"
3.10	Cultural Resources	Appendix G	"
3.10.1	Rock Borrow Area	Appendix G	"
3.10.2	Soil Borrow Areas	Appendix G	"
3.10.3	Acreages with Wind-Blown Contamination	Appendix G	"
3.10.4	Evaporation Pond No. 3	Appendix G	"
3.11	References	--	--
4.	**Radiological Status of Facility**	5.0 Radiation Protection Appendix B	16.4 Radiological Status of facility
4.1	Contaminated Structures	"	16.4.1 Contaminated Structures
4.2	Contaminated Systems and Equipment	"	16.4.2 Contaminated Systems and Equipment
4.3	Surface Soil Contamination	"	16.4.3 Surface Soil Contamination
4.4	Subsurface Soil Contamination	"	16.4.4 Subsurface Soil Contamination
4.5	Surface Water	" Updated CAP (Table 1.0-2)	16.4.5 Surface water
4.6	Groundwater	Updated CAP (Table 1.0-2)	16.4.6 Groundwater
4.7	References	--	--
5.	**Decommissioning Standards for Soil and Material**	4.2.4 Evaluation Findings 4.4.3 Acceptance Criteria 5.2.3 Acceptance Criteria Appendix C Appendix H	6.0 Radiological Criteria for Decommissioning 16.4 Radiological Status of Facility

Table 1.0-1 Cross Reference Checklist of NUREG-1620 and NUREG-1757 to Decommissioning and Reclamation Plan Update 2011

Location of Information in License Submittal		NUREG-1620	NUREG-1757
5.1	Unrestricted Release Criteria for Soil	"	"
5.1.1	Radium-226 Soil Standard	"	"
5.1.2	Other Radionuclide Soil Standards	"	"
5.1.2.1	Determination of Radium-226 Benchmark Dose	"	"
5.1.1.1	Site Specific Natural Uranium Soil Standard-Radium Benchmark Approach	"	"
5.1.1.2	Natural Uranium Soils Standard-Toxicological End Point	"	"
5.1.3	Summary of Decommissioning Standards for Soil	"	"
5.2	Unrestricted Release Criteria for Material and Equipment	Appendix C	"
5.3	References	--	--
6.	**Environmental Information**	Appendix B	15.7.4 15.7.5 Appendix E
7.	**ALARA Analysis**	4.4.3 Acceptance Criteria Appendix F	6.0 ALARA Analyses (Volume II) Appendix N ALARA Analyses
7.1	Unrestricted Release Criteria for Soil	"	"
7.1.1	Radium-226 Soil Standard	"	"
7.1.2	Other Radionuclide Soil Standards	"	"
7.2	Unrestricted Release Criteria for Material and Equipment	"	"
7.3	References	--	--
8.	**Decommissioning Alternatives**	5.0 Radiation Protection Appendix B Updated CAP (Table 1.0-2)	15.7.4 15.7.5 Appendix E
8.1	Alternatives Considered	"	"
8.2	References	--	--
9.	**Planned Decommissioning Activities**	2.5.3 Acceptance Criteria 4.4.3 Acceptance Criteria 5.2.3 Acceptance Criteria Appendix J	17.1 Planned Decommissioning Activities
9.1	Tailings Piles	"	"
9.1.1	Large Tailings Pile	"	"
9.2	Small Tailings Pile	"	"
9.3	Ponds	"	"
9.3.1	Evaporation Pond No. 1 (EP-1)	"	"
9.3.2	Evaporation Pond No. 2 (EP-2)	"	"
9.3.3	Evaporation Pond No. 3 (EP-3)	"	"
9.3.4	Collection Ponds	"	"
9.4	Borrow Areas	"	"
9.5	Contaminated Structures	"	17.1.1 Contaminated Structures
9.5.1	Buildings within Administration Compound (Previous Trucking Yard)	"	17.1.1 Contaminated Structures
9.5.2	Reverse Osmosis Facility	"	17.1.1 Contaminated Structures

Table 1.0-1 Cross Reference Checklist of NUREG-1620 and NUREG-1757 to Decommissioning and Reclamation Plan Update 2011

Location of Information in License Submittal		NUREG-1620	NUREG-1757
9.6	Contaminated Systems and Equipment	"	17.1.2 Contaminated systems and Equipment
9.7	Sequence of Removal of Structures, Equipment and Systems	--	--
9.8	Soil	5.2.1 Areas of Review 5.2.2 Review Procedures 5.2.3 Acceptance Criteria Appendix C Appendix E	17.1.3 Soil
9.8.1	Surface Soil Contamination	"	17.1.3 Soil
9.8.2	Subsurface Soil Contamination	"	17.1.3 Soil
9.8.3	Outlying Land Areas	"	17.1.3 Soil
9.9	Regrading and Vegetation	2.5.2 Review Procedures 2.6.3 Acceptance Criteria 3.5.1 Areas of Review Appendix C & E	17.1.3 Soil
9.10	Surface Water	3.0 Surface Water and Erosion Protection	17.1.4 Surface and Groundwater
9.11	Groundwater	Updated CAP (Table 1.0-2)	17.1.4 Surface and Groundwater
9.12	Decommissioning Schedule	Appendix E	17.1.5 Schedules
9.13	References	--	--
10.	**Project Management and Organization**	Appendix C	17.2 Project Management and Organization
10.1	Decommissioning Management Organization	"	17.2.1 Management Organization
10.2	Decommissioning Task Management	"	17.2.2 Task Management
10.3	Decommissioning Management Positions and Qualifications	--	17.2.3 Management Positions and Qualifications
10.4	Training	--	17.2.4 Training
10.5	Contractor Support	--	17.2.5 Contractor Support
10.6	References	--	--
11.	**Health and Safety Program during Decommissioning**	5.2.2 Review Procedures 5.3 Radiation Safety Controls and Monitoring	17.3 Radiation Safety and Health Program
11.1	Barrick Gold Safety and Health Policy and Commitments	"	"
11.2	Radiation Safety and Health Program during Decommissioning	"	"
11.2.1	Radiation Safety and Controls for Monitoring Workers	5.3 Radiation Safety Controls And Monitoring	17.3.1 Radiation Safety Controls and Monitoring for Workers
11.2.1.1	Workplace Air Sampling Program	"	"
11.2.1.2	Respiratory Protection Program	"	"
11.2.1.3	Internal Exposure Determination	"	"
11.2.1.4	External Exposure Determination	"	"
11.2.1.5	Summation of Internal and External Exposure	"	"
11.2.1.6	Contamination Control Program	"	"
11.2.2	Instrumentation Program	"	"
11.2.3	Health Physics Audits, Inspections and Recordkeeping	"	17.3.3 Health Physics Audits, Inspections and

Table 1.0-1 Cross Reference Checklist of NUREG-1620 and NUREG-1757 to Decommissioning and Reclamation Plan Update 2011

Location of Information in License Submittal		NUREG-1620	NUREG-1757
			Recordkeeping Program
11.3	References	--	--
12.	**Environmental Monitoring and Control Program**	5.3.3 Acceptance Review	17.4 Environmental Monitoring and Control Program
12.1	Environmental ALARA Evaluation		17.4.1 Environmental ALARA Evaluation Programs
12.2	Effluent Monitoring	5.3.3 Acceptance Review	17.4.2 Effluent Monitoring Program
2.2.1	Effluent Control Program	Appendix F	17.4.3 Effluent Control Program
13.	**Waste Management Program**	4.1.3 Acceptance Criteria 4.3.3 Acceptance Criteria 4.4.3 Acceptance Criteria	17.5 Radioactive Waste Management Program
13.1	Radioactive Waste	"	17.5.1 Solid Radioactive Waste
13.1.1	Solid Byproduct Material	"	17.5.1 Solid Radioactive Waste
13.1.2	Liquid Byproduct Material	"	17.5.2 Liquid Radioactive Waste
13.2	Non-Radioactive Wastes	"	17.5.3 (Mixed waste)
13.2.1	Hazardous Wastes	"	Appendix H
13.2.2	Solid Non-hazardous Wastes	--	17.5.3 (Mixed Waste)
13.3	References		--
14.	**Quality Assurance Program**	5.2.3 Acceptance Criteria	17.6 Quality Assurance Program
14.1	Organization	""	17.6.1 Organization
14.2	Quality Assurance Program	""	17.6.2 Quality Assurance Program
14.3	Document Control	"	17.6.3 Document Control
14.4	Control of Measuring and Testing Equipment	"	17.6.4 Control of Measuring and Test Equipment
14.5	Corrective Action	"	17.6.5 Corrective Action
14.6	Quality Assurance Records	"	17.6.6 Quality Assurance Records
14.7	Audits and Surveillance	"	17.6.7 Audits and Surveillance
15.	**Facility Radiation Surveys**	5.2.2 Review Procedures Appendix B	15.4 Decommissioning Surveys 4.0 Facility radiation Surveys of Volume II
15.1	Release Criteria	"	"
15.2	Characterization Surveys	"	"
15.3	Final Status Survey Design	"	"
15.4	Final Status Survey Report	"	"
15.5	References	--	--
16.	Restricted Use	Appendix C	17.7 Restricted Use
17.	**Unrestricted Use**	Appendix C	17.7 Unrestricted Use
17.1	References	--	--
18.	**Decommissioning Cost Estimate and Surety Fund**	Appendix C	15.2 Financial assurance
18.1	Long-term Surveillance Site Plan	Appendix D	--
18.2	References	--	--

Table 1.0-2 NUREG-1620 Acceptance Criteria and Relevant CAP Sections

NUREG - 1620 Checklist Item		Updated CAP Section and/or Appendix
1.	Sufficient data are available to adequately define relevant parameters and to support models, assumptions, and boundary conditions necessary for developing detailed and site-scale models of the groundwater cleanup and the estimation of cleanup time. The data are also sufficient to assess the degree to which processes related to the groundwater cleanup that affect compliance with the technical criteria in Appendix A of 10 CFR Part 40 have been characterized. Information required for site-scale reactive transport models can include:	Sections 2, 3, and 4; Appendix G
1a.	Site description:	
	(i) Chronology/history of uranium milling operations	Section 2.3, Appendix B
	(ii) List of known leaching solutions and other chemicals used in the milling process	Appendix B
	(iii) Summary of known impacts of the site activities on the hydrologic system and background water quality. Protecting Water Resources	Section 4, Appendix E
	(iv) Quantity and chemical/textural characteristics of wastes generated at the mill site	Section 2.3, Appendix B
	(v) Information pertaining to surrounding land and water uses	Section 2.2
	(vi) Meteorological data for the region including precipitation and other data to support estimates of evapotranspiration	Section 2.1
1b.	Description of hydrogeologic units: (i) Hydrostratigraphic cross sections/maps (ii) Hydrogeologic units that constitute the aquifer(s) (iii) Description of perched aquifers (areal/volumetric extent) (iv) Description of the unsaturated zone (thickness, extent) (v) Geologic characteristics (presence of layers, continuity, faults)	Section 3, Appendix C
1c.	Data on the hydraulic and transport properties of each aquifer:	
	(i) Hydraulic conductivity (ii) Thickness of each unit (iii) Hydraulic head contour maps (of each aquifer) (iv) Information on background horizontal and vertical hydraulic gradients and temporal variations to determine flow directions (v) Vertical hydraulic gradients and inter-aquifer flow within and between multiple aquifer systems (vi) Effective porosity (vii) Storativity or specific yield (for transient simulations) (viii) Longitudinal, vertical and horizontal transverse dispersivity	Section 3, Appendix C
	(ix) Retardation factors	Appendix C

Table 1.0-2 NUREG-1620 Acceptance Criteria and Relevant CAP Sections

NUREG - 1620 Checklist Item		Updated CAP Section and/or Appendix
1d	Data on regional recharge rates and groundwater/surface water interactions with nearby streams, rivers, or lakes: (i) Areal recharge rates. (ii) Information on water fluxes to and from rivers, aquifers, and surface water bodies (iii) Data on surface water bodies (e.g., stream flow rates, dimensions of nearby surface water bodies) (iv) Concentration of hazardous constituents in surface water bodies	Section 3.2.1, Appendix D
1e.	Characteristics of the mill tailings:	
	(i) Identification of contaminant source terms	Section 4.2
	(ii) Hydraulic properties of mill tailings material (iii) Unsaturated flow and transport parameters of mill tailings material	Appendix B
	(iv) Design and materials for mill tailings cover	2011 Decommissioning and Reclamation Plan
	(v) Information on the spatial and temporal distribution of seepage fluxes from the mill tailings to the upper-most aquifer (including the historical variation in rates) (vi) Information on mill tailings draining mechanisms and drainage volume	Appendix G, Sections 4.2 and 5.3.1
	(vii) Geotechnical properties of the mill tailings and their temporal variation due to drainage of leachates (viii) Tailings volume (ix) Data on the volume, chemical and mineralogical characteristics, and concentration of mill tailings and tailings solution/leachate	Appendix B
	(x) Mass of hazardous constituents placed in the tailings pile and other disposal or storage areas	Section 2.4.4
1f.	Data on geochemical conditions and water quality:	Section 4
	(i) Concentration of hazardous constituents	Section 4.2.1, Appendix E
	(ii) Background (baseline) groundwater quality	Section 4.1, Appendix A
	(iii) Delineation of the nature and extent of the hazardous constituent plume	Section 4.2, Appendix E
	(iv) Characterization of subsurface geochemical properties	Section 4.1
	(v) Identification of attenuation mechanisms and estimation of attenuation rates.	Sections 2.4.4 and 4.2.3, Appendix E
	(vi) Mass of hazardous constituents in the aquifer	Section 2.4.4

Table 1.0-2 NUREG-1620 Acceptance Criteria and Relevant CAP Sections

NUREG - 1620 Checklist Item		Updated CAP Section and/or Appendix
1g.	Site cleanup data: (i) Information on grout curtains, slurry walls, drains, interceptor ditches, and other facilities designed to reduce the spreading of the hazardous constituent plume (if used) (ii) Information on pumping, injection, and sampling wells (coordinates, depths, completion diagrams, flow rates) (iii) Pumping/injection rates and rate history for each well (if pumping has been ongoing) (iv) Information on the presence or the absence of liners for the mill tailings pile and evaporation ponds	Section 5.3, Appendix M
	(v) Mass of hazardous constituents recovered to date	Section 2.4.4 and 5.3.1
2.	Parameter values, assumed ranges, probability distributions, and/or bounding assumptions used in the modeling of groundwater cleanup are technically defensible and reasonably account for uncertainties and variabilities. The technical bases for each parameter value, ranges of values, or probability distributions used in the modeling of the groundwater cleanup are provided. Sensitivity analyses are provided that (i) identify aquifer flow and transport parameters that are expected to significantly affect the site model outcome; (ii) test the degree to which the performance of the groundwater cleanup may be affected if a range of parameter values must be used as input to the model due to sparsity of, or uncertainty in, available data; and (iii) test for the need for additional data. Sufficient bases are provided for parameter values, representative parameter values are taken from the literature, and the bounds and statistical distributions are provided for hydrologic and transport parameters that are important to the estimation of cleanup time and that are included in the modeling of the groundwater cleanup. Site data fitted to theoretical models compare reasonably well. American Standard for Testing and Materials D 5490 provides guidance for comparing groundwater flow model simulations to site-specific information. If there is departure of site data from the theoretical model, then an alternative model is considered. The assumptions used in modeling are consistent with site data and observations. Models used to describe local phenomena, such as the fluxes through the tailings pile, are based on consistently applied conditions.	Appendix G
3.	Important design features, physical phenomena, and consistent and appropriate assumptions are identified and described sufficiently for incorporation into any modeling that supports the groundwater cleanup, including the estimate of cleanup time, and the technical bases are provided. Detailed models and site-scale models used to support the corrective action plan, or other supporting documents, and identify and describe aspects that are important to the cleanup and the estimate of cleanup time.	Appendix G

Table 1.0-2 NUREG-1620 Acceptance Criteria and Relevant CAP Sections

NUREG - 1620 Checklist Item		Updated CAP Section and/or Appendix
4.	Alternative modeling approaches consistent with available data and current scientific understanding are investigated where necessary, and results and limitations are appropriately factored into the groundwater corrective action plan. The licensee provides sufficient evidence that relevant site features have been considered, that the models are consistent with available data and current scientific understanding, and that the effects on cleanup time have been evaluated. Specifically, the licensee adequately considers alternative modeling approaches where necessary to incorporate uncertainties in site parameters and ensure they are propagated through the modeling. Uncertainty in data interpretations is considered by analyzing reasonable conceptual models that are supported by site data, or by demonstrating through sensitivity studies that the uncertainties have little impact on the groundwater corrective action plan.	Appendix G
5.	The site-scale model for groundwater cleanup provides results consistent with the output of detailed or site data. Specifically, the site model is consistent with detailed models of geological, hydrological, and geochemical processes for the site. For example, for flow and transport through the aquifer, hydraulic conductivity distributions are reasonably consistent with sensitivity studies of the range of hydraulic conductivities and varying statistical distributions, field observations, and laboratory tests, when applicable. The licensee documents how the model output is validated in relation to site characteristics. Where appropriate, in developing the site model for groundwater cleanup, the licensee considers and evaluates alternative models that are reasonably justified by the available database, with reasonable values assigned to distribution statistics to compensate for limited data availability. The licensee uses numerical and analytical modeling approaches reflecting varying degrees of complexity consistent with information obtained from site characterization. The licensee employs the upper and lower bounds of input parameter ranges to examine the robustness of the modeling.	Appendix G
6.	Adequate waste management practices are defined. The disposition of effluent generated during active remediation is addressed in the corrective action plan. Appendix F to this standard review plan contains NRC staff policy for effluent disposal at licensed uranium recovery facilities for conventional mills. When retention systems such as evaporation ponds are used, design considerations from erosion protection and stability along with construction plans reviewed by a qualified engineer are included. Evaporation and retention ponds should meet the design requirements of 10 CFR Part 40, Appendix A, Criterion 5A. Ideally, the ponds should have leak detection systems capable of reliably detecting a leak from the pond into the groundwater and should be located where they will not impede the timely surface reclamation of the tailings impoundment.	Section 5.3
	If water is to be treated and reinjected, either into an upper aquifer or into a deep disposal well, the injection program is approved by the appropriate state or federal authority.	Sections 1.1 and 5.3.2

Table 1.0-2 NUREG-1620 Acceptance Criteria and Relevant CAP Sections

NUREG - 1620 Checklist Item		Updated CAP Section and/or Appendix
	If effluent is to be discharged to a surface water body, licensees obtain a National Pollutant Discharge Elimination System permit for discharge to surface water. If plans to manage effluents are in place from earlier operations, they may be included in the corrective action plan by reference.	Section 1.1
7.	Appropriate site access control is provided by the licensee. Site access control should be provided by the licensee until site closure to protect human health and the environment from potential harm. Site access is controlled by limiting access to the site with a fence and by conducting periodic inspections of the site.	Sections 2.2, 2.3, and 2.4
8.	Effective corrective action and compliance monitoring programs are provided. Licensees are required, by Criterion 7 of Appendix A to 10 CFR Part 40, to implement corrective action and compliance monitoring programs. The licensee monitoring programs are adequate to evaluate the effectiveness of groundwater cleanup and control activities, and to monitor compliance with groundwater cleanup standards. The description of the monitoring program includes or references the following information:	Sections 2.4.3, 4.2, and 7
8a.	(a) QA procedures used for collecting, handling, and analyzing groundwater samples;	Section 7.5
8b.	(b) The number of monitor wells and their locations;	Section 7.2.1
8c.	(c) A list of constituents that are sampled and the monitoring frequency for each monitored constituent;	Sections 7.2.2 and 7.2.3
8d.	(d) Action levels that trigger implementation of enhanced monitoring or revisions to cleanup activities (i.e., timeliness and effectiveness of the corrective action).	Section 7.4
9.	Design of Surface Impoundments. The reviewer shall determine that any lined impoundment built as part of the corrective-action program to contain wastes is acceptably designed, constructed, and installed. The design, installation, and operation of these surface impoundments must meet relevant guidance provided in Regulatory Guide 3.11, Section 1 (NRC 1977). Materials used to construct the liner shall be reviewed to determine that they have acceptable chemical properties and sufficient strength for the design application. The reviewer shall determine that the liner will not be overtopped. The reviewer shall determine that a proper quality control program is in place. (see source doc for more information on this)	Sections 2.3 and 2.4
10.	Financial Surety is Provided. The licensee must maintain a financial surety, within the specific license, for the restoration of groundwater, with the surety sufficient to recover the anticipated cost and time frame for achieving compliance before the land is transferred to the long-term custodian. The financial surety must be sufficient to cover the cost of corrective action measures that will have to be implemented if required to restore groundwater quality to the established site-specific standards (including an ACL standard) before the site is transferred to the government for long-term custody.	Section 8

Table 2.1-1 Latitude, Longitude and Coordinates for the Homestake Mining Company Grants Site License Boundary and Center-Point of License Boundary

Layer	Geographic Projection: NAD 83 (Degrees)		NAD1983 StatePlane New Mexico West FIPS 3003 (Feet)	
	Latitude	Longitude	Northing	Easting
A	35.23382261746	-107.85677941914	1540419	2716090
A	35.23250369183	-107.85775599490	1539939	2715798
A	35.22859566329	-107.86066987919	1538517	2714928
A	35.22607215784	-107.86255585619	1537598	2714364
A	35.22916866297	-107.86248708143	1538725	2714385
A	35.22916620007	-107.87136247537	1538725	2711735
A	35.23644871868	-107.87122609167	1541376	2711776
A	35.23644673838	-107.87709695498	1541376	2710023
A	35.24722707785	-107.87710274695	1545300	2710023
A	35.24722781809	-107.87500573262	1545300	2710649
A	35.25860124406	-107.87496734130	1549439	2710663
A	35.25549267821	-107.86749477656	1548307	2712893
A	35.24714628272	-107.86749106994	1545269	2712893
A	35.24693361606	-107.84896616632	1545190	2718424
A	35.24447686743	-107.85107748908	1544296	2717794
A	35.24258903187	-107.85265300720	1543609	2717323
A	35.24150286912	-107.85356677644	1543214	2717050
A	35.24095980926	-107.85388182112	1543016	2716956
A	35.23977028997	-107.85432276603	1542583	2716824
A	35.23847733337	-107.85479518786	1542113	2716683
A	35.23687406194	-107.85539357667	1541529	2716504
A	35.23524492965	-107.85599193476	1540937	2716325
A	35.23449500297	-107.85630688078	1540664	2716231
A	35.23382261746	-107.85677941914	1540419	2716090
B*	35.24157326349	-107.86590301219	1543241	2713367

* Center-Point of HMC license boundary

Table 2.1-2 Current Major Facilities Located at the HMC Grants Reclamation Project

Facility	Status/Use
Large Tailings Pile (LTP)	Interim Cover on top; permanent rock cover on side slopes Tailings Flushing and dewatering system
Small Tailings Pile (STP)	Interim cover on top EP-1 on top of STP
East Collection Pond	Groundwater treatment facilities
West Collection Pond	Groundwater treatment facilities
Evaporation Pond No. 1 (EP-1)	Groundwater treatment facilities
Evaporation Pond No. 2 (EP-2)	Groundwater treatment facilities
Evaporation Pond No. 3 (EP-3)	Groundwater treatment facilities
Reverse Osmosis Water Treatment System	Groundwater treatment facilities
Office/Warehouse Building [4 Bays]	Office, visitor reception, maintenance bays, equipment and supplies storage, laboratory, restrooms, change room/laundry
Warehouse Building 1 [2 Bays]	Equipment/supplies storage
Warehouse Building 2	Equipment/supplies storage

Note:
Location of assets shown in Figure 2.1-1

Table 2.1-3 Federal Statutes and Authorities

Statute	Administering Agency	Permitting and Enforcement Authority	Comments
FEDERAL			
AEA	Atomic Energy Commission (NRC)	NRC	Radioactive Material License
CAA			
Title I (PSD: NSPS, NESHAPS)	EPA (Air Programs)	NMED (AQB)	EPA Oversight
Title V	EPA (Air Programs)	NMED (AQB)	
CWA			
402 [NPDES]	EPA	NMED (WQB)	EPA Oversight
404 [Dredge & Fill]	DA Drinking Water Program	DA	
SDWA			
Drinking Water Supplies • Approved Facilities • Monitoring/Certified Labs	EPA Region VI Drinking Water Program	NMED (DWB)	EPA Oversight
UIC Program	EPA Region VI UIC Program	NMED (GQB)	EPA Oversight
TSCA			
• PCBs	EPA Region VI Toxics and Pesticides Program	NMED (AQB)	EPA Oversight
RCRA)			
• Subtitle C [Hazardous Waste]	EPA Region VI Waste Program	NMED (HWB)	EPA Oversight
• Subtitle D [Solid Waste]		NMED (SWB)	EPA Oversight
FIFRA	EPA Region VI Toxics and Pesticide Program	NMDA	Main issues pertain to use of approved pesticides and herbicides and possible applicator license.
NEPA of 1969	Council on Environmental Quality; applicable federal agency (e.g., NRC)	No Permit Required	NEPA requirements via NRC radioactive material license amendments.
Endangered Species Act	DOI Policy for all federal agencies, e.g., USFWS	Consultation with USFWS	
Bald Eagle & Golden Eagle Protection Act	DOI	DOI	No permit or approvals required unless a nest interferes with resource development and needs to be relocated.
Migratory Bird Treaty Act	USFWS	USFWS – coordination through NEPA	Law implements international treaty that protects birds that migrate across national borders.
River and Harbors Act • Dredge and fill • Protection of navigable waters, e.g., streams downgradient from HMC Site	ACOE	DA	Could be applicable for any water diversions.
Occupational Safety & Health Act	OSHA	New Mexico OHSB	OSHA has authority for surface operations (no mining activities).
HMTA	DOT	DOT delegates enforcement authorities to other federal agencies. Shared and overlapping authorities for shipments.	Act preempts state and local requirements unless requirements offer equal or greater levels of protection.

Table 2.1-3 Federal Statutes and Authorities

Statute	Administering Agency	Permitting and Enforcement Authority	Comments
HMTA Uniform Safety Act	DOT	DOT	Purpose is to clarify maze of conflicting local, state, and federal requirements.
Pollution Prevention Act	EPA Region VI Pollution Prevention Program	EPA Region VI	Non-delegable to states.
OPA • Facility Response Plans • SPCC Plan Upgrades	EPA Region VI	EPA Region VI	Non-delegable to states. Supplements requirements in the CWA.
CERCLA	EPA Region VI	EPA Region VI	Cleanup of sites contaminated with hazardous substances under MOU with NRC. Reporting of releases of hazardous substances.
Executive Order 12898 Federal Actions to address environmental justice in minority populations and low-income populations.	EPA Office of Environmental Justice	Coordinate lead agency's efforts to integrate environmental justice into all policies, programs, and activities.	Fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to development, implementation, and enforcement of environmental laws, regulations, and policies.

Notes:
ACOE – U.S. Army Corps of Engineers
AEA – Atomic Energy Act
AQB – Air Quality Bureau
CAA – Clean Air Act
CERCLA – Comprehensive Environmental Response, Compensation, and Liability Act
CWA – Clean Water Act
DA – Department of Army
DOI – Department of Interior
DWB – Drinking Water Bureau
DOT – Department of Interior
EPA – Environmental Protection Agency
FIFRA – Federal Insecticide, Fungicide, & Rodenticide Act
GQB – Groundwater Quality Bureau
HMTA – Hazardous Materials Transportation Act
HWB – Hazardous Waste Bureau
MOU – Memorandum of Understanding
NEPA – National Environmental Policy Act
NESHAPS – National Emission Standards for Hazardous Air Pollutants
NMDA – New Mexico Department of Agriculture
NMED – New Mexico Environment Department
NPDES – National Pollutant Discharge Elimination System
NRC – Nuclear Regulatory Commission
NSPS – New Source Performance Standard
OSHA – Occupational Safety and Health Administration
OHSB – Occupational Health and Safety Bureau
OPA – Oil Pollution Prevention Act
PCBS – polychlorinated biphenyls
RCRA – Resource Conservation and Recovery Act
SDWA – Safe Drinking Water Act
SPCC – Spill Prevention Control and Countermeasures
SWB – Solid Waste Bureau
TSCA – Toxic Substances Control Act
UIC – Underground Injection Control
USFWS – U. S. Fish and Wildlife Service
WQB – Water Quality Bureau

Table 2.1-4 State of New Mexico Statutes and Authorities

New Mexico Environmental Act and Regulation and Administrative Code			
Standard, Requirement, Criterion, or Limitation	**NMAC Citation**	**Title/Media**	**Description**
NEW MEXICO WATER QUALITY ACT	Title 20	Environmental Protection	--
New Mexico Water Quality Control Commission Regulations Ground and Surface Water Protection	20.6.2	Groundwater and Surface Water Protection	--
	20.6.2.1203	Groundwater	Notice of Discharge-Removal
	20.6.2.2101	Surface Water	General NPDES Discharge Requirements
	20.6.2.3101	Groundwater	Protection of groundwater with concentration of 10,000 mg/l or less TDS.
	20.6.2.3103	Groundwater	Establishment of Contaminant-Specific Standards for groundwater of 10,000 mg/l or less TDS.
	20.6.2.3104	Groundwater	Discharge permit required for into groundwater in compliance with 20.6.2.3111 NMAC.
	20.6.2.4101	Groundwater and Surface Water	Prevention and abatement of water pollution.
	20.6.2.4103 A-D	Groundwater and Surface Water	Abatement Standards and Requirements
	20.6.2.4111	Groundwater and Surface Water	Abatement Plan Modification
	20.6.2.5000 through 20.6.5299	Groundwater	Underground Injection Control
New Mexico Water Quality Control Commission Regulations Standards for Interstate and Intrastate Surface Waters	20.6.4.8.A(1)	Surface Water	Anti-degradation Policy and Implementation Plan for Surface Water
New Mexico Water Quality Control Commission Regulations Standards for Interstate and Intrastate Surface Waters	20.6.4.12	Surface Water	Compliance with Water Quality Standards
	20.6.4.13.A-L	Surface Water	General Surface Water Criteria
	20.6.4.122	Surface Water	Rio Grande Basin (San Mateo Creek Basin) Designated Water Use and Criteria
	20.6.4.900.A, C,D,F,G,H2	Surface Water	Criteria Applicable to Existing, Designated, or Attainable Uses Unless Otherwise Specified In 20.6.4.97 through 20.6.4.899.

Table 2.1-4 State of New Mexico Statutes and Authorities

New Mexico Environmental Act and Regulation and Administrative Code			
Standard, Requirement, Criterion, or Limitation	**NMAC Citation**	**Title/Media**	**Description**
OFFICE OF THE STATE ENGINEER – UNDERGROUND WATER			
New Mexico Rules and Regulations Governing Well Driller's Licensing; Construction, Repair. and Plugging of Wells	19.27.4	Groundwater	Well driller's licensing; construction, repair, and plugging of wells and boreholes.
Statutes Governing the Appropriation and Use of Groundwater	NMSA 1978, 72-2-8, 72-2-12, 72-13-4	Groundwater	Article 1-17; Application for Pollution Plume Control Wells and Pollution Recovery Wells; Article 1-18; Requirements for Metering of Groundwater Withdrawal. Applicable for new groundwater wells.
NEW MEXICO WATER SUPPLY SYSTEMS			
New Mexico Regulations for Public Drinking Water Systems	20.7.10.100	Drinking Water Systems	Health-based standards for public drinking water systems (MCLs and MCLGs).
NEW MEXICO AIR QUALITY CONTROL ACT			
New Mexico Air Quality Regulations	20.2	Air	Air Quality Regulations
	20.2.6	Air	Open burning restrictions
	20.261	Air	Smoke and visible emissions restrictions
NEW MEXICO HAZARDOUS WASTE ACT			
New Mexico Hazardous Waste Regulations	20.4.1.300	Hazardous Waste	Standards for Generators of Hazardous Waste.
	20.5	Petroleum Storage Tanks	Aboveground fuel storage tank(s) and remediation of spills and leaks.
NEW MEXICO SOLID WASTE ACT			
New Mexico Solid Waste Regulations	20.9.2.10	Solid Waste	Special general provisions – prohibited acts
Maximum Size, Sizing Criteria, Design Criteria	20.9.4.9	Solid Waste	Special waste (i.e., asbestos)
NEW MEXICO PREHISTORIC AND HISTORIC SITES			
New Mexico Cultural Properties Act	NMSA 1978, 18-6-1 through 18-6-27	Historic Building Structure Sites or Artifacts	Preservation, protection, and enhancement of structures, sites, and objects of historical significance within the state.

Table 2.1-4 State of New Mexico Statutes and Authorities

New Mexico Environmental Act and Regulation and Administrative Code			
Standard, Requirement, Criterion, or Limitation	**NMAC Citation**	**Title/Media**	**Description**
New Mexico Prehistoric and Historic Sites Preservation Act	NMSA 1978, 18-8-1 through 18-8-8.	Prehistoric or Historic Sites	Acquisition, stabilization, restoration, or protection of significant prehistoric or historic sites.
New Mexico Prehistoric and Historic Sites Regulations	4.10.12	Prehistoric or Historic Sites	Provides for implementation of the Act; sites are discovered and may be impacted.
NEW MEXICO WILDLIFE CONSERVATION ACT, ENDANGERED PLANT SPECIES ACT, AND NOXIOUS WEED CONTROL ACT			
New Mexico Wildlife Conservation Act	NMSA 1978, 17-2037 through 17-2-46	Threatened and Endangered Species	Regulation and protection of threatened and endangered species.
New Mexico Endangered Plant Species Act	NMSA 1978, 75-6-1	Threatened and Endangered Species	Regulation and protection of threatened and endangered species.
New Mexico Endangered Plants Regulations	19.21	Threatened and Endangered Plants	Protection of threatened and endangered flora.

Notes:
MCLs – Maximum Contaminant Levels
MCLGs – Maximum Contaminant Level Goals
mg/l – milligrams per liter
NMAC – New Mexico Administrative Code
NMSA – New Mexico Statutes Annotated
NPDES – National Pollutant Discharge Elimination System
TDS – total dissolved solids

Table 2.1-5 Current Licenses, Permits, and Approvals

Regulatory Agency	License, Permits, and Approvals	Regulatory Authority
FEDERAL		
U.S. NRC	NRC License SUA-1471	Atomic Energy Act of 1954, as amended Energy Reorganization Act of 1974 (Public Law 93-438) Applicable parts of Title 10, CFR, Chapter I, Parts 19, 20, 30, 31, 32, 33, 34, 35, 36, 39, 40, 51, 70, and 71
EPA	CERCLA ID NM007860935	Comprehensive Environmental Response, Compensation and Liability Act of 1980, as amended 10 CFR 300 National Oil and Hazardous Substances Pollution Contingency Plan
	SPCC Plan	Oil Pollution Act of 1970 10 CFR 40 Part 112 Oil Pollution Prevention
	EPA oversight of NMED delegated authority	As per applicable NMED regulations
STATE OF NEW MEXICO		
NMED	Discharge Permit 725 (regulates discharges to 3 evaporation ponds and 2 collection ponds)	NMSA 1978, 74-6-1 through 74-6-17 New Mexico Water Control Commission Ground and Surface Water Protection NMAC Title 20.6.2
	Discharge Permit 200 (regulates injection of contaminated alluvial groundwater to tailings piles and extraction and reverse osmosis system)	NMSA 1978, 74-6-1 through 74-6-17 New Mexico Water Control Commission Ground and Surface Water Protection NMAC Title 20.6.2
NMED HWB	Hazardous Waste Generator ID NMD007860935	NMSA 1978, 74-4-1 through 74-4-14 New Mexico Water Control Commission Hazardous Waste Bureau NMAC 20.4.1
NMOSE	NMOSE Permits for Construction and Operations of: • Collection Ponds (2) • Evaporation Ponds (3) • Large Tailings Pile • Small Tailings Pile	NMSA 1978, 72-5 Office of State Engineer NMAC 19.25.12 Dam Design, Construction, and Dam Safety
	NMOSE Water Appropriations Permits	NMSA 1978, 72-12 (Underground Waters) Office of State Engineer NMAC 1978, 19-27-1 (Underground

Table 2.1-5 Current Licenses, Permits, and Approvals

Regulatory Agency	License, Permits, and Approvals	Regulatory Authority
		Water - General Provisions) NMAC 1978, 19-27-24 (Bluewater Basin)
	NMOSE Permits for Collection/Injection Wells/Monitor Wells	NMSA 1978,72-12 (Underground Waters) Office of State Engineer NMAC 19-27-4 (Well Driller Licensing; Construction, Repair, and Plugging of Wells)
New Mexico Historic Preservation Division NMSHPO	New Mexico Archaeological Permits (a number issued for undisturbed areas subject to disturbance)	NMSA 1978, 18-6-1 through 18-6-27, 18-8-1 through 18-8-8 NMSHPO NMAC 4.10-1 through 4.10-17
State OSHA	Workers safety program	NMSA 1978, 50-9-1 through 50-9-25 New Mexico Environment Department New Mexico OHSB NMAC 11-15-1 through 11-5-4 (New Mexico Plan

Notes:
CERCLA – Comprehensive Environmental Response, Compensation, and Liability Act
CFR – Code of Federal Regulations
EPA – Environmental Protection Agency
HWB – Hazardous Waste Bureau
NMAC – New Mexico Administrative Code
NMED – New Mexico Environment Department
NMOSE – New Mexico Office of State Engineer
NMSA – New Mexico Statutes Annotated
NMSHPO – New Mexico State Historic Preservation Office
NRC – Nuclear Regulatory Commission
OHSB – Occupational Health and Safety Bureau
SPCC – Spill Prevention Control and Countermeasures

Table 2.1-6 History of Regulatory Oversight of Licensing and Permitting at the Grants Reclamation Site

Licensing Authority	Regulatory Authority
AEC 1958-1974	The AEC administered the original radioactive materials license for the site from 1958 to 1974, when the State of New Mexico became an NRC Agreement State, granting it the authority to regulate uranium milling activities. The NMEIB and the NMEID assumed regulatory authority over the original AEC license, including its renewal.
State of New Mexico 1974-1986	The State of New Mexico was responsible for licensing and regulating uranium milling operations at the site from 1974 to 1986, when it relinquished its authority back to the NRC.
	The site was placed on the EPA's Superfund NPL in September 1983 at the request of the State of New Mexico due to elevated selenium concentrations in the alluvial aquifer near the site. As a result, the site's groundwater restoration activities are also being overseen under the EPA's Superfund Program, in accordance with CERCLA.
NRC 1986-present	The NRC regulates site activities specifically under a Source and Byproduct Material License (License No. SUA 1471), issued in accordance with CFR10 CFR Part 40. The current NRC license, as amended, authorizes HMC to possess residual uranium and by-product material generated by past milling operations in accordance with approved license conditions. Currently, the two principal licensed activities are the implementation of the CAP and decommissioning and closure of the remaining assets at the site.
	Due to overlap in the regulatory requirements of the NRC and EPA Region VI, the two agencies signed an MOU in December 1993, defining the regulatory roles and responsibilities for each federal agency. Under the MOU, the NRC is the designated lead agency for the radioactive materials disposal, reclamation, and closure activities, while the EPA, in consultation with the NMED, is responsible for overseeing all reclamation activities carried out under the NRC's authority to ensure these actions will allow attainment of ARARs under CERCLA. The NMED administers two groundwater discharge permits at the Grants site.
DOE (post-closure)	Once EPA removes the site from the NPL list and NRC approves completion of the reclamation and decommissioning and HMC's funding provision for post-closure long-term monitoring and ongoing routine maintenance, the license will be transferred to the DOE under UMTRCA for long-term custody and care of the site.

Notes:
AEC – U.S. Atomic Energy Commission
ARARs – Applicable, relevant, and appropriate requirements
CAP – Corrective Action Program
CERCLA – Comprehensive Environmental Response, Compensation, and Liability Act
DOE – Department of Energy
EPA – Environmental Protection Agency
HMC – Homestake Mining Company
MOU – Memorandum of Understanding
NMEIB – New Mexico Environmental Improvement Board
NMEID – New Mexico Environmental Improvement Division
NPL – National Priority List
NRC – Nuclear Regulatory Commission
UMTRCA – Uranium Mill Tailings Radiation Control Act

Table 2.2-1 Major Activities Completed During Phase 1 of Decommissioning and Reclamation Program

Completion Date	Activity Completed
November 1990	Complete construction of Evaporation Pond No. 1 (EP-1)
July 1993	Received NRC approval for reclamation activities
September 1993	Commence reclamation activities, recontour large tailings pile
October 1993	Commence mill building demolition
January 1994	Complete recontouring of large tailings pile
February 1994	Complete mill building demolition and encapsulation
April 1994	Complete interim cover on top of the large tailings pile
September 1994	Complete replacement of trucking yard fill material
June 1995	Complete radon barrier on outslopes of large tailings pile
September 1995	Complete retrieval of windblown byproduct materials and place interim cover on small tailings pile
December 1995	Complete mill demolition and decommissioning, including construction of diversion levee
December 1995	Complete construction of Evaporation Pond No. 2 (EP-2)
March 1996	Complete erosion protection placement on outslopes of large tailings pile
November 2010	Complete construction of Evaporation Pond No. 3 (EP-3)
November 2010	Completion of replacement of stormwater downdrains pipe project
December 2010	Completion of radon barrier repair project

Table 2.2-2 Burial Pits Used for Mill Debris and Off Site Caustic Terminal Debris

Burial Pit	Disposed of Materials	Location
#1	Mill debris	Mill site area
#2	Mill debris	Mill site area
#3	Mill debris	Mill site area
#4	Mill debris	Mill site area
#5	Mill debris	Mill site area
#6	Mill debris	Mill site area
#7	Mill debris	Mill site area
#8	Caustic terminal debris	Mill site area
#9	Roaster/Dryer	Northeast toe of LTP
#10	Asbestos debris	Northeast toe of LTP

Notes:
Burial pits locations are shown in Figure 2.2-2.
LTP = Large Tailings Pile
Source: AKG 1996

Table 2.2-3 Summary of Completed Placement of Soils and Rock from HMC Borrow Areas

Location	Placement	Quantity Placed (cy)	Source
Mill Cover and Disposal Pits			
• Soil Cover	Replacement of contaminated mill soils	99,364	East Borrow Area
• Rock Cover	Rock mixed with soil cover	--	--
Large Tailings Pile			
• Compacted Tailings	Tailings material placed and compacted on the mail pile fill area	836,739	Redistribution of Tailings (LTP)
• Interim Cover	Clean borrow material consisting of clayey soils and sandy clays	388,938	West Borrow Area (Primary Source)
• Interim Radon Barrier (Fill)	Placed over tailings surface to prevent erosion of the tailings until placement of the final radon barrier (top, west and south slopes)	725,107	West Borrow Area (Primary Source)
• Bedding Material	Side slopes of LTP; placed on the Final Radon Barrier cover	96,624	East Borrow Area
• Temporary Cover	Temporary cover placed on eastern extension of the LTP; purpose was to contain windblown material until placement of final radon barrier	64,226	North Borrow Area
• Final Rock Cover	Final erosion control on side slopes of LTP	135,704	Rock Quarry
Small Tailings Pile			
• Interim Radon Barrier	Interim radon barrier on South Triangle Area of STP	33,082	South Borrow Area
Ore Pad	Replacement of windblown-contaminated soils that were removed	73,880	North Borrow Area
Trucking Yard (Current Administration Compound)	Replacement of contaminated soils to reestablish pre-cleanup elevations	6,000	East Borrow Area
Site Drainage	Reestablishment of site drainage following site cleanup activities	12,440	East Borrow Area
County Road # 63	Excavation and reconstruction of adjacent county road (contamination)	20,452	West Borrow Area North Borrow Area
State Hwy 605	Excavation and reconstruction of road materials (contamination)	31,095	East Borrow Area
Evaporation Pond EP-2	Construction of new EP-2: fill material	102,110	East Borrow Area
Diversion Levee			
• Construction of Levee	Fill for stormwater diversion structure upgradient of mill site (fill)	65,880	North Borrow Area
• Rock Cover	Erosion control	4,237	Rock Quarry

Source: Knight Piesold 1996

Table 2.2-4 Yearly Variations of Settlement Point Monitoring Data Measurements 2001 – 2011

Settlement Point No.	Elevation (feet amsl)										
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
X-1	0.10	0.11	-0.05	-0.04	0.21	-0.07	-0.03	0.09	-0.16	-0.05	-0.33
B-1	0.06	0.09	-0.04	0.02	0.01	0.06	-0.12	0.13	-0.16	0.17	-0.10
C-1	0.07	0.10	-0.05	0.02	0.03	0.06	-0.09	0.13	-0.16	-0.01	-0.27
D-1	0.10	0.05	-0.05	0.02	0.03	0.06	-0.16	0.14	-0.16	0.02	-0.26
A-2	0.05	0.07	-0.02	0.04	0.01	-0.14	0.05	0.16	-0.17	0.19	-0.10
B-2	0.10	0.09	-0.04	0.02	0.01	0.06	-0.02	0.11	-0.14	0.16	-0.12
C-2	0.10	0.07	-0.06	0.06	-0.04	0.05	0.00	0.16	-0.20	-0.03	-0.30
D-2	0.07	0.08	-0.04	0.05	-0.07[a]	2.28[d]	0.32	0.12	-0.14	0.0[d]	[c]
E-2	0.07	0.07	-0.03	0.02	0.03	-0.04	-0.05	0.16	-0.17	0.11	-.016
A-3	0.06	0.13	-0.06	-0.01	0.05	1.87[b]	0.06[b]	-1.86	-0.14	0.15	-0.10
C-3	0.06	0.10	-0.03	-0.04	0.20	-0.07	0.00	0.10	-0.14	-0.05	-0.33
D-3	0.06	0.13	-0.05	-0.03	0.06	0.12	-0.05	0.09	-0.07	-0.03	-0.22
E-3	0.01	0.11	-0.05	-0.02	0.05	-0.06	-0.05	0.11	-0.12	0.07	-0.14
A-4	0.04	0.14	-0.06	0.02	0.09	-0.27	0.18	0.10	-0.10	0.18	-0.07
B-3	0.08	0.12	0.03	0.00	0.05	0.09	[c]	[c]	[c]	[c]	[c]
B-4	0.04	0.14	-0.01	-0.04	0.07	-0.04	-0.01	0.07	-0.11	0.12	-0.14
C-4	0.39	0.17	-0.04	-0.13	0.16	-0.07	0.04	0.11	-0.14	0/0	-2.3[e]
D-4	0.04	0.15	-0.05	-0.13	0.15	-0.02	-0.02	0.11	-0.09	0.01	-0.23
E-4	0.04	0.18	-0.02	-0.12	0.49	-0.13	0.07	0.13	-0.12	0.10	-0.14
A-5	0.03	0.16	-0.00	-0.13	0.04	-0.08	0.04	0.12	-0.14	0.16	-0.06
B-5	0.05	0.11	-0.06	-0.16	0.12	0.12	-0.04	0.10	-0.13	0.20	-0.12
C-5	0.10	0.10	-0.03	-0.02	-0.07	0.17	-0.04	0.07	-0.13	0.16	-0.06
D-5	0.09	0.08	0.01	-0.18	0.12	0.09	-0.05	0.10	-0.08	0.02	-0.23
E-5	0.07	0.09	0.01	-0.03	0.02	-0.13	0.04	0.13	-0.09	0.10	-0.04
A-6	0.01	0.14	-0.03	-0.10	0.04	-0.06	0.06	1.09	-0.09	0.14	-0.06
B-6	0.05	0.15	-0.04	-0.09	0.04	0.08	-0.03	0.11	-0.10	0.16	-0.07
C-6	0.06	0.14	-0.08	0.06	-0.12	0.05	0.05	0.11	-0.11	0.17	-0.07
D-6	0.03	0.03	-0.03	0.06	-0.10	0.09	-0.03	0.12	-0.09	0.03	-0.23
E-6	0.03	0.10	-0.01	0.02	-0.07	-0.19	0.17	0.09	-0.09	0.09	-0.12
A-7	0.02	0.07	0.02	-0.01	-0.05	0.02	-0.01	0.15	-0.16	0.24	0.03
B-7	0.01	0.09	0.03	0.03	-0.08	0.10	-0.03	0.14	-0.13	0.23	0.01
C-7	0.05	0.09	0.04	-0.05	-0.02	0.10	-0.04	0.16	-0.18	0.21	-0.04
D-7	0.04	0.06	0.06	-0.04	-0.03	0.11	-0.08	0.15	-0.13	-0.11	-0.24
D-8	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[c]
E-7	0.02	0.08	0.04	-0.03	-0.05	-0.07	0.11[d]	0.06	-0.12[d]	0.09[d]	-0.13[d]
A-8	0.05	0.07	0.04	0.01	-0.11	0.01	0.03	0.16	-0.14	0.16	-0.06
B-8	0.07	0.04	0.04	-0.02	-0.09	0.12	0.00[b]	0.14	-0.15	0.19	-0.05
C-8	0.04	0.03	0.03	-0.02	-0.07	0.15	-0.07	[c]	[c]	[c]	[c]
E-8	0.02	0.07	0.03	0.00	-0.10	0.02	0.03	0.13	-0.13	0.09	-0.13

Table 2.2-4 Yearly Variations of Settlement Point Monitoring Data Measurements 2001 – 2011

Settlement Point No.	Elevation (feet amsl)										
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
A-9	-0.02	0.13	0.00	0.00	-0.13	0.00	0.07	0.16	-0.13	0.15	-0.06
B-9	1.15	0.13	-0.02	-0.01	-0.14	0.13	-0.02	0.19	-0.15	0.19	-0.05
C-9	-0.01	0.05	0.06	-0.03	-0.17	0.15	0.03	0.17	-0.17	0.20	-0.06
D-9	0.00	-0.23	0.03	0.02	-0.17	0.13	-0.01	-0.82	-0.15	0.06	-0.19
E-9	-0.02	0.31	-0.19	0.01	-0.15	-0.04	0.06	0.18	-0.16	0.09	-0.12
A-10	-0.11	0.11	0.00	0.01	-0.05	0.01	-0.01	0.19	-0.19	0.16	-0.07
B-10	-0.03	0.09	0.00	0.01	-0.01	[c]	[c]	[c]	[c]	[c]	[c]
C-10	0.00	0.09	0.00	-0.01	-0.02	0.13	-0.03	0.18	-0.18	0.18	-0.08
D-10	0.01	0.07	0.01	0.01	-0.01	0.11	-0.05	0.21	-0.15	0.07	-0.17
E-10	-0.11	0.10	0.01	0.04	-0.05	-0.11	0.06	0.21	-0.19	0.09	-0.13
A-11	-0.10	0.12	0.01	0.01	-0.02	-0.04	-0.01	0.19	-0.19	0.14	-0.08
B-11	-0.10	0.11	0.00	0.00	-0.02	0.08	-0.03	0.16	-0.18	0.16	-0.07
C-11	-0.09	0.10	-0.01	-0.03	-0.02	0.05	-0.03	0.19	[c]	[c]	[c]
D-11	-0.09	0.03	0.05	-0.01	-0.03	0.05	-0.07	0.17	-0.18	0.08	-0.10

Notes:

Table denotes differences in settlement measurements by comparing readings to the previous year.

[a] D-2 Monument broken (top elevation = 9995.29, broken piece = 2.21; reported elevation = 6657.50)

[b] Monument broken, shot taken at top of broken piece

[c] Destroyed – missing

[d] Damaged – loose and leaning

[e] C-4 broken; located at break

amsl – above mean sea level

Source: Letter from Strachan, C. MFG Consulting Scientists and Engineers to A. Cox, Homestake Mining Company Regarding *Homestake Grants Large Tailings Impoundment, Review of 2003 Settlement Monitoring Data.* December 22, 2003 [for 2000 – 2003 data]

Souder, Miller & Associates. Individual monitoring data sheets for years 2004 – 2010, 2010-2011

Table 2.2-5 Total Settlement Well Monitoring Data Measurements 2001 - 2011

Settlement Well No.	Elevation (feet amsl)										
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
X-1	10.89	11.00	10.95	10.91	11.12	11.05	11.02	11.11	10.95	10.90	10.57
B-1	0.40	0.49	0.45	0.47	0.48	0.54	0.42	0.55	0.39	0.56	0.46
C-1	0.47	0.57	0.52	0.54	0.57	0.63	0.54	0.67	0.51	0.50	0.23
D-1	0.44	0.49	0.44	0.46	0.49	0.49	0.36	0.53	0.37	0.39	0.13
A-2	0.36	0.43	0.41	0.45	0.46	0.32	0.37	0.53	0.36	0.55	0.45
B-2	2.13	2.22	2.16	2.20	2.21	2.27	2.25	2.36	2.22	2.38	2.26
C-2	3.29	3.36	3.3	3.36	3.32	3.37	3.37	3.53	3.33	3.30	3.00
D-2	1.67	1.75	1.71	1.76	1.69[a]	3.97	3.93	4.05	3.91	3.91	[c]
E-2	0.58	0.65	0.62	0.64	0.67	0.63	0.58	0.74	0.57	0.68	0.52
A-3	0.66	0.79	0.73	0.72	0.77	2.64[b]	2.70[b]	2.84[b]	0.70	0.85	0.75
C-3	6.88	6.98	6.95	6.91	7.11	7.04	7.04	7.14	7.00	6.95	6.62
D-3	2.46	2.59	2.54	2.51	2.57	2.69	2.64	2.73	2.66	2.63	2.41
E-3	-0.17	-0.06	0.0?	-0.11	-0.06	-0.12	-0.17	-0.06	-0.18	-0.11	-0.03
A-4	0.45	0.59	0.65	0.67	0.76	0.49	0.67	0.77	0.67	0.85	0.78
B-3	4.00	4.12	4.09	4.09	4.14	4.23	[c]	[c]	[c]	[c]	[c]
B-4	2.29	2.43	2.42	2.38	2.45	2.41	2.40	2.47	2.36	2.48	2.34
C-4	4.64	4.81	4.77	4.64	4.80	4.73	4.74	4.88	4.74	4.74	2.44[e]
D-4	1.60	1.75	1.7	1.57	1.72	1.70	1.68	1.79	1.70	1.71	1.48
E-4	0.36	0.54	0.52	0.40	0.59	0.46	0.53	0.66	0.54	0.64	0.50
A-5	0.48	0.64	0.64	0.51	0.55	0.47	0.51	0.63	0.49	0.65	0.59
B-5	1.44	1.55	1.61	1.65	1.57	1.69	1.65	1.75	1.62	1.18	1.06
C-5	3.33	3.42	3.45	3.43	3.36	3.53	2.49	3.56	3.43	3.59	3.53
D-5	1.51	1.59	1.6	1.41	1.54	1.63	1.58	1.68	1.60	1.62	1.39
E-5	0.27	0.36	0.37	0.34	0.36	0.23	0.27	0.40	0.31	0.41	0.37
A-6	0.12	0.26	0.23	0.13	0.17	0.11	0.17	0.26	0.17	0.31	0.25
B-6	0.59	0.74	0.70	0.61	0.65	0.73	0.70	0.81	0.71	0.87	0.80
C-6	1.31	1.45	1.37	1.43	1.31	1.36	1.41	1.52	1.41	1.58	1.51
D-6	0.12	0.26	0.23	0.27	0.17	0.26	0.23	0.35	0.26	0.29	0.06
E-6	0.10	0.20	0.19	0.21	0.14	-0.05	0.12	0.21	0.12	0.21	0.09
A-7	0.10	0.19	0.19	0.18	0.13	0.15	0.14	0.27	0.13	0.37	0.40
B-7	1.29	1.38	1.41	1.44	1.36	1.46	1.41	1.55	1.42	1.65	1.66
C-7	5.46	5.55	5.59	5.54	5.82	5.62	5.58	5.74	5.56	5.77	5.73
D-7	2.06	2.12	2.18	2.14	2.11	2.22	2.14	2.29	2.16	2.05	1.81
D-8	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[c]	[c]
E-7	0.14	0.22	0.26	0.23	0.18	0.11	0.22	0.28	0.16[d]	0.25[d]	0.12[d]
A-8	0.12	0.19	0.23	0.24	0.13	0.14	0.19	0.35	0.21	0.37	0.31
B-8	2.71	2.75	2.79	2.77	2.68	2.80	2.80[b]	2.94	1.79	2.98	2.93
C-8	3.47	3.50	3.53	3.51	3.44	3.59	3.52	[c]	[c]	[c]	[c]
E-8	0.08	0.15	0.18	0.18	0.08	0.10	0.13	0.26	0.13	0.22	0.35

Table 2.2-5 Total Settlement Well Monitoring Data Measurements 2001 - 2011

Settlement Well No.	Elevation (feet amsl)										
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
A-9	0.03	0.16	0.16	0.16	0.03	0.03	0.10	0.26	0.13	0.28	0.22
B-9	2.85	2.98	2.96	2.40	2.81	2.94	2.92	3.11	2.96	3.15	3.10
C-9	3.19	3.24	3.30	3.17	3.10	3.25	3.28	3.45	3.28	2.43	2.37
D-9	1.42	-0.81	1.57	1.59	1.42	1.55	1.54	1.72	1.57	1.63	1.44
E-9	0.08	0.39	0.20	0.21	0.06	0.02	0.08	0.26	0.10	0.19	0.07
A-10	-0.25	-0.14	-0.14	-0.13	-0.18	-0.17	0.18	0.01	-0.18	-0.02	-0.05
B-10	1.64	1.73	1.73	1.72	1.75	[c]	[c]	[c]	[c]	[c]	[c]
C-10	2.42	2.51	2.51	2.50	2.48	2.61	2.58	2.76	2.58	2.76	2.68
D-10	1.76	1.83	1.84	1.85	1.84	1.95	1.90	2.11	1.96	2.03	1.86
E-10	0.03	0.13	0.14	0.18	0.13	0.02	0.08	0.29	0.10	0.19	0.06
A-11	-0.10	0.02	0.03	0.04	0.02	-0.02	-0.03	0.16	-0.03	0.11	0.03
B-11	-0.11	0.00	0.00	0.00	-0.02	0.06	0.03	0.19	0.01	0.17	0.10
C-11	0.11	0.21	0.20	0.18	0.16	0.21	0.18	0.37	[c]	[c]	[c]
D-11	-0.06	-0.03	0.03	0.01	-0.02	0.03	-0.04	0.13	-0.05	0.03	-0.07

Notes:

[a] D-2 Monument broken (top elevation = 9995.29, broken piece = 2.21; reported elevation = 6657.50)

[b] Monument broken, shot taken at top of broken piece

[c] Destroyed – missing

[d] Damaged – loose and leaning

[e] C-4 broken; located at break

Source: Letter from Strachan, C. MFG Consulting Scientists and Engineers to A. Cox, Homestake Mining Company Regarding *Homestake Grants Large Tailings Impoundment, Review of 2003 Settlement Monitoring Data.* December 22, 2003 [for 2000 – 2003 data]

Souder, Miller & Associates. Individual monitoring data sheets for years 2004 – 2010.

amsl – above mean sea level

Table 3.2-1 Cibola County, New Mexico U.S. Census Bureau Statistics

Units	Cibola County	New Mexico	Date
Population, 2011 Estimate	27,658	2,082,224	2011
Population, 2010 (April) estimates base	27,213	2,059,180	2011
Population, percent change, April 1, 2010 to July 1, 2011	1.6%	1.1%	2011
Persons under 5 years old, percent	7.1%	7.0%	2011
Persons under 18 years old, percent	24.8%	24.9%	2011
Persons 65 years old and over, percent	13.1%	13.6%	2011
Male persons, percent	50.8%	49.5%	2011
Female persons, percent	49.2%	50.5%	2011
White persons, percent	54.8%	83.4%	2011
Black persons, percent	1.3%	2.5%	2011
American Indian and Alaska Native persons, percent	41.0%	10.1%	2011
Asian persons, percent	0.6%	1.6%	2011
Native Hawaiian and Other Pacific Islander, percent	0.1%	0.2%	2011
Persons reporting two or more races, percent	2.1%	2.3%	2011
Persons of Hispanic or Latino origin, percent	37.6%	46.7%	2011
White persons not Hispanic, percent	21.5%	40.2%	2011
Housing Units	11,148	908,132	2011
Homeownership, percent (2006 – 2010)	68.3%	69.6%	2010
Housing units in multi-unit structures, percent (2006 – 2010)	8.0%	15.1%	2010
Median value of owner-occupied housing units (2006 – 2010)	$74,800	$158,400	2010
Households (2006 – 2010)	8,089	756,112	2010
Persons per Household (2006 – 2010)	3.11	2.61	2010
Median household income (2006 – 2010)	$37,361	$43,820	2010
Persons below poverty level, percent (2006 – 2010)	24.0%	18.4%	2010
Private nonfarm establishments	340	44,221[b]	2010
Private nonfarm employment	5,796	600,165[b]	2010
Private nonfarm employment, percent change 2000 - 2009	-3.6%	9.2%[b]	2010
Non-employer establishments	1,025	120,470	2010
Total number of firms	1,513	157,231	2007
Black-owned firms, percent	<100	1.2%	2007
American Indian and Alaska Native owned firms, percent	14.4%	5.3%	2007
Asian-owned firms, percent	1.7	2.1%	2007
Native Hawaiian and Other Pacific Islander owned firms, percent	<100	0.1%	2007
Hispanic-owned firms, percent	22.1	23.6%	2007
Women-owned firms, percent	26.6%	31.7%	2007
Building permits	0	4,067[b]	2011
Federal spending	302,251	23,958,984[b]	2010
Retail sales ($1000)	217,448	24,469,997	2007
Retail sales per capita	$7,992	$12,429	2007
Merchant wholesale trade sales ($1000)	15,859	10,589,286	2007
Manufacturer's shipments ($1000)	0[a]	17,122,725	2007
Accommodation and food services sales ($1000)	117,318	3,734,300	2007
Building Permits	0	4,067	2011

Note:
[a] Counties with 500 employees or less are excluded.
[b] Includes data not distributed by county.
Source: USCB 2012a

Table 3.2-2 City of Grants Government Employment and Payroll (March 2007)

Function	Full-Time Employees	Monthly Full-Time Payroll	Average Yearly Full-Time Wage	Part-Time Employees	Monthly Part-Time Payroll
Financial Administration	6	$13,485	$26,970	0	$0
Other Government Administration	13	$28,065	$25,906	0	$0
Judicial and Legal	3	$4,970	$19,880	0	$0
Police Protection - Officers	19	$49,259	$31,111	0	$0
Police - Other	2	$3,662	$21,972	0	$0
Firefighters	9	$28,868	$38,491	0	$0
Streets and Highways	8	$14,907	$22,361	0	$0
Airports	1	$1,840	$22,080	0	$0
Welfare	15	$20,480	$16,384	0	$0
Parks and Recreation	4	$7,399	$22,197	23	$6,042
Water Supply	6	$12,219	$24,438	0	$0
Local Libraries	4	$7,663	$22,989	0	$0
Other and Unallocable	10	$20,668	$24,802	0	$0
Totals for Government	100	$213,485	$25,618	23	$6,042

Source: City-Data 2011b

Table 3.2-3 Village of Milan Government Employment and Payroll (March 2007)

Function	Full-Time Employees	Monthly Full-Time Payroll	Average Yearly Full-Time Wage	Part-Time Employees	Monthly Part-Time Payroll
Financial Administration	6	$11,861	$23,722	0	$0
Other Government Administration	7	$8,250	$14,143	0	$0
Judicial and Legal	0	$0	--	2	$1,929
Police Protection - Officers	8	$19,883	$29,825	0	$0
Police - Other	6	$9,466	$18,932	1	$840
Firefighters	0	$0	--	1	$819
Fire - other	0	$0	--	23	$1,058
Streets and Highways	2	$4,116	$24,696	0	$0
Parks and Recreation	11	$18,216	$19,872	7	$4,708
Water Supply	6	$10,780	$21,560	0	$0
Other and Unallocable	3	$4,873	$19,492	1	$1,591
Totals for Government	49	$87,445	$21,415	35	$10,945

Source: City-Data 2011c

Table 3.5-1 Homestake Grants Site Meteorological Station Equipment

Parameter	Meteorological Equipment	Serial Number
Wind Direction	RM Young Model 05305	88027
Wind Speed	RM Young Model 05305	88027
Temperature	Vaisala Model HMP45AC	C5110079
Precipitation	Weathertronics Model 6011	374
Relative Humidity	Vaisala Model HMP45AC	C5110079
Barometric Pressure	Vaisala Model PTB110	D2430004
Solar Radiation	LiCor 200X	PY31168

Table 3.5-2 Average Monthly Maximum and Minimum Temperatures for Regional NWS Sites

Month		Grants, NM* °F (°C)	Bluewater, NM** °F (°C)	San Mateo, NM*** °F (°C)
Period of Record		5/1/1953 to 9/30/2012	5/1/1896 to 11/30/1959	4/1/1918 to 2/29/1988
January	Max	46.4 (8.0)	44.6 (7.0)	40.6 (4.8)
	Min	14.3 (-9.8)	10.8 (-11.8)	15.4 (-9.2)
February	Max	51.6 (10.9)	48.8 (9.3)	44.6 (7.0)
	Min	18.6 (-7.4)	15.1 (-9.4)	19.1 (-7.2)
March	Max	58.8 (14.8)	56.2 (13.4)	51.6 (10.9)
	Min	23.8 (-4.5)	20.3 (-6.5)	25.2 (-3.8)
April	Max	67.6 (19.8)	66.1 (18.9)	60.9 (16.1)
	Min	30.3 (-0.9)	27.7 (-2.4)	30.7 (-0.7)
May	Max	76.7 (24.8)	74.7 (23.7)	70.6 (21.4)
	Min	39.1 (3.9)	34.8 (1.6)	40.4 (4.7)
June	Max	86.9 (30.5)	85.2 (29.6)	81.1 (27.3)
	Min	47.7 (8.7)	43.8 (6.6)	50.0 (10.0)
July	Max	88.7 (31.5)	86.6 (30.3)	83.1 (28.4)
	Min	55.3 (12.9)	51.1 (10.6)	55.3 (12.9)
August	Max	85.7 (29.8)	83.9 (28.8)	79.6 (26.4)
	Min	53.2 (11.8)	49.3 (9.6)	53.3 (11.8)
September	Max	80.1 (26.7)	78.9 (26.1)	73.2 (22.9)
	Min	44.7 (7.1)	40.6 (4.8)	46.3 (7.9)
October	Max	69.9 (21.0)	68.5 (20.3)	62.9 (17.2)
	Min	32.7 (0.4)	29.1 (-1.6)	35.9 (2.2)
November	Max	56.9 (13.8)	56.3 (13.5)	50.9 (10.5)
	Min	22.0 (-5.6)	16.6 (-8.6)	25.3 (-3.7)
December	Max	47.4 (8.6)	46.4 (8.0)	41.4 (5.2)
	Min	14.5 (-9.7)	11.2 (-11.6)	17.0 (-8.3)
Average Annual	Max	68.1 (20.0)	66.4 (19.1)	61.7 (16.5)
	Min	33.0 (0.6)	29.2 (-1.6)	35.5 (1.9)

* Grants Airport Station – WRCC 2013a
** Bluewater 3 WSW Station – WRCC 2013b
*** San Mateo Station - WRCC 2013c

Table 3.5-3 Summary of Temperature Data and the Total Measured Precipitation for HMC On-site MET Station, February 4, 2009 through February 3, 2011

Time Period	Temperature (°C)				Precipitation (inches)
	Average	σ	Minimum	Maximum	
Jan - Mar	1.0	7.6	-30.1	23.2	9.8
Apr - Jun	14.7	7.9	-9.1	33.3	5.1
Jul - Sep	20.1	6.5	0.1	34.3	4.3
Oct - Dec	4.2	8.7	-20.2	27.3	1.0
All	9.3	10.8	-30.1	34.3	20.3

Notes:
°C = degrees Celsius
HMC = Homestake Mining Company

Table 3.5-4 Average Monthly Precipitation for Regional NWS Sites

Month	Grants, NM* inches (cm)	Bluewater, NM** inches (cm)	San Mateo, NM*** inches (cm)
Period of Record	**5/1/1953 to 9/30/2012**	**5/1/1896 to 11/30/1956**	**4/1/1918 to 2/29/1988**
January	0.50 (1.27)	0.37 (0.94)	0.39 (0.99)
February	0.43 (1.09)	0.45 (1.14)	0.29 (0.74)
March	0.52 (1.32)	0.37 (0.94)	0.37 (0.76)
April	0.45 (1.14)	0.43 (1.09)	0.30 (0.76)
May	0.51 (1.29)	0.57 (1.45)	0.49 (1.24)
June	0.56 (1.42)	0.56 (1.42)	0.52 (1.32)
July	1.72 (4.37)	1.85 (4.70)	1.68 (4.27)
August	2.01 (5.10)	2.26 (5.74)	2.16 (5.49)
September	1.29 (3.27)	1.30 (3.30)	1.11 (2.82)
October	1.09 (2.77)	0.65 (1.65)	0.74 (1.88)
November	0.55 (1.39)	0.39 (0.99)	0.45 (1.14)
December	0.67 (1.70)	0.38 (0.97)	0.35 (0.89)
Average Annual Total	10.29 (26.14)	9.58 (24.33)	8.84 (22.45)
Average Annual Snowfall	12.3 (31.2)	15.6 (39.62)	11.8 (29.97)

Notes:

* Grants Airport Station – WRCC 2013a

** Bluewater 3 WSW Station – WRCC 2013b

*** San Mateo Station - WRCC 2013c

Table 3.5-5 Summary of Relative Humidity Data for HMC Onsite MET Station February 4, 2009 through December 31, 2012

Time Period	Relative Humidity (%)			
	Average	σ	Minimum	Maximum
Jan - Mar	51.6	24.9	4.4	97.4
Apr - Jun	31.5	21.7	3.8	97.0
Jul - Sep	45.2	23.0	6.4	96.9
Oct - Dec	62.6	22.0	6.5	96.8
All	43.8	25.0	3.8	97.4

Table 3.5-6 Summary of Barometric Pressure Data for HMC Onsite MET Station February 4, 2009 through December 31, 2012

Time Period	Barometric Pressure (in. Hg)			
	Average	σ	Minimum	Maximum
Jan - Mar	23.6	0.2	23.0	24.1
Apr - Jun	23.6	0.1	23.1	23.9
Jul - Sep	23.7	0.1	23.1	24.0
Oct - Dec	23.6	0.2	22.9	23.9
All	23.6	0.1	22.9	24.1

Table 3.5-7 Summary of Solar Radiation Data for HMC Site's Onsite MET Station February 4, 2009 through December 31, 2012

Time Period	Solar Radiation (W/m^2)			
	Average	σ	Minimum	Maximum
Jan - Mar	193.9	275.0	0.0	1019.0
Apr - Jun	315.2	372.3	0.0	1146.0
Jul - Sep	215.7	293.9	0.0	1100.0
Oct - Dec	127.9	194.9	0.0	665.0
All	240.0	320.7	0.0	1146.0

Table 3.5-8 Frequency Distribution of Hourly Measurements for Wind Speed and Direction for HMC MET Station (January 1, 2009 through December 31, 2012)

Directions/Wind Classes (m/s)	0.5 - 2.1	2.1 - 3.6	3.6 - 5.7	5.7 - 8.8	8.8 - 11.1	>= 11.1	Total
348.75 - 11.25	0.02544	0.01759	0.01768	0.00461	0.00039	0.00003	0.06306
11.25 - 33.75	0.03544	0.01482	0.01321	0.00211	0.00009	0	0.063
33.75 - 56.25	0.06363	0.01202	0.00426	0.00071	0	0	0.07733
56.25 - 78.75	0.06895	0.01402	0.00143	0.00009	0.00006	0	0.0811
78.75 - 101.25	0.04652	0.00792	0.00089	0.0003	0.00003	0	0.05338
101.25 - 123.75	0.02422	0.00247	0.00098	0.00024	0.00009	0	0.02686
123.75 - 146.25	0.01506	0.00482	0.00646	0.00801	0.00155	0.00042	0.03483
146.25 - 168.75	0.01339	0.01399	0.02643	0.01827	0.00259	0.00036	0.07196
168.75 - 191.25	0.01295	0.01539	0.01658	0.00664	0.00101	0.0006	0.05098
191.25 - 213.75	0.01098	0.00798	0.00616	0.00446	0.00119	0.00089	0.03037
213.75 - 236.25	0.01235	0.00673	0.00771	0.00827	0.00289	0.00208	0.03839
236.25 - 258.75	0.01289	0.00592	0.01137	0.01595	0.00655	0.00345	0.05384
258.75 - 281.25	0.01542	0.00982	0.02045	0.02339	0.00437	0.00205	0.07242
281.25 - 303.75	0.0194	0.01051	0.01101	0.00952	0.00268	0.00086	0.05178
303.75 - 326.25	0.02155	0.01387	0.01467	0.01009	0.00196	0.00045	0.06003
326.25 - 348.75	0.01946	0.01458	0.01616	0.01056	0.00149	0.00024	0.05995
Sub-Total	**0.40061**	**0.16539**	**0.16827**	**0.11821**	**0.02583**	**0.01096**	**0.88927**
Calms							**0.06991**
Missing/Incomplete							**0.04082**
Total							**1**

Table 3.5-9 Frequency Distribution of Hourly Measurements for Wind Speed and Direction for HMC MET Station (January through March from January 1, 2009 through December 31, 2012)

Directions / Wind Classes (m/s)	0.5 - 2.1	2.1 - 3.6	3.6 - 5.7	5.7 - 8.8	8.8 - 11.1	>= 11.1	Total
348.75 - 11.25	0.02652	0.02199	0.02734	0.00745	0.00081	0.00012	0.07221
11.25 - 33.75	0.03374	0.02094	0.02117	0.0043	0.00012	0	0.06882
33.75 - 56.25	0.06782	0.01221	0.005	0.0007	0	0	0.07351
56.25 - 78.75	0.07038	0.01105	0.00023	0	0	0	0.07002
78.75 - 101.25	0.04886	0.00628	0	0	0	0	0.04728
101.25 - 123.75	0.02873	0.00174	0.00023	0.00012	0	0	0.02643
123.75 - 146.25	0.01675	0.00302	0.00244	0.00337	0.00058	0	0.02244
146.25 - 168.75	0.01128	0.00849	0.01989	0.0128	0.0014	0.00081	0.04688
168.75 - 191.25	0.0114	0.00942	0.01105	0.00733	0.00023	0.00093	0.03461
191.25 - 213.75	0.00977	0.00558	0.00605	0.0043	0.00093	0.00116	0.02384
213.75 - 236.25	0.01187	0.00535	0.00651	0.00721	0.00256	0.00326	0.03152
236.25 - 258.75	0.01245	0.00419	0.0107	0.01373	0.0071	0.00279	0.04369
258.75 - 281.25	0.01489	0.00954	0.01652	0.02187	0.00582	0.00268	0.06114
281.25 - 303.75	0.0185	0.01012	0.01024	0.00849	0.00407	0.00116	0.04508
303.75 - 326.25	0.01943	0.01338	0.01757	0.01233	0.00349	0.00035	0.05705
326.25 - 348.75	0.01792	0.01594	0.0242	0.01768	0.00279	0.00023	0.06752
Sub-Total	**0.36036**	**0.13654**	**0.1536**	**0.10433**	**0.02563**	**0.01157**	**0.79204**
Calms							**0.06533**
Missing/Incomplete							**0.14263**
Total							**1**

Table 3.5-10 Frequency Distribution of Hourly Measurements for Wind Speed and Direction for HMC MET Station (April through June from January 1, 2009 through December 31, 2012)

Directions / Wind Classes (m/s)	0.5 - 2.1	2.1 - 3.6	3.6 - 5.7	5.7 - 8.8	8.8 - 11.1	>= 11.1	Total
348.75 - 11.25	0.02085	0.0118	0.00894	0.00309	0.00023	0	0.03859
11.25 - 33.75	0.02498	0.00882	0.00607	0.00103	0	0	0.03515
33.75 - 56.25	0.04767	0.01089	0.00229	0.00057	0	0	0.05277
56.25 - 78.75	0.05042	0.02154	0.00218	0	0.00023	0	0.0639
78.75 - 101.25	0.03426	0.01111	0.00115	0.00034	0.00011	0	0.04037
101.25 - 123.75	0.01547	0.00149	0.00149	0.00057	0.00023	0	0.01654
123.75 - 146.25	0.01238	0.00516	0.00733	0.01226	0.00332	0.00069	0.03535
146.25 - 168.75	0.01238	0.01169	0.02487	0.02177	0.00539	0.00023	0.06557
168.75 - 191.25	0.01008	0.01306	0.01558	0.00963	0.00275	0.00138	0.04509
191.25 - 213.75	0.00928	0.00779	0.00779	0.00882	0.00321	0.00218	0.03357
213.75 - 236.25	0.01077	0.00917	0.01329	0.01604	0.00596	0.00435	0.0512
236.25 - 258.75	0.00997	0.00814	0.01994	0.03323	0.01513	0.00905	0.08201
258.75 - 281.25	0.01352	0.01157	0.03564	0.04641	0.00905	0.00424	0.10348
281.25 - 303.75	0.01662	0.01283	0.01581	0.01696	0.00573	0.00183	0.05996
303.75 - 326.25	0.01719	0.01421	0.01742	0.01054	0.00218	0.00138	0.05405
326.25 - 348.75	0.01421	0.01398	0.01249	0.00756	0.00195	0.00069	0.04371
Sub-Total	**0.27498**	**0.14886**	**0.16521**	**0.16225**	**0.04765**	**0.02235**	**0.82131**
Calms							**0.0379**
Missing/Incomplete							**0.14079**
Total							**1**

Table 3.5-11 Frequency Distribution of Hourly Measurements for Wind Speed and Direction for HMC MET Station (July through September January 1, 2009 through December 31, 2012

Directions / Wind Classes (m/s)	0.5 - 2.1	2.1 - 3.6	3.6 - 5.7	5.7 - 8.8	8.8 - 11.1	>= 11.1	Total
348.75 - 11.25	0.02752	0.01866	0.01275	0.00121	0.00013	0	0.05056
11.25 - 33.75	0.03651	0.01356	0.00698	0.00094	0.00027	0	0.04887
33.75 - 56.25	0.05383	0.01154	0.00456	0.00094	0	0	0.05946
56.25 - 78.75	0.05785	0.01329	0.00322	0.0004	0	0	0.06273
78.75 - 101.25	0.04242	0.00913	0.00242	0.00094	0	0	0.04606
101.25 - 123.75	0.02685	0.00483	0.00201	0.00027	0.00013	0	0.0286
123.75 - 146.25	0.01826	0.00953	0.01383	0.01463	0.00188	0.00027	0.04899
146.25 - 168.75	0.01933	0.02698	0.04483	0.02282	0.00134	0.00027	0.09696
168.75 - 191.25	0.02121	0.02752	0.02416	0.00416	0.00027	0	0.06486
191.25 - 213.75	0.01651	0.01195	0.00617	0.00188	0.00013	0	0.03074
213.75 - 236.25	0.01799	0.00752	0.0051	0.00376	0.00054	0.00027	0.0295
236.25 - 258.75	0.01973	0.00685	0.00483	0.00537	0.00054	0.00081	0.03198
258.75 - 281.25	0.02134	0.00899	0.01114	0.00658	0.00027	0	0.04054
281.25 - 303.75	0.02336	0.0106	0.00886	0.00295	0.00027	0	0.03863
303.75 - 326.25	0.02913	0.01799	0.01034	0.00537	0.00027	0	0.05293
326.25 - 348.75	0.02564	0.01544	0.01235	0.00497	0.00027	0	0.04921
Sub-Total	**0.38378**	**0.17984**	**0.14561**	**0.06475**	**0.00529**	**0.00135**	**0.78063**
Calms							**0.05833**
Missing/Incomplete							**0.16104**
Total							**1**

Table 3.5-12 Frequency Distribution of Hourly Measurements for Wind Speed and Direction for HMC MET Station (October through December from January 1, 2009 through December 31, 2012)

Directions / Wind Classes (m/s)	0.5 - 2.1	2.1 - 3.6	3.6 - 5.7	5.7 - 8.8	8.8 - 11.1	>= 11.1	Total
348.75 - 11.25	0.02718	0.01812	0.02107	0.00623	0.00034	0	0.06277
11.25 - 33.75	0.04655	0.01586	0.01778	0.00204	0	0	0.07077
33.75 - 56.25	0.08359	0.01337	0.00521	0.00068	0	0	0.08851
56.25 - 78.75	0.09525	0.01008	0.00034	0	0	0	0.09094
78.75 - 101.25	0.0598	0.00532	0.00023	0	0	0	0.05624
101.25 - 123.75	0.02628	0.00215	0.00034	0	0	0	0.02476
123.75 - 146.25	0.01337	0.00227	0.00328	0.00272	0.00045	0.00068	0.01959
146.25 - 168.75	0.01144	0.01065	0.0188	0.01631	0.00204	0.00011	0.05108
168.75 - 191.25	0.01031	0.01325	0.01654	0.0051	0.00068	0	0.03948
191.25 - 213.75	0.00917	0.00714	0.00464	0.00249	0.00034	0.00011	0.02057
213.75 - 236.25	0.00963	0.00498	0.00555	0.00544	0.00215	0.00023	0.02408
236.25 - 258.75	0.01042	0.00464	0.00906	0.00997	0.00261	0.00079	0.03226
258.75 - 281.25	0.0128	0.00906	0.0171	0.01631	0.00181	0.00102	0.05
281.25 - 303.75	0.01971	0.00849	0.00883	0.00872	0.00034	0.00034	0.03996
303.75 - 326.25	0.02152	0.01053	0.0128	0.01144	0.0017	0	0.04991
326.25 - 348.75	0.02095	0.01314	0.01518	0.01133	0.00079	0	0.05283
Sub-Total	**0.41135**	**0.12828**	**0.13491**	**0.085**	**0.0114**	**0.00283**	**0.77376**
Calms							**0.08685**
Missing/Incomplete							**0.13939**
Total							**1**

Table 3.6-1 Seismic Activities within 200 Miles of the HMC Grants Reclamation Project Since 1973

Date	Time	Magnitude	Focus Depth km (miles)	Latitude (°N)	Longitude (°W)	Distance* miles (km)	Direction from Site	Associated Fault**
February 9, 1973	17:38:37	3.2	5 (3.1)	36.43	-110.425	170 (274)	NW	Unknown
March 17, 1973	07:43:06	4.5	6 (3.7)	36.087	-106.168	110 (177)	NE	Embudo
September 22, 1973	23:38:36	3.1	5 (3.1)	34.465	-106.952	80 (129)	SE	Unnamed Intrabasin
December 24, 1973	02:20:15	4.1	18 (11.2)	35.258	-107.739	7 (11)	E	Unknown
December 3, 1975	10:12:23	3.9	27 (16.8)	32.83	-108.663	170 (274)	SSE	Mockingbird Hill
January 5, 1976	06:23:33	4.6	25 (15.5)	35.844	-108.341	60 (97)	NW	Unknown
March 5, 1977	03:00:55	4.2	22 (13.7)	35.915	-108.286	60 (97)	NW	Unknown
March 22, 1980	00:49:13	3.4	5 (3.1)	34.595	-105.915	120 (193)	ESE	Unknown
September 11, 1980	17:34:38	3.1	5 (3.1)	36.459	-105.187	170 (274)	NE	Unknown
May 9, 1981	12:35:51	3.1	5 (3.1)	33.994	-107.03	100 (161)	SE	La Jencia
September 20, 1982	03:55:17	3.5	11 (6.8)	33.95	-107.056	95 (153)	SE	La Jencia
November 3, 1982	17:54:06	3.0	5 (3.1)	35.187	-109.012	70 (113)	W	Unknown
March 2, 1983	23:22:19	4.3	8 (5.0)	34.302	-106.892	85 (137)	SE	Cliff
April 30, 1983	07:34:20	3.5	7 (4.3)	33.316	-106.438	155 (249)	SE	San Andres Mountains
September 15, 1983	23:25:36	3.2	5 (3.1)	35.142	-104.388	200 (320)	E	Unknown
April 14, 1985	21:48:00	3.3	5 (3.1)	35.174	-109.071	70 (113)	W	Unknown
June 27, 1985	18:20:00	3.4	0 (0)	33.621	-106.475	135 (217)	SE	San Andres Mountains
August 16, 1985	14:56:53	4.1	7 (4.3)	34.13	-106.832	100 (161)	SE	West Joyita
December 15, 1985	07:14:52	3.6	5 (3.1)	35.281	-104.635	180 (290)	E	Unknown
August 27, 1986	18:06:56	3.2	5 (3.1)	35.16	-105.094	155 (249)	E	Unknown
January 15, 1988	07:33:29	3.1	5 (3.1)	37.515	-106.684	170 (274)	NNE	Unknown
July 15, 1988	00:38:10	3.3	5 (3.1)	36.374	-110.448	170 (274)	NW	Unknown
April 18, 1989	10:45:48	3.5	5 (3.1)	34.669	-110.925	180 (290)	WSW	Unknown
July 17, 1989	20:10:22	3.0	5 (3.1)	34.038	-110.946	195 (314)	WSW	Unknown
October 14, 1989	08:05:15	3.4	5 (3.1)	34.361	-108.212	60 (97)	SSW	Hickman
November 19, 1989	03:21:14	3.0	5 (3.1)	38.055	-107.767	195 (314)	N	Ridgeway
November 29, 1989	06:54:39	4.7	13 (8.1)	34.455	-106.891	80 (129)	SE	Unnamed Intrabasin
January 29, 1990	13:16:11	4.8	12 (7.5)	34.463	-106.879	80 (129)	SE	Unnamed Intrabasin
January 31, 1990	01:08:19	4.0	10 (6.2)	34.445	-106.86	80 (129)	SE	Unnamed Intrabasin
February 21, 1990	12:02:19	3.6	5 (3.1)	34.014	-106.544	115 (185)	SE	Unknown
February 27, 1990	13:23:22	3.9	5 (3.1)	33.953	-106.588	110 (177)	SE	Unknown
May 5, 1990	16:26:23	3.6	6 (3.7)	34.449	-106.878	80 (129)	SE	Unnamed Intrabasin
July 21, 1990	19:28:23	3.0	7 (4.3)	34.458	-106.858	80 (129)	SE	Unnamed Intrabasin
July 21, 1990	20:30:31	3.1	7 (4.3)	34.455	-106.856	80 (129)	SE	Unnamed

Table 3.6-1 Seismic Activities within 200 Miles of the HMC Grants Reclamation Project Since 1973

Date	Time	Magnitude	Focus Depth km (miles)	Latitude (°N)	Longitude (°W)	Distance* miles (km)	Direction from Site	Associated Fault**
								Intrabasin
July 21, 1990	23:48:05	3.2	11 (6.8)	34.453	-106.854	80 (129)	SE	Unnamed Intrabasin
July 22, 1990	21:27:05	3.7	10 (6.2)	34.838	-106.006	110 (177)	ESE	Unknown
July 31, 1990	07:32:40	3.3	7 (4.3)	34.456	-106.862	80 (129)	SE	Unnamed Intrabasin
November 8, 1990	10:46:54	4.3	6 (3.7)	34.449	-106.856	80 (129)	SE	Unnamed Intrabasin
November 8, 1990	11:03:47	3.1	8 (5.0)	34.453	-106.861	80 (129)	SE	Unnamed Intrabasin
November 10, 1990	12:18:17	3.1	7 (4.3)	34.45	-106.851	80 (129)	SE	Unnamed Intrabasin
November 15, 1990	07:25:24	3.6	6 (3.7)	34.457	-106.859	80 (129)	SE	Unnamed Intrabasin
May 10, 1991	12:15:54	3.4	5 (3.1)	37.459	-106.578	170 (274)	NNE	Unknown
June 5, 1991	18:44:15	3.0	4 (2.5)	34.447	-106.849	80 (129)	SE	Unnamed Intrabasin
June 20, 1991	00:16:05	3.5	0 (0)	33.619	-106.475	135 (217)	SE	San Andres Mountains
June 25, 1991	21:02:14	3.0	1 (0.6)	37.209	-110.358	195 (314)	NW	Unknown
December 9, 1991	12:47:17	3.1	14 (8.7)	34.85	-106.553	110 (177)	ESE	Unknown
June 10, 1993	00:15:10	3.2	0 (0)	33.619	-106.475	135 (217)	SE	San Andres Mountains
December 22, 1993	19:25:11	3.2	10 (6.2)	33.331	-105.682	180 (290)	SE	Unknown
July 4, 1995	03:59:05	3.8	5 (3.1)	36.246	-104.814	185 (298)	ENE	Unknown
March 24, 1996	20:16:13	3.5	10 (6.2)	34.255	-105.681	140 (225)	SE	Unknown
March 24, 1996	20:19:23	3.7	10 (6.2)	34.27	-105.689	140 (225)	SE	Unknown
July 22, 1996	10:06:15	3.5	10 (6.2)	34.204	-105.711	140 (225)	SE	Unknown
May 20, 1997	09:41:06	3.2	10 (6.2)	34.188	-105.742	145 (233)	SE	Unknown
December 31, 1997	13:28:30	3.5	5 (3.1)	34.533	-106.154	110 (177)	ESE	Unknown
December 31, 1997	13:32:07	3.5	5 (3.1)	34.55	-106.15	110 (177)	ESE	Unknown
December 31, 1997	13:33:59	3.4	5 (3.1)	34.55	-106.15	110 (177)	ESE	Unknown
January 4, 1998	08:05:32	4.0	5 (3.1)	34.553	-106.191	110 (177)	ESE	Unknown
January 6, 1998	08:36:47	3.9	5 (3.1)	34.916	-110.495	150 (241)	WSW	Unknown
October 18, 1998	07:13:11	3.4	5 (3.1)	36.033	-111.091	195 (314)	WNW	Unknown
April 28, 2000	07:32:26	3.6	5 (3.1)	36.844	-104.923	195 (314)	NE	Unknown
September 13, 2003	15:22:41	3.8	5 (3.1)	36.831	-104.907	195 (314)	NE	Unknown
May 24, 2004	21:36:29	3.5	5 (3.1)	34.465	-106.899	80 (129)	SE	Unnamed Intrabasin
August 1, 2004	06:50:48	4.3	5 (3.1)	36.874	-105.104	195 (314)	NE	Unknown
November 14, 2004	21:27:50	3.5	5 (3.1)	33.253	-106.201	165 (266)	SE	Almogordo
November 24, 2004	N/A	3.0	5 (3.1)	35.105	-107.51	20 (32)	SE	Unknown
January 28, 2005	22:37:08	3.8	5 (3.1)	34.709	-110.998	180 (290)	WSW	Unknown

Table 3.6-1 Seismic Activities within 200 Miles of the HMC Grants Reclamation Project Since 1973

Date	Time	Magnitude	Focus Depth km (miles)	Latitude (°N)	Longitude (°W)	Distance* miles (km)	Direction from Site	Associated Fault**
January 30, 2005	11:37:51	4.0	5 (3.1)	34.766	-111.079	180 (290)	WSW	Unknown
February 8, 2005	09:41:50	3.6	5 (3.1)	34.689	-111.012	180 (290)	WSW	Unknown
March 2, 2005	11:12:57	5.1	5 (3.1)	34.715	-110.97	180 (290)	WSW	Unknown
April 24, 2005	11:02:36	3.4	5 (3.1)	36.92	-105.07	195 (314)	NE	Unknown
July 1, 2005	06:34:25	3.2	5 (3.1)	34.678	-110.997	180 (290)	WSW	Unknown
July 1, 2005	17:41:06	3.4	5 (3.1)	34.583	-111.092	190 (306)	WSW	Unknown
July 4, 2005	10:45:25	3.0	5 (3.1)	36.86	-105.097	195 (314)	NE	Unknown
October 30, 2006	02:35:13	3.5	5 (3.1)	36.811	-104.963	195 (314)	NE	Unknown
May 23, 2007	05:16:55	3.4	5 (3.1)	34.067	-106.94	95 (153)	SE	Socorro Canyon
July 4, 2007	18:30:30	3.2	5 (3.1)	36.029	-111.209	195 (314)	WNW	Unknown
August 15, 2007	06:52:58	3.0	5 (3.1)	35.561	-106.196	95 (153)	ENE	La Bajada
September 8, 2007	07:15:41	3.6	5 (3.1)	33.697	-108.811	120 (193)	SW	Unknown
November 3, 2007	09:30:41	3.1	5 (3.1)	32.557	-107.904	185 (298)	S	Blue Mountain
January 29, 2008	02:30:24	3.1	5 (3.1)	36.871	-104.988	195 (314)	NE	Unknown
June 4, 2008	14:02:43	3.7	5 (3.1)	36.51	-106.355	120 (193)	NE	Unknown
June 6, 2008	20:09:59	3.7	9 (5.6)	37.36	-109.47	170 (274)	NNW	Unknown
September 14, 2009	18:27:24	3.5	5 (3.1)	36.545	-106.46	55 (89)	S	Unknown
September 14, 2009	13:03:15	3.4	5 (3.1)	34.464	-107.83	120 (193)	NE	Unknown
November 20, 2009	14:54:30	3.7	5 (3.1)	36.892	-104.987	195 (314)	NE	Unknown
December 11, 2009	20:32:27	3.2	5 (3.1)	36.927	-105.03	195 (314)	NE	Unknown
May 24, 2010	07:27:08	3.6	5 (3.1)	33.298	-109.231	155 (249)	SW	Unknown
May 24, 2010	23:53:43	3.6	5 (3.1)	33.273	-109.252	155 (249)	SW	Unknown
May 25, 2010	08:22:58	3.0	5 (3.1)	33.268	-109.198	155 (249)	SW	Unknown
December 17, 2010	01:31:07	3.0	5 (3.1)	36.408	-106.707	90 (145)	NE	Unknown
December 17, 2010	01:31:45	3.0	5 (3.1)	36.375	-106.722	90 (145)	NE	Unknown
December 18, 2010	06:55:27	3.2	5 (3.1)	36.372	-106.611	90 (145)	NE	Unknown
March 12, 2011	04:16:05	3.2	5 (3.1)	36.86	-104.98	196 (315)	NE	Unknown
April 06, 2011	23:38:35	3.2	5 (3.1)	34.40	-107.02	75 (120)	S	Unknown
May 19, 2011	22:45:39	3.2	5 (3.1)	33.82	-107.65	98 (158)	S	Unknown
October 17, 2011	16:38:51	3.5	5 (3.1)	35.85	-105.97	114 (184)	ENE	Pojoaque
January 08, 2012	19:11:12	3.2	5 (3.1)	34.83	-110.94	176 (284)	W	Unknown

Notes:
Data Source: USGS National Earthquake Information Center (USGS 2013); circular area search based approximate latitude and longitude of Facility (35.24157326349 -07.8650301219)

Only earthquakes Magnitude 3.0 or greater included.
* Distance from: 35.24157326349 -107.8650301219
** Associate fault determination based on USGS Quaternary Fold and Fault Database (USGS 2010).
HMC = Homestake Mining Company
km = kilometers

Table 3.7-1 Annual Land Treatment Water Usage for Sections 28, 33 and 34 at the Grants Project

Year	Water Usage (acre-ft)	Irrigated Area (acre)	Area Irrigated
2000	715	270	Sections 33 and 34
2001	695	270	Sections 33 and 34
2002	995	330	Sections 28, 33 and 34
2003	949	330	Sections 28, 33 and 34
2004	1028	354	Sections 28, 33 and 34
2005	1034	394	Sections 28, 33 and 34
2006	837	370	Sections 28, 33 and 34
2007	789	370	Sections 28, 33 and 34
2008	1054	395	Sections 28, 33 and 34
2009	731	394	Sections 28, 33 and 34
2010	201	120	Section 34
2011	213	100	Section 28

Source: HMC et al. 2012

Table 3.10-1 Wildlife Species Known to Occur in the HMC Grants Reclamation Project Area

Common Name	Scientific Name
Mammals	
Desert cottontail	*Sylvilagus audubonii*
Black-tailed jackrabbit	*Lepus californicus*
Silky pocket mouse	*Perognathus flavus*
Botta's pocket gopher	*Thomomys bottae*
Deer mouse	*Peromyscus* spp.
Ord's kangaroo rat	*Dipodomys ordii*
White-throated woodrat	*Neotoma albigula*
Mexican woodrat	*Neotoma mexicana*
Spotted ground squirrel	*Spermophilus spilosoma*
Rock squirrel	*Spermophilus variegatus*
Black-tailed prairie dog	*Cynomys ludovicianus*
Coyote	*Canis latrans*
Mule deer	*Odocoileus hemionus*
Birds	
Common raven	*Corvus corax*
American kestrel	*Falco sparverius*
Black-throated sparrow	*Amphispiza bilineata*
Red-winged blackbird	*Agelaius phoeniceus*
Western meadowlark	*Sturnella neglecta*
Horned lark	*Eremophila alpestris*
Reptiles	
Western rattlesnake	*Crotalus oreganus*
Lesser earless lizard	*Holbrookia maculata*
Horned lizard	*Phrynosoma* spp.

Sources: HMC 1982, Salter 1990, Bridges and Meyer 2007

Table 3.10-2 Listed and Sensitive Species Potential for Occurrence in the HMC Grants Reclamation Project Area

Common Name	Scientific Name	Federal Status	State Status	Preferred Habitat	Potential for Occurrence
Acoma fleabane	*Erigeron acomanus*	Species of Concern	None	Sandy slopes and benches beneath sandstone cliffs of the Entrada Sandstone Formation in piñon-juniper woodland; 2,100-2,170 m (amsl)	None; there is no suitable habitat in the project area and the project area is located below the elevational range for this species.
American peregrine falcon	*Falco peregrinus anatum*	Species of Concern	Threatened	Cliffs in forested or wooded habitats	Low; there is no suitable nesting habitat in or near the project area. Individuals may pass through when migrating or foraging.
Arctic peregrine falcon	*Falco peregrinus tundrius*	Species of Concern	Threatened	Forested or wooded montane habitats	Low; individuals may pass through when migrating.
Bald Eagle	*Haliaeetus leucocephalus alascanus*	None	Threatened	Timbered areas along coasts, rivers, and large lakes	Low; there is no suitable nesting or roosting habitat in or near the project area. Individuals may pass through when migrating.
Black-footed ferret	*Mustela nigripes*	Endangered	None	Large prairie dog colonies (more than 40 hectares in size)	None; the prairie dog colonies in and near the project area are small (<40 hectares) and therefore not suitable for this species.
Cebolleta southern pocket gopher	*Thomomys umbrinus paguatae*	Species of Concern	None	Sycamore, cottonwood, and rabbitbrush riparian habitats	None; there is no suitable habitat in or near the project area.
Cinder phacelia	*Phacelia serrata*	Species of Concern	None	Volcanic cinders; also roadcuts and abandoned quarries in open, sunny locations; near ponderosa pine and piñon-juniper woodlands; 1,800-2,200 m	Low; there is some potential for this species to be found within disturbed areas, but the habitat is not ideal.
Gray vireo	*Vireo vicinior*	None	Threatened	Open woodlands and shrublands	None; there is no suitable habitat in or near the project area.

Table 3.10-2 Listed and Sensitive Species Potential for Occurrence in the HMC Grants Reclamation Project Area

Common Name	Scientific Name	Federal Status	State Status	Preferred Habitat	Potential for Occurrence
Gypsum phacelia	*Phacelia sp. nov.*	Species of Concern	None	Weathered gypsum outcrops and gypsiferous and pure gypsum soils in woodland and desert scrub at elevations of 1,600-2,300 m (amsl)	None; there is no suitable habitat in or near the project area.
Mexican spotted owl	*Strix occidentalis lucida*	Threatened	None	Closed-canopy, old growth forest, especially in steep, narrow canyons	None; there is no suitable habitat in or near the project area.
Mountain plover	*Charadrius montanus*	Proposed	None	Shortgrass prairie, barren ground, disturbed areas, especially areas of flat topography and with no nearby surface water	Low; there is some potential for nesting in disturbed areas in and around the project area, but the habitat is not ideal.
New Mexico silverspot butterfly	*Speyeria nokomis nitocris*	Species of Concern	None	Alpine meadows	None; there is no suitable habitat in or near the project area.
Northern goshawk	*Accipiter gentilis*	Species of Concern	None	Various forest types, especially mature, closed-canopy forest	None; there is no suitable habitat in or near the project area.
Parish's alkali grass	*Puccinellia parishii*	None	Endangered	Alkaline springs, seeps, and seasonally wet areas that occur at the heads of drainages or on gentle slopes at 800-2,200 m	None; there is no suitable habitat in the project area.
Pecos sunflower	*Helianthus paradoxus*	Threatened	Endangered	Saturated saline soils of desert wetlands. Usually associated with desert springs (cienegas) or the wetlands created from modifying desert springs; 1,000-2,000 m	None; there is no suitable habitat in or near the project area.
Rio Grande sucker	*Catostomus plebeius*	Species of Concern	None	Pools, runs, and riffles of small to moderately large streams	None; this species is believed to be extirpated from the Rio San Jose watershed and there are no suitable aquatic habitats in the project area.

Table 3.10-2 Listed and Sensitive Species Potential for Occurrence in the HMC Grants Reclamation Project Area

Common Name	Scientific Name	Federal Status	State Status	Preferred Habitat	Potential for Occurrence
Southwestern willow flycatcher	*Empidonax traillii extimus*	Endangered	Endangered	Riparian habitats	None; there is no suitable habitat in or near the project area.
Spotted bat	*Euderma maculatum*	None	Threatened	Subalpine coniferous forest, montane forest, pinyon-juniper woodland, open semi-desert shrubland. Roosts in crevices in cliffs and canyons.	Low; there is some potential for this species to forage or obtain water in the project area although there are no suitable roosting sites.
Western burrowing owl	*Athene cunicularia hypugaea*	Species of Concern	None	Open land with small mammal burrows, especially prairie dog burrows	Moderate; there is some potential for this species to use prairie dog or ground squirrel burrows within the project area. Few individuals would be expected based on the lack of extensive prairie dog colonies.
Yellow-billed cuckoo	*Coccyzus americanus*	Candidate	None	Lowland riparian woodlands	None; there is no suitable habitat in or near the project area.
Zuni bluehead sucker	*Catostomus discobolus yarrowi*	Candidate	Endangered	Headwater streams to large rivers with moderate to fast flowing water above a rubble-rock substrate	None; there are no known occurrences of this species in the Rio San Jose watershed where this project is located, and there are no suitable aquatic habitats in the project area.
Zuni fleabane	*Erigeron rhizomatus*	Threatened	None	Nearly barren detrital clay hillsides with soils derived from shales of the Chinle or Baca formations; most often on north or east-facing slopes in open piñon-juniper woodlands at 2,200-2,400 m	None; there is no suitable habitat in the project area and the project area is located below the elevational range for this species.

Sources: NHNM 2011; NatureServe 2010; USFWS 2010; Biota Information System of New Mexico 2009; New Mexico Rare Plant Technical Council 1999.

amsl – above mean sea level

Table 5.1-1 Soil Decommissioning Standards for the Grants Reclamation Projects

Parameter	Soil Depth (cm)	Primary Soil Standard [a] (pCi/g)	Soil Cleanup Goal [b] (pCi/g)
Radium-226	0-15	10.5	NA
	>15	20.5	NA
Natural Uranium	NA	404	159

Notes:

[a] Standard includes contribution from natural background radioactivity

[b] Soil Cleanup Goal is based on chemical toxicity.

Table 9.1-1 Estimated Quantities of Demolition and Reclamation Debris

Description	Total Volume (cubic yards)
Groundwater System Decommissioning	
• Wells – Surface Casing	15
• Surface Piping	106
	121
Reverse Osmosis (RO) Plant	
• RO Building	327
• RO Process Equipment	1,471
• RO Building Foundations	245
	2,043
Office and Yard Area	
• Removal of Rock in Yard	4,000
• Main Office/Warehouse, Miscellaneous Buildings	500
• Water Towers	100
	4,600
Ponds [a]	
• Pond Liners	2,367
• Pond Contaminated Soil	39,446
• Pond Sludge Mixed with Soil 1:1	262,906
	304,719
TOTAL	**311,483**

Note: [a] Includes East and West Collection Ponds, EP-2 and EP-3; EP-1 liner remains in place

Table 9.3-1 Estimated Quantity of Borrow Material and Excavated Soils/Gravel Material During Demolition and Decommissioning

Source Description	Quantity	
	Acres	Cubic Yards
Large Tailings Pile Closure		
• Borrow Area Investigation	400	--
• Clear and Grub Borrow Areas	240	--
• Radon Barrier Material; haul and place	--	770,000
• Rock Cover material; haul and place	--	87,000
• Revegetation of Borrow Areas	240	--
Small Tailings Pile		
• Clear and Grub Borrow Areas	105	--
• Prepare and grade of tailings pile surface	--	170,000
• Radon Barrier Material; haul and place	--	340,000
• Rock Cover material; haul and place		
- Top of impoundment	--	32,000
- Impoundment side slopes	--	28,000
• Revegetation of Borrow Areas	105	--
Ponds Closure		
• Removal of Sediment – placement in WDC	--	80,000
• Removal of Liners & Piping – placement in WDC	--	865,000
• Excavate Underlying Impacted Soil	--	37,500
• Remove/Regrade Earthen Berms	--	120,000
• Import Fill Placement and Grading	--	50,000
• Revegetation	25	--
Demolition of Remaining Facilities		
• RO Plant Demolition		
- Backfill/Regrade Demolition Area	--	1,500
- Revegetation	25	--
• Office/Shop Area Demolition		
- Removal of Yard Gravel – Placement in WDC	--	4,000
- Backfill/Regrade Demolition Area	--	1,500
- Revegetation	5	--

Source: HMC 2012

Note: Borrow material used for radon barrier cover for LTP, STP and WDC will originate from the North Borrow Area.

Table 10.3-1 HMC Grants Reclamation Project Staff Functional Responsibilities

Functional Tasks	Oversight Responsibility
Licensing and Permitting	Project Manager; Senior Project Engineer, Senior Environmental Engineer
Project Controls	Senior Project Engineer
Project Engineering	Senior Project Engineer
Operations	Site Supervisor, Specialized Contractors
Waste Management	Senior Environmental Engineer, Site Supervisor, Utility Operator/Senior Health Physic Technician
Security	Senior Project Engineer, Site Supervisor
Radiation Protection	Project Manager, Senior Environmental Engineer, Utility Operator/ Senior Health Physics Technician, Contract Radiation Health Physicist
Environmental Health and Safety	Project Manager, Senior Environmental Engineer, Senior Project Engineer, Utility Operator/ Senior Health Physic Technician, Contract Radiation Health Physicist,
Quality Assurance (demolition, reclamation, personnel and environmental monitoring)	Senior Project Engineer, Senior Environmental Engineer, Site Supervisor, Utility Operator/ Senior Health Physic Technician, Contract Radiation Health Physicist

Table 10.3-2 HMC Grants Reclamation Project Staff Positions and General Job Description

Position [a]	General Responsibilities Description	Minimum Educational Requirements
Project Manager, Grants, Pitch, Ortiz & new Mexico Programs	• Overall responsibility for all site reclamation and decommissioning activities • Responsible for hiring personnel and contractors • Serves as the site Radiation Safety Officer (RSO)	Bachelor's Degree
Senior Project Engineer	• Supervises and coordinates operational and maintenance activities • Manages all stages of contractor dealings onsite • Ensures all contractors comply with regulatory guidelines, company policy, state laws, and local laws • Provides engineering technical assistance to onsite operations • Provides site environmental, safety and health support	Bachelor's Degree
Site Supervisor Utility Operator/ Water Management	• Supervises and coordinates operational and maintenance activities under direction of Project Manager and Senior Project Engineer • Supervises Utility Operations	High School Diploma or Equivalent
Senior Environmental Engineer	• Acts as PM when the PM is absent from the site. • Under direction of PM, supervises and coordinates reclamation operational and maintenance activities • Assists PM in preparation with correspondence with federal and state agencies • Regulatory oversight and support in regard to site remediation activities • Ensures all required training of staff and contractors is completed • Negotiations and interaction with regulatory agencies and stakeholders to ensure regulatory compliance and compliance with effective remediation and closure activities • Oversight and management of regulatory compliance requirements of environmental consulting support parties	Bachelor's Degree
Utility Operation/Radiation Technician	• Performs all duties to conduct environmental monitoring (e.g., field water sampling and hi-vol sampling) • Conducts radiation monitoring and maintains radiation monitoring equipment • Daily water system inspections and readings • Acts as Site Supervisor when Site Supervisor is absent	High School Diploma or Equivalent

Table 10.3-2 HMC Grants Reclamation Project Staff Positions and General Job Description

Position [a]	General Responsibilities Description	Minimum Educational Requirements
Utility Operator (3 position)	• Performs duties to maintain groundwater restoration program • Occasional heavy equipment operations • Supports contracted hydrologist activities	High School Diploma or Equivalent
Environmental Technician	• Supports groundwater restoration program • Groundwater database management • Maintain groundwater database system • Manages groundwater status reports • Miscellaneous administrative duties	High School Diploma or Equivalent
Senior Accountant	• Project Accounting • Records Management • Administrative functions	High School Diploma or Equivalent

[a] All positions are required to ensures safety/environmental compliance during all sites activities, complying with applicable laws and regulations.

Table 11.2-1 HMC Grants Reclamation Project Standard Environmental and Health Operating Procedures

ENVIRONMENTAL MONITORING PROCEDURES	
EM-1	Procedures for soil and field gamma surveys for determination of Ra-226 concentrations in soils
EM-2	Environmental monitoring program except groundwater monitoring
EM-3	Soil cleanup verification survey and sampling plan (Deleted by License Amendment 32)
EM-4	Water spill reporting and response
HEALTH PROCEDURES	
HP-1	HMC radiation work air sampling procedure
HP-2	HMC removable alpha survey procedure
HP-3	HMC procedure for calculation of radiation doses to personnel
HP-4	HMC procedure for the survey of equipment prior to release for unrestricted use
HP-5	HMC procedure for gamma (external radiation)
HP-6	HMC ALARA procedure
HP-7	HMC respiratory protection procedures
HP-8	HMC bioassay procedures
HP-9	Reverse Osmosis Plant product water sampling and analysis
HP-10	HMC radiological instrument calibration
HP-11	HMC personnel external gamma monitoring
HP-12	HMC alpha survey procedure for contamination on skin and personal clothing
HP-13	Radon daughter WL Measurements
HP-14	HMC radiation protection training
HP-15	HMC groundwater monitoring
HP-16	HMC radiation work permit

Table 12.2-1 Ambient Air Environmental Monitoring Program

Type of Sample	Number of Samples	Locations	Method	Frequency	Analytical Parameters
Air Particulates	4	HMC1, HMC1-A[a], HMC2, HMC3, at or near the site boundary in sectors that have the highest concentrations of radioactive airborne particulates (Figure 12.2-1)	Continuous (High Vol)	Weekly filter change or more frequently as required. Samples composited and analyzed quarterly.	Natural Uranium, Radium-226, Thorium-230 Vanadium
	2	HMC4, HMC5, at site boundary nearest occupied residences (Figure 12.2-1)	Continuous (High Vol)	Weekly filter change or more frequently as required. Samples composited and analyzed quarterly	Natural Uranium, Radium-226, Thorium-230 Vanadium
	1	HMC6 background location	Continuous (High Vol)	Weekly filter change or more frequently as required. Samples composited and analyzed quarterly	Natural Uranium, Radium-226, Thorium-230 Vanadium
Radon Gas	9	See Table 12.2-2 and Figure 12.2-1	Continuous Track-Etch	Quarterly	Rn-222
Direct Radiation	8	See Table 12.2-2 and Figure 12.2-1	OSL[b]	Semi-Annual	Gamma Exposure Rate

Notes:
[a]HMC1-A was added in Quarter 1 2010 due to the construction of Evaporation Pond No. 3.
[b]optically stimulated luminescence (OSL) detectors

Table 12.2-2 Ambient Air Environmental Monitor Locations and Sampling Parameters

Location	Sampling Unit	Northing	Easting
HMC-1	Hi-Volume Particulate (Air) Track-Etch Cup (Radon) OSL[a] Badge (Gamma)	1547458.8	491370.5
HMC1-A[b]	Hi-Volume Particulate (Air) Track-Etch Cup (Radon) OSL[a] Badge (Gamma)	1549715.8	491387.7
HMC-2	Hi-Volume Particulate (Air) Track-Etch Cup (Radon) OSL[a] Badge (Gamma)	1546349.5	495053.2
HMC-3	Hi-Volume Particulate (Air) Track-Etch Passive (Radon) OSL[a] Badge (Gamma)	1543048.7	495640.5
HMC-4	Hi-Volume Particulate (Air) Track-Etch Cup (Radon) OSL[a] Badge (Gamma)	1538751.1	488918.0
HMC-5	Hi-Volume Particulate (Air) Track-Etch Passive (Radon) OSL[a] Badge (Gamma)	1541268.4	488546.3
HMC-6	Hi-Volume Particulate (Air) Track-Etch Cup (Radon) OSL[a] Badge (Gamma)	1543813.1	488297.3
HMC-7	Track-Etch Cup (Radon)	1540395.7	493293.8
HMC-16 (Background)	Track-Etch Cup (Radon) & OSL[a] Badge (Gamma)	1556470.5	485135.1

Notes:

a optically stimulated luminescence (OSL) detectors

b An additional HI-Vol air monitoring station was added in first quarter of 2010 due to the construction of Evaporation Pond No. 3 . Sampler is located to northeast of Evaporation Pond No. 3, which is downgradient of the pond based on a prevailing wind direction from the southwest.

Table 12.2-3 Summary of Airborne Radionuclide Concentrations (µCi/ml) for High Volume Air Samplers for Years 2009 to 2012

Location	Radionuclide	Mean	Standard Deviation	Maximum	Minimum
HMC-1	Natural Uranium	6.0E-16	5.2E-16	1.5E-15	1.4E-17
	Radium-226	4.9E-17	3.7E-17	1.2E-16	9.0E-18
	Thorium-230	3.1E-17	2.1E-17	7.1E-17	7.1E-18
HMC-1A [a]	Natural Uranium	3.8E-16	3.0E-16	9.8E-16	7.0E-17
	Radium-226	4.3E-17	2.1E-17	8.0E-17	1.0E-17
	Thorium-230	2.4E-17	1.5E-17	6.0E-17	1.0E-17
HMC-2	Natural Uranium	4.5E-16	4.2E-16	1.3E-15	1.4E-17
	Radium-226	7.6E-17	6.5E-17	2.0E-16	2.0E-17
	Thorium-230	5.4E-17	5.0E-17	2.0E-16	2.0E-17
HMC-3	Natural Uranium	1.2E-15	1.7E-15	6.2E-15	3.4E-17
	Radium-226	4.6E-17	2.7E-17	1.0E-16	1.8E-17
	Thorium-230	3.0E-17	2.2E-17	1.0E-16	1.0E-17
HMC-4	Natural Uranium	1.1E-15	1.3E-15	4.3E-15	1.8E-17
	Radium-226	4.4E-17	2.4E-17	9.0E-17	1.0E-17
	Thorium-230	2.5E-17	1.4E-17	5.1E-17	1.0E-17
HMC-5	Natural Uranium	2.2E-15	2.6E-15	8.3E-15	1.7E-17
	Radium-226	3.9E-17	2.0E-17	8.0E-17	2.0E-17
	Thorium-230	2.9E-17	1.7E-17	6.0E-17	1.0E-17
HMC-6	Natural Uranium	5.0E-16	4.8E-16	1.7E-15	1.8E-17
	Radium-226	5.2E-17	2.8E-17	1.2E-16	2.0E-17
	Thorium-230	3.2E-17	1.7E-17	7.6E-17	2.0E-17

[a] 2010 - 2012 (Monitor installed first quarter 2010).

Table 12.2-4 Annual Effective Dose Equivalent (in mrem) for Nearest Residences and Background from Airborne Particulate 2009 - 2012

Date	U-234	U-238	Th-230	Ra-226	Total
	(mrem)				
HMC-4 (Nearest Resident)					
2009	0.871	0.779	0.091	0.003	1.7
2010	0.774	0.692	0.054	0.002	1.5
2011	0.270	0.241	0.036	0.002	0.5
2012	0.232	0.208	0.059	0.003	0.5
HMC-5 (Nearest Resident)					
2009	1.442	1.289	0.106	0.003	2.8
2010	1.738	1.553	0.077	0.002	3.4
2011	0.611	0.546	0.036	0.002	1.2
2012	0.407	0.364	0.054	0.003	0.8
HMC-6 (Background)					
2009	0.237	0.212	0.113	0.004	0.6
2010	0.376	0.336	0.083	0.003	0.8
2011	0.104	0.093	0.054	0.003	0.3
2012	0.230	0.206	0.059	0.003	0.5

Note:
ND-reported non-detectable concentrations

Table 12.2-5 Semi-Annual Radon Track Etch Results in PicoCurries/Liter (pCi/L) at Air Monitoring Stations

Year	Period	HMC-1	HMC1-A	HMC-2	HMC-3	HMC-4	HMC-5	HMC-6	HMC-7	HMC-16
2012-1	First Half	0.8	1.3	1.5	1.1	1.6	1.6	1.3	1.4	1.2
2012-2	Second Half	1.2	1.9	1.9	1.1	1.9	1.9	1.6	1.0	0.7
2011-1	First Half	0.8	0.8	0.8	0.6	1.2	1.2	1.0	0.9	0.4
2011-2	Second Half	1.1	1.0	1.2	0.9	1.4	1.2	1.0	1.2	0.6
2010-1	First Half	[a]	[b]	1.3	[a]	1.3	1.4	1.1	0.9	0.7
2010-2	Second Half	2.4	1.2	1.4	1.0	1.3	1.5	0.9	1.1	0.7
2009-1	First Half	2.0	[b]	2.0	1.6	1.7	2.1	1.6	1.2	1.2
2009-2	Second Half	1.6	[b]	1.8	1.4	1.8	1.5	1.4	1.2	2.5
All Periods	Average	**1.4**	**1.1**	**1.4**	**1.1**	**1.5**	**1.5**	**1.2**	**1.1**	**1.0**
	Std. Deviation	**0.7**	**0.2**	**0.4**	**0.4**	**0.2**	**0.3**	**0.3**	**0.2**	**0.7**

[a] Not reported due to data processing issues.
[b] Monitoring had not been implemented.

Table 12.2-6 Net Committed Dose Equivalent (mrem/period) from Radon

Year	Net Concentration (pCi/L)		CEDE (mrem/year)	
	HMC-4	HMC-5	HMC-4	HMC-5
2012	0.78	0.78	59	59
2011	0.80	0.70	59	54
2010	0.61	0.77	45.8	57.4
2009	-0.10	-0.05	-7.5	-3.8

Table 12.2-7 Net Annual Gamma-Ray Exposure Rate at Nearest Neighbor Locations

Year	Net Annual Exposure (mrem/year) [a]				
	HMC-1	HMC-2	HMC-3	HMC-4 [b]	HMC-5 [b]
2012	3.0	12	6	15	17
2011	3.5	17	0	15	15.5
2010	0	14	8	17	22
2009	1	13	36	11	9

[a] Values assume 10 percent occupany.
[b] Location used to demonstrate compliance with public dose limits.

mrem/year = millirem per year

Table 12.2-8 Groundwater Monitoring Program (8-99, as modified by License Amendment 34)

Well Number	Parameter to be Monitored	Frequency of Monitoring
#1 and #2 Deep Wells	D	Annually
Broadview Acres Wells 446, SUB1, SUB2, SUB3	G	Annually
Felice Acres Wells 490, 492, 493, 494	G	Annually
Murray Acres Wells 802, 844	G	Annually
Pleasant Valley Wells 688, 846	G	Annually
Regional Wells 920, 942	G	Annually
Site Monitoring Wells F, FB, GH, MO, CW2	G	Annually
Collection System Wells	Total Volume	Monthly
Injection System Wells	Total Volume	Monthly
Reversal Wells B, BA, KZ, KF, SO, SP, S1, S2	Water Level	Weekly
Point of Compliance Wells D1, X, S4	B, F	Annually
Background Well P	B	Annually

Notes:
B = Water level, pH, TDS, SO_4, Cl, HCO_3, CO_3, Na, Ca, Mg, K, NO_3, U, Se, Mo, Ra-226
D = Ca, Mg, K, Na, HCO_3, CO_3, Cl, SO_4, pH, TDS, Al, As, Ba, Cd, Co, Cu, CN, F, Fe, Pb, Mn, Hg, Mo, Ni, NO_3 as N, Se, Ag, Zn, U, Filtered Ra-226
F = V, Ra-228, Th-230
G = Water level, SO_4, U, Se, TDS, Mo

Table 12.2-9 HMC Water Quality Analysis for Well D-1 (2001 - 2012)

MAJOR IONS	UNITS	2001		2002		2003		2004		2005		2006		2007		2008		2009		2010		2011		2012	
		Results	RL	Results	RL	Results	RL	Results	RL	Results	RL	Results	RL	Results	RL	Results	RL	Results	RL	Results	RL	Results	RL	Results	RL
ALKALINITY, TOTAL AS CaCO3	mg/L	428	1.0	445	1.0	437	1.0	400	1.0	433	1.0	412	1.0	282	2.0	261	1.0	300	1.0	338	5	376	5	251	5
CARBONATE AS CO3	mg/L	<1.0	1.0	<1.0	1.0	<1.0	1.0	<1.0	1.0	6	1.0	<1.0	1.0	<1.0	1.0	<1.0	1.0	<1.0	1.0	<5	5	<5.0	5	< 5	5
BICARBONATE AS HCO3	mg/L	522	1.0	542	1.0	533	1.0	488	1.0	518	1.0	502	1.0	344	1.0	319	1.0	367	1.0	413	5	459	5	306	5
CALCIUM	mg/L	211	1.0	212	1.0	219	1.0	227	1.0	209	0.5	220	2.0	316	1.0	361	1.0	285	1.0	260	1	219	0.5	219	0.5
CHLORIDE	mg/L	92	0.1	196	0.1	197	0.1	190	1.0	213	1.0	211	1.0	194	1.0	181	1.0	162	1.0	149	2	152	2	117	2
MAGNESIUM	mg/L	49.1	1.0	53.1	1.0	52.1	1.0	53.9	1.0	54	0.5	52	2.0	62.4	0.5	74.1	0.5	59.7	0.5	53.8	0.5	47.5	0.5	46	0.5
NITROGEN, NITRATE+NITRITE AS N	mg/L	2.67	0.1	2.58	0.1	2.6	0.1	3.31	0.15	2.7	0.1	3.5	0.1	6.4	0.2	6.8	0.1	4.0	0.1	2.3	0.5	2.2	0.2	2.1	0.1
POTASSIUM	mg/L	4.2	1.0	4.1	1.0	4.4	1.0	5.1	1.0	4.4	0.5	4.8	0.5	3.6	0.5	4.3	0.5	3.9	0.5	2.9	0.5	4	0.5	3.2	0.5
SODIUM	mg/L	329	1.0	336	1.0	330	1.0	357	1.0	352	0.5	338	3.0	383	8.0	440	8.0	388	1.0	404	1	430	0.5	307	0.5
SULFATE	mg/L	769	1.0	720	1.0	730	1.0	849	1.0	821	1.0	846	1.0	1260	2.0	1520	10	1210	1.0	1210	8	1040	8	1040	8
PHYSICAL PROPERTIES																									
pH	s.u.	7.95	0.1	7.93	0.1	7.76	0.1	7.18	0.01	7.66	0.01	7.43	0.01	7.50	0.01	7.57	0.01	7.42	0.01	7.69	0.01	7.96	0.01	7.52	0.01
SOLIDS,TOTAL DISSOLVED TDS@180C	mg/L	1960	10	1920	10	1950	10	2020	10	1960	10	1900	10	2430	10	2900	10	2360	10	2290	10	2170	10	2020	10
METALS, DISSOLVED																									
MOLYBDENUM	mg/L	0.97	0.03	1.05	0.03	0.89	0.03	0.83	0.03	1.08	0.03	0.87	0.03	0.46	0.03	1.35	0.03	1.2	0.03	1.26	0.03	2.78	0.03	1.04	0.03
SELENIUM	mg/L	0.111	0.005	0.089	0.005	0.102	0.005	0.158	0.005	0.098	0.005	0.169	0.005	0.508	0.005	0.6	0.005	0.33	0.005	0.244	0.005	0.154	0.005	0.157	0.005
URANIUM	mg/L	1.34	0.0003	1.15	0.0003	1.09	0.0003	1.18	0.0003	1.10	0.0003	1.06	0.0003	0.955	0.0003	1.76	0.0003	1.41	0.0003	1.52	0.0003	2.16	0.0003	0.855	0.0003
URANIUM PRECISION (±)	mg/L	0.003		0.002		0.025		1.65		0.0044		0.0106		0.001		0.203		0.186		0.246	0.00005	0.348	0.00005	0.138	0.00005
VANADIUM	mg/L	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.1	0.1	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01
RADIONUCLIDES-DISSOLVED																									
URANIUM ACTIVITY	uCi/ML	9.1E-07	2.00E-10	7.80E-07	2.00E-10	7.40E-07	2.0E-10	8.00E-07	2.0E-10	7.40E-07	2.0E-10	7.20E-07	2.00E-10	6.50E-07	2.00E-10	1.20E-06	2.00E-10	9.50E-07	2.00E-10	1.00E-06	2.00E-10	1.5E-06	2.00E-10	5.8E-07	2.00E-10
URANIUM ACTIVITY PRECISION (±)	uCi/ML	1.80E-09		1.60E-09		1.50E-09		1.10E-06		3.0E0-09		7.20E-09		6.50E-10		1.40E-07	2.00E-11	1.30E-07	3.00E-11	1.70E-07	3.00E-11	2.4E-07	3.00E-11	9.3E-08	3.00E-11
RADIUM 226	pCi/L	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.2	0.2	2.7	0.2	<0.2	0.2	1.2	0.2	0.2		0.09		0.23		1.3		<-0.1	-0.1
RADIUM 226 PRECISION (±)	pCi/L	0.3	0.20			0.2				0.8		0.2		0.5		0.1		0.11		0.1		0.27		0.08	0
RADIUM 226 MDC	pCi/L															0.2		0.16		0.1		0.22		0.2	0
RADIUM-228	pCi/L	<1.0	1.4	<1.0	<1.0	<1.0	<1.0	<1.0	1.0	<1.0	1.0	<1.0	1.0	<1.0	1.0	0.5		-0.3		0.4		<0.7		<-0.3	
RADIUM 228 PRECISION (±)	pCi/L	0.9		0.2		0.2				2.0		0.6		1.0		0.8		0.6		0.7		0.6		0.8	0
RADIUM 228 MDC	pCi/L															1.3		1.0		1.2		1		1.3	0
THORIUM 230	pCi/L	0.5	0.2	0.5	<0.2	0.3	0.2	<0.2	0.2	0.3	0.2	<0.2	0.2	<0.2	0.2	0.0	0.2	0.02		0.09		0.3		<0.06	0.06
THORIUM 230 PRECISIC (±)	pCi/L	0.5		0.4		0.3				0.3		0.4		0.2		0.1		0.08		0.1		0.1		0.09	0
THORIUM MDC	pCi/L																	0.2		0.3		0.1		0.2	0
DATA QUALITY																									
A/C BALANCE (± 5)	%	-1.95		0.19		0.06		0.254		-2.7		-3.18		-0.176		1.03		0.113		-1.71		-0.0311		-3.21	
ANIONS	meq/L	30.2		29.6		29.7		31.3		31.9		32.0		37.8		42.5		36		36.3		33.6		30	
CATIONS	meq/L	29.1		29.7		29.8		31.4		30.3		30.1		37.6		43.3		36.1		35.1		33.6		28.2	
SOLIDS, TOTAL DISSOLVED CALC.	mg/L	1.07		1805		1812		1940		1920		1930		2410		2770		2340		2330		2106			
TDS BALANCE (0.80-1.20)	dec. %	1.07		1.06		1.08		1.04		1.02		0.98		1.01		1.05		1.01		0.98		1.00		1.05	

RL - Analyte Reporting Limit

QCL - Quality Control Limit

MDC - Minimum Detectable Concentration

MCL - Maximum Contaminant Level

ND - Not Detected at the Reporting Level

U - Not Detected at Minimum Detectable Concentration

D - RL Increased due to Sample Matrix

H - Received at laboratory past EPA recommended Holding Time

LLD - Lower Limit of Detection

Table 12.2-10 HMC Water Quality Analysis for Well S-4 (2001 - 2012)

MAJOR IONS	UNITS	2001		2002		2003		2004		2005		2006		2007		2008		2009		2010		2011		2012	
		Results	RL	Results	RL	Results	RL	Results	RL	Results	RL	Results	RL	Results	RL	Results	RL	Results	RL	Results	RL	Results	RL	Results	RL
ALKALINITY, TOTAL AS CaCO3	mg/L	428	1.0	350	1.0	323	1.0	371	1.0	412	1.0	460	1.0	480	1.0	471	1.0	441	1.0	471	1.0	440	5	452	5
CARBONATE AS CO3	mg/L	<1.0	1.0	<1.0	1.0	<1.0	1.0	<1.0	1.0	<1.0	1.0	<1.0	1.0	<1.0	1.0	<1.0	1.0	<1.0	1.0	<1.0	1.0	<5.0	5	< 5	5
BICARBONATE AS HCO3	mg/L	522	1.0	426	1.0	393	1.0	452	1.0	503	1.0	561	1.0	580	1.0	574	1.0	538	1.0	574	1.0	537	5	551	5
CALCIUM	mg/L	211	1.0	410	1.0	392	1.0	348	0.5	168	0.5	241	2.0	253	0.5	253	1.0	242	1.0	253	1.0	259	0.5	251	0.5
CHLORIDE	mg/L	192	0.1	150	0.1	151	0.1	234	1.0	209	1.0	250	1.0	217	1.0	209	1.0	211	1.0	209	1.0	224	2	235	2
MAGNESIUM	mg/L	49.1	1.0	86	1.0	95.7	1.0	92	0.5	44.3	0.5	65	2.0	68	0.5	67	0.5	64.2	0.5	67	0.5	65.6	0.5	65.7	0.5
NITROGEN, NITRATE+NITRITE AS N	mg/L	2.67	0.1	<0.10	0.1	<0.10	0.1	10.5	0.15	3.1	0.1	2.6	0.1	2.0	0.1	1.7	0.1	1.7	0.1	1.7	0.1	0.8	0.1	0.7	0.1
POTASSIUM	mg/L	4.2	1.0	6.5	1.0	6.9	1.0	8	0.5	5	0.5	5.9	0.5	5.1	0.5	5.1	0.5	4.8	0.5	5.1	0.5	5.1	0.5	4.7	0.5
SODIUM	mg/L	329	1.0	530	1.0	411	1.0	654	5.0	409	0.5	331	3.0	284	0.5	299	8.0	284	1.0	299	8.0	320	0.5	296	0.5
SULFATE	mg/L	769	1.0	1700	1.0	1700	1.0	2040	1.0	845	1.0	870	1.0	774	1.0	771	10.0	719	1.0	771	10.0	763	8	806	8
PHYSICAL PROPERTIES																									
pH	s.u.	7.95	0.1	7.9	0.01	7.8	0.01	7.00	0.01	7.80	0.01	7.56	0.01	7.58	0.01	7.63	0.01	7.31	0.01	7.63	0.01	7.81	0.01	7.46	0.01
SOLIDS,TOTAL DISSOLVED TDS@180C	mg/L	1960	10	3280	10	3010	10	3880	10	2000	10	2010	10	2060	10	1880	10	1910	10	1880	10	1930	10	2100	10
METALS, DISSOLVED																									
MOLYBDENUM	mg/L	0.97	0.03	0.54	0.03	0.33	0.03	7.62	0.03	4.62	0.03	1.71	0.03	1.03	0.03	0.87	0.03	0.80	0.03	0.87	0.03	0.60	0.03	0.53	0.03
SELENIUM	mg/L	0.111	0.005	0.013	0.005	0.007	0.005	1.06	0.005	0.094	0.005	0.063	0.005	0.036	0.005	0.035	0.005	0.023	0.005	0.035	0.005	0.026	0.005	0.029	0.005
URANIUM	mg/L	1.34	0.0003	2.9	0.0003	1.56	0.0003	5.35	0.08	4.29	0.0003	1.85	0.0003	0.969	0.0003	0.635	0.0003	0.581	0.0003	0.635	0.0003	0.364	0.0003	0.373	0.003
URANIUM PRECISION (±)	mg/L	0.003		0.067		0.003		0.0214		0.0172		0.0185		0.0019		0.0732	0.00003	0.0769		0.0732	0.00003	0.0588	0.00005	0.0602	0.00005
VANADIUM	mg/L	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01
RADIONUCLIDES-DISSOLVED																									
URANIUM ACTIVITY	uCi/ML	9.1E-07	2.00E-10	2.00E-06	2.00E-10	1.10E-06	2.0E-10	3.60E-06	2.0E-10	2.90E-06	2.0E-10	1.30E-06	2.00E-10	6.60E-07	2.00E-10	4.30E-07	2.00E-10	3.90E-07	2.0E-10	4.30E-07	2.0E-10	2.5E-07	2.0E-10	2.5E-07	2.0E-10
URANIUM ACTIVITY PRECISION (±)	uCi/ML	1.80E-09		4.50E-08		2.40E-08		1.40E-08		1.20E-08		1.30E-08		1.30E-09		5.00E-08	2.00E-11	5.20E-08	3.0E-11	5.00E-08	2.0E-11	4.0E-08	2.0E-11	4.1E-08	3.0E-11
RADIUM 226	pCi/L	<0.2	0.2	0.7	0.2	0.6	0.2	1.7	0.2	0.9	0.2	<0.2	0.2	<0.2	0.2	0.3		0.25		0.3		0.29		<0.14	0
RADIUM 226 PRECISION (±)	pCi/L	0.3		0.3		0.3		0.5		0.4		0.3		0.3		0.1		0.13		0.1		0.17		0.14	0
RADIUM 226 MDC	pCi/L															0.2		0.17		0.2		0.22		0.21	0
RADIUM-228	pCi/L	<1.0	1.0	<1.0	1.0	<1.0	1.0	<1.0	1.0	<1.0	1.0	<1.0	1.0	<1.0	1.0	0.3		0.1		0.3		1.1		<0.3	0.3
RADIUM 228 PRECISION (±)	pCi/L	1.0		8.00E-01		1.0		<0.0		1.0		0.6		1.0		0.8		0.6		0.8		0.7		0.8	0
RADIUM 228 MDC	pCi/L															1.3		1.1		1.3		1.0		1.4	0
THORIUM 230	pCi/L	0.5	0.2	<0.2	0.2	<0.2	0.2	0.3	0.2	0.4	0.2	<0.2	0.2	<0.2	0.2	0.1	0.2	0.003		0.1	0.2	0.3		<0.04	0.04
THORIUM 230 PRECISIC (±)	pCi/L	0.5		0.1		0.2		0.3		0.4		0.5		0.3		0.1		0.07		0.1		0.1		0.09	0
THORIUM MDC	pCi/L																	0.2				0.2		0.2	0
DATA QUALITY																									
A/C BALANCE (± 5)	%	-1.95		4.32		-0.58		MD		-3.24		-3.95		-1.97		-0.292		-0.136		-0.292		2.11		-2.49	
ANIONS	meq/L	30.2		46.7		46.2		MD		31.9		34.5		31.9		31.5		29.9		31.5		31.0		32.5	
CATIONS	meq/L	29.1		50.9		45.6		MD		29.9		31.9		30.7		31.3		29.8		31.3		32.4		30.9	
SOLIDS, TOTAL DISSOLVED CALC.	mg/L	1828		3097		2955		MD		1940		2050		1920		1890		1840		1890		1940			
TDS BALANCE (0.80-1.20)	dec. %	1.07		1.06		1.02		MD		1.03		0.098		1.07		0.990		1.04		0.990		0.990		1.070	

RL - Analyte Reporting Limit

QCL - Quality Control Limit

MDC - Minimum Detectable Concentration

MCL - Maximum Contaminant Level

ND - Not Detected at the Reporting Level

U - Not Detected at Minimum Detectable Concentration

D - RL Increased due to Sample Matrix

H - Received at laboratory past EPA recommended Holding Time

LLD - Lower Limit of Detection

Table 12.2-11 HMC Water Quality Analysis for Well X (2001 - 2012)

MAJOR IONS	UNITS	2001		2002		2003		2004		2005		2006		2007		2008		2009		2010		2011		2012	
		Results	RL	Results	RL	Results	RL	Results	RL	Results	RL	Results	RL	Results	RL	Results	RL	Results	RL	Results	RL	Results	RL	Results	RL
ALKALINITY, TOTAL AS CaCO3	mg/L	256	1.0	83	1.0	106	1.0	150	1.0	105	1.0	216	1.0					307	1.0			324	5	327	5
CARBONATE AS CO3	mg/L	<1.0	1.0	<1.0	1.0	<1.0	1.0	<1.0	1.0	<1.0	1.0	<1.0	1.0					<1.0	1.0			<5.0	5	< 5	5
BICARBONATE AS HCO3	mg/L	312	1.0	101	1.0	129	1.0	183	1.0	128	1.0	264	1.0					375	1.0			395	5	399	5
CALCIUM	mg/L	57.6	1.0	25.6	1.0	51	1.0	105	0.5	49.1	0.5	122	2.0					139	0.5			138	0.5	179	0.5
CHLORIDE	mg/L	32.3	0.1	159	0.1	33.7	0.1	71	1.0	49	1.0	93	1.0	90	1.0	90	1.0	80	1.0	88	1.0	91	1	152	1
MAGNESIUM	mg/L	16.3	1.0	5.4	1.0	8.3	1.0	13.1	0.5	4.4	0.5	12	2.0					24	0.5			30.1	0.5	39.7	0.5
NITROGEN, NITRATE+NITRITE AS N	mg/L	1.2	0.1	0.62	0.1	0.8	0.1	0.95	0.1	0.8	0.1	0.8	0.1	1.1	0.1	0.8	0.05	0.8	0.1	1.4	0.2	1.5	0.2	1.5	0.1
POTASSIUM	mg/L	2.6	1.0	1.4	1.0	1.9	1.0	2.1	0.5	1.1	0.5	2.3	0.5					2.7	0.5			4.3	0.5	4.8	0.5
SODIUM	mg/L	68.6	1.0	149	1.0	30.6	1.0	61.3	0.5	60.7	0.5	99.1	0.5					116	0.5			122	0.5	156	0.5
SULFATE	mg/L	63	1.0	160	1.0	73	1.0	207	1.0	114	1.0	261	1.0	288	1.0	267	1.0	247	1.0	290	4.0	248	4	415	4
PHYSICAL PROPERTIES																									
pH	s.u.	8.1	0.01	7.94	0.01	7.91	0.01	7.10	0.01	7.65	0.01	7.78	0.01					7.42	0.01			7.94	0.01	7.49	0.01
SOLIDS,TOTAL DISSOLVED TDS@180C	mg/L	427	10	155	10	267	10	572	10	348	10	736	10	914	10	728	10	852	10	899	10	859	10	1250	10
METALS, DISSOLVED																									
MOLYBDENUM	mg/L	0.15	0.03	0.30	0.03	0.13	0.03	0.07	0.03	0.3	0.03	0.13	0.03	0.07	0.03	0.07	0.03	0.05	0.03	0.05	0.03	0.04	0.03	0.04	0.03
SELENIUM	mg/L	<0.005	0.005	<0.005	0.005	0.007	0.005	<0.005	0.005	<0.005	0.005	0.019	0.005	0.007	0.005	<0.005	0.005	<0.005	0.005	0.006	0.005	0.007	0.005	0.008	0.005
URANIUM	mg/L	0.045	0.0003	0.009	0.0003	0.0166	0.0003	0.0671	0.0003	0.05	0.0003	0.119	0.0003	0.127	0.0003	0.0368	0.0003	0.0634	0.0003	0.031	0.0003	0.0397	0.0003	0.0649	0.003
URANIUM PRECISION (±)	mg/L	0.000		0.000		0.00003		0.0011		0.0002		0.0012		0.0001				0.0084	0.00004	0.005	0.00005	0.00641	0.00005	0.0105	0.00005
VANADIUM	mg/L	0.01	0.01	0.01	0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	0.01	0.01					<0.01	0.01			<0.01	2.00E-10	<0.01	0.01
RADIONUCLIDES-DISSOLVED																									
URANIUM ACTIVITY	uCi/ML	3.0E-08	2.00E-10	6.1E-09	2.0E-10	1.10E-08	2.0E-10	4.50E-08	2.0E-10	3.20E-08	2.0E-10	8.1E-08	2.0E-10	8.60E-08	2.0E-10	2.5E-08	2.0E-10	4.3E-08	2.0E-10	2.10E-08	2.0E-10	2.7E-08	2.0E-10	4.4E-08	2.0E-10
URANIUM ACTIVITY PRECISION (±)	uCi/ML	3.4E-10		6.70E-11		3.30E-10		7.30E-10		1.30E-10		8.1E-10		8.60E-11		2.9E-09	2.0E-11	5.7E-09	3.0E-11	3.40E-09	3.0E-11	4.3E-09	3.0E-11	7.1E-09	3.0E-11
RADIUM 226	pCi/L	<0.2	0.2	<0.2	0.2	<0.2	0.2	<0.2	0.2	<0.2	0.2	<0.2	0.2					-0.2				7.8		<-0.1	-0.1
RADIUM 226 PRECISION (±)	pCi/L	0.1		0.2		0.2		0.5		0.3		0.2						0.08				0.63		0.09	0
RADIUM 226 MDC	pCi/L																	0.19				0.24		0.22	0
RADIUM-228	pCi/L	1.3	1.0	5.4	1.0	<1.0	1.0	<1.0	1.0	<1.0	1.0	<1.0	1.0					-0.9				<0.2		<-0.5	-0.5
RADIUM 228 PRECISION (±)	pCi/L	1.0		1.4		0.8		<0		1.0		0.6						0.7				0.7		0.9	0
RADIUM 228 MDC	pCi/L																	1.2				1.1		1.5	0
THORIUM 230	pCi/L	<0.2	0.2	<0.2	0.2	<0.2	0.2	0.4	0.2	0.4	0.2	<0.2	0.2					0.080				0.2		<0.09	0.09
THORIUM 230 PRECISIC (±)	pCi/L	0.2		0.2		0.2		0.4		0.4		0.5						0.1				0.1		0.1	0
THORIUM MDC	pCi/L																	0.2				0.09		0.2	0
DATA QUALITY																									
A/C BALANCE (± 5)	%	-1.15		-2.05		-0.59		MD		-3.68		-4.11						1.51				1.65		-1.23	
ANIONS	meq/L	7.46		2.51		4.68		MD		5.9		12.4						13.6				14.3		19.6	
CATIONS	meq/L	7.29		2.41		4.62		MD		5.48		11.5						14.0				14.8		19.1	
SOLIDS, TOTAL DISSOLVED CALC.	mg/L	403		133		268		MD		344		723						818				853			
TDS BALANCE (0.80-1.20)	dec. %	1.06		1.16		1.00		MD		1.01		1.02						1.04				1.01		1.07	

RL - Analyte Reporting Limit

QCL - Quality Control Limit

MDC - Minimum Detectable Concentration

MCL - Maximum Contaminant Level

ND - Not Detected at the Reporting Level

U - Not Detected at Minimum Detectable Concentration

D - RL Increased due to Sample Matrix

H - Received at laboratory past EPA recommended Holding Time

LLD - Lower Limit of Detection

MD - Missing Data

Table 12.2-12 HMC Water Quality Analysis for Well P (2001 - 2012)

MAJOR IONS	UNITS	2001		2002		2003		2004		2005		2006		2007		2008		2009		2010		2011		2012	
		Results	RL	Results	RL	Results	RL	Results	RL	Results	RL	Results	RL	Results	RL	Results	RL	Results	RL	Results	RL	Results	RL	Results	RL
ALKALINITY, TOTAL AS CaCO3	mg/L	199	1.0	199	1.0	208	1.0	198	1.0	200	1.0	205	1.0											208	5.0
CARBONATE AS CO3	mg/L	<1.0	1.0	<1.0	1.0	<1.0	1.0	<1.0	1.0	<1.0	1.0	5.0	1.0											< 5	5.0
BICARBONATE AS HCO3	mg/L	243	1.0	242	1.0	253	1.0	242	1.0	244	1.0	243	1.0											254	5.0
CALCIUM	mg/L	238	1.0	246	1.0	259	1.0	256	0.5	228	0.5	224	0.5											234	0.5
CHLORIDE	mg/L	53.8	1.0	57.7	1.0	54.6	1	73	1.0	62	1.0	77	1.0											50	1.0
MAGNESIUM	mg/L	51.2	1.0	52.3	1.0	54.3	1.0	52.8	0.5	47.5	0.5	48.9	0.5											45.6	0.5
NITROGEN, NITRATE+NITRITE AS N	mg/L	8.4	0.1	8	0,1	7	0.1	7.22	0.15	6.7	0.2	7.1	0.2											4.6	0.5
POTASSIUM	mg/L	5.0	1.0	4.8	1.0	5.5	1.0	5.6	0.5	5.1	0.5	5	0.5											5	0.5
SODIUM	mg/L	239	1.0	244	1.0	250	1.0	253	0.5	236	0.5	234	3.0											237	0.5
SULFATE	mg/L	983	1.0	1010	1.0	1070	1.0	1130	1.0	1020	1.0	1010	1.0	1030	1.0	1020	1.0	1040	1.0	1190	1.0	1060	8	1010	8
PHYSICAL PROPERTIES																									
pH	s.u.	7.9	0.01	7.99	0.01	7.78	0.01	7.06	0.01	7.72	0.01	8.52	0.01											7.45	0.01
SOLIDS,TOTAL DISSOLVED TDS@180C	mg/L	1870	10	1950	10	1860	10	1940	10	1860	10	1820	10	1840	10	1830	1	1810	1	2020	10	1840	10	1800	10
METALS, DISSOLVED																									
MOLYBDENUM	mg/L	<0.03	0.03	<0.03	0.03	<0.03	0.03	<0.03	0.03	<0.03	0.03	<0.03	0.03	<0.03	0.03	<0.03	0.03	<0.03	0.03	<0.03	0.03	<0.03	0.03	<0.03	0.03
SELENIUM	mg/L	0.17	0.005	0.179	0.005	0.167	0.005	0.18	0.05	0.171	0.005	0.162	0.005	0.13	0.005	0.142	0.005	0.118	0.005	0.075	0.005	0.115	0.005	0.117	0.005
URANIUM	mg/L	0.03	0.0003	0.027	0.0003	0.027	0.0003	0.0325	0.0003	0.03	0.0003	0.0286	0.0003	0.0304	0.0003	0.0248	0.0003	0.0281	0.0003	0.0335	0.0003	0.0318	0.0003	0.0311	0.0003
URANIUM PRECISION (±)	mg/L	0.001		0.001		0.0001		0.0005				0.0003		0.00003		0.00286	0.0003	0.00372	0.00004	0.0054		0.00513	0.00005	0.00501	0.00005
VANADIUM	mg/L									<0.01	0.01	<0.01	0.01											<0.01	0.01
RADIONUCLIDES-DISSOLVED																									
URANIUM ACTIVITY	uCi/ML	2.0E-08	2.00E-10	1.8E-08	2.0E-10	1.80E-09	2.0E-10	2.20E-08	2.0E-10	0.00E+00	2.0E-10	1.9E-08	2.0E-10	2.10E-08	2.0E-10	1.7E-08	2.0E-10	1.9E-08	2.0E-10	2.30E-08	2.0E-10	2.1E-08	2.0E-10	2.1E-08	2.0E-10
URANIUM ACTIVITY PRECISION (±)	uCi/ML	4.7E-10		4.20E-10		4.20E-10		3.50E-10				2.3E-10		2.10E-11		1.9E-09	2.0E-11	2.5E-09	3.0E-09	3.60E-09	3.0E-11	3.5E-09	3.0E-11	3.4E-09	3.0E-11
RADIUM 226	pCi/L	0.4	0.2	<0.2	0.2	0.8	0.2	0.5	0.2	<0.2	0.2	<0.2	0.2											0.27	-1000
RADIUM 226 PRECISION (±)	pCi/L	0.3		0.2		0.4		0.3		0.5		0.5												0.15	0
RADIUM 226 MDC	pCi/L																							0.18	0
RADIUM-228	pCi/L									<1.0	1.0	<1.0	1.0											<0.4	0.4
RADIUM 228 PRECISION (±)	pCi/L									1.0		1.6												0.6	0
RADIUM 228 MDC	pCi/L																							1	0
THORIUM 230	pCi/L									<0.2	0.2	<0.2	0.2											<-0.008	-0.008
THORIUM 230 PRECISIO (±)	pCi/L									0.1		0.3												0.05	0
THORIUM MDC	pCi/L																							0.2	0
DATA QUALITY																									
A/C BALANCE (± 5)	%	0.14		0.28		-0.04		-2.99		-3.25		-4.21												-1.95	
ANIONS	meq/L	26.6		27.2		28.5		30		27.5		27.8												26.9	
CATIONS	meq/L	26.7		27.4		28.5		28.3		25.8		25.6												25.8	
SOLIDS, TOTAL DISSOLVED CALC.	mg/L	1730		1772		1852		1920		1750		1750												1740	
TDS BALANCE (0.80-1.20)	dec. %	1.08		1.1		1.00		1.01		1.06		1.04												1.030	

RL - Analyte Reporting Limit

QCL - Quality Control Limit

MDC - Minimum Detectable Concentration

MCL - Maximum Contaminant Level

ND - Not Detected at the Reporting Level

U - Not Detected at Minimum Detectable Concentration

D - RL Increased due to Sample Matrix

H - Received at laboratory past EPA recommended Holding Time

LLD - Lower Limit of Detection

MD - Missing Data

Table 12.2-13 Summary of Point of Compliance and Background Monitor Wells (2001 – 2012)

Major Ions	Point of Compliance Wells						Background Well	
	Well D-1		Well S-4		Well X		Well P	
	Mean	Range	Mean	Range	Mean	Range	Mean	Range
	mg/l (unless noted otherwise)							
Alkalinity, Total as $CaCO_3$	364	251 - 445	425	323 – 480	208	83 – 327	202	198 – 208
Carbonate as $CaCO_3$ [a]	<5	<1.0 – 6.0	<1.0	<1.0 - <5.0	<1.0	<1.0 - <5.0	1.7	<1.0 – 5.0
Bicarbonate as HCO_3	443	306 - 542	518	393 – 580	254	101 – 399	246	242 – 254
Calcium	247	209 – 361	273	168 – 410	96.3	25.6 – 179	241	224 – 259
Chloride	171	92 – 213	208	150 – 250	85.8	32.3 - 159	61	50 – 77
Magnesium	54.8	46.0 - 74.1	69.1	44.3 – 95.7	17.0	4.4 – 39.7	50.4	45.6 – 54.3
Nitrogen, Nitrite + Nitrite as N	3.43	2.10 – 6.80	2.75	0.70 – 10.50	1.02	0.62 – 1.5	7.00	4.6 – 8.4
Potassium	4.1	2.9 – 5.1	5.5	4.2 – 8.0	2.6	1.1 – 4.8	5.1	4.8 – 5.6
Sodium	366	307 - 440	371	284 – 654	95.9	30.6 – 156	242	234 – 253
Sulfate	1,001	720 – 1,520	1,044	719 – 2,040	219	63 – 415	1,048	983 – 1,190
PHYSICAL PROPERTIES								
pH	7.63	7.18 – 7.96	7.62	7.0 – 7.95	7.70	7.10 – 8.10	7.77	7.06 – 8.52
Solids, Total Dissolved TDS @ 180°C	2,157	1,900 – 2,900	2,325	1,880 – 3,880	667	155 – 1,250	1,870	1,800 -2,020
METALS – DISSOLVED								
Molybdenum	1.15	0.46 – 2.78	1.71	0.33 – 7.62	0.12	0.04 – 0.3	<0.03	<0.03
Selenium	0.23	0.09 – 0.60	0.13	0.007 – 1.06	0.01	0.006 – 0.019	0.14	0.08 – 0.18
Uranium	1.30	0.86 – 2.16	1.74	0.36 – 5.35	0.06	0.009 – 0.127	0.029	0.025 – 0.034
Uranium Precision (±)	0.23	0.001 – 1.65	0.040	0.002 – 0.077	0.003	0.0 – 0.011	0.0023	0.00003 – 0.0054
Vanadium	<0.01	<0.01 – <0.1	<0.01	<0.01	0.01[a]	<0.01 – 0.01[a]	<0.01	<0.01
RADIONUCLIDES – DISSOLVED								
Uranium Activity	8.81 E-07	5.80E-07 – 1.50E-06	1.19E-06	2.50E-07 – 3.60E-06	3.76E-08	6.1E-09 – 8.6E-08	1.69E-08	0.00E+00 – 2.30E-08
Uranium Activity Precision (±)	1.71E-07	6.50E-10 – 1.10E-06	2.87E-08	1.30E-09 – 5.20E-08	2.16E-09	6.7E-11 – 7.10E-09	1.53E-09	2.10E-11 – 3.6E-09
Radium 226	0.85	0.09 – 2.7	0.63	0.25 – 1.7	3.8	-0.2 – 7.8	0.49 [a]	<0.2 – 0.8
Radium 226 Precision (±)	0.27	0.08 – 0.8	0.25	0.1 – 0.5	0.26	0.08 – 0.63	0.34	0.15 – 0.5
Radium 226 MDC	0.18	0.1 – 0.22	0.20	0.17 – 0.22	0.22	0.19 – 0.24	0.18	0.18

Table 12.2-13 Summary of Point of Compliance and Background Monitor Wells (2001 – 2012)

Major Ions	Point of Compliance Wells						Background Well	
	Well D-1		Well S-4		Well X		Well P	
	Mean	Range	Mean	Range	Mean	Range	Mean	Range
	mg/l (unless noted otherwise)							
Radium 228 [a]	0.20	-0.3 – 0.5	0.45	0.1 – 1.1	1.93	-0.9 – 5.4	<1.0	<0.4 - <1.0
Radium 228 Precision (+)	0.76	0.2 – 2.0	0.83	0.6 – 1.0	0.89	0.6 – 1.4	1.07	0.6 - 1.6
Radium 228 MDC	1.16	1.0 – 1.3	1.22	1.0 – 1.4	1.3	1.1 - 1.5	1.00	1.00
Thorium 230 [a]	0.25	0 – 0.5	0.24	0.003 – 0.5	0.27	0.08 – 0.4	<0.2	<-0.008 - <0.2
Thorium 230 Precision (+)	0.23	0.08 – 0.50	0.23	0.07 – 0.5	0.24	0.1 – 0.5	0.15	0.05 – 0.3
Thorium 230 MDC	0.20	0.1 – 0.3	0.20	0.20	0.16	0.09 – 0.2	0.2	0.2
DATA QUALITY								
A/C Balance (+ 5)	-0.94	-3.21 – 1.03	-0.77	-3.95 – 4.32	-1.21	-4.11 – 1.65	-1.72	-4.21 – 0.28
Anions	33.4	29.6 – 42.5	34.3	29.9 – 46.7	10.1	2.5 – 19.6	27.8	26.6 – 30.0
Cations	32.9	28.2 – 43.3	34.0	29.1 – 50.9	9.9	2.4 – 19.1	26.9	25.6 – 28.5
Solids, Total Dissolved Calculated	1,942	1 – 2,770	2,135	1,828 – 3,097	506	133 – 853	1,788	1,730 – 1,920
TDS Balance (0.80 – 1.20)	1.03	0.98 – 1.08	0.95	0.098 – 1.07	1.05	1.00 – 1.16	1.05	1.0 – 1.1

Notes:
a Less than values assumed to be present at that value.
RL – Analyte Reporting Limit
D –RL – Increase due to Sample Matrix
QCL – Quality Control Limit
H – Received at Lab past EPA recommended Holding Time
MDC – Minimum Detectable Concentration
LLD – Lower Limit of Detection
MCL – Maximum Contaminant Level
ND – Not Detected at the Reporting Level
U – Not Detected at Minimum Detectable Concentration

Table 12.2-14 Groundwater Quality Site Standards for the HMC Grants Site

Constituent of Concern	Alluvial Aquifer	Chinle Mixing Zone	Upper Chinle Non-Mixing Zone	Middle Chinle Non-Mixing Zone	Lower Chinle Non-Mixing Zone
Selenium (mg/L)	0.32	0.14	0.06	0.07	0.32
Uranium (mg/L)	0.16	0.18	0.09	0.07	0.03
Molybdenum (mg/L)	0.10	0.10	0.10	0.10	0.10
Sulfate (mg/L)	1,500	1,750	914	857	2,000
Chloride (mg/L)	250	250	412	250	634
Total Dissolved Solids (mg/L)	2,734	3,140	2,010	1,560	4,140
Nitrate (mg/L)	12	15	*	*	*
Vanadium (mg/L)	0.02	0.01	0.01	*	*
Thorium-230 (pCi/L)	0.3	*	*	*	*
Radium-226 + Radium-228 (pCi/L)	5	*	*	*	*

Notes:
* No standard for the constituent in the indicated zone
mg/L = milligrams per liter
pCi/L = picocuries per liter

Table 12.2-15 Radon Flux Measurements for Large and Small Tailings Piles

Year	Total No. of Canisters	Total Number of Readings	Number of Measurement Location		Average Measured Flux [a] (Average) pCi/m^2s		Gamma Exposure Reading (Average/Range) uR/Hr
			LTP	STP	LTP	STP	
2003	89	97	52	46	14.1	5.58	[b]
2004	89	99	66	33	20.3	7.7	[b]
2005	97	101	61	36	15.3	8.21	[b]
2006	97	102	61	36	20.6	6.9	28.8 11 - 160
2007	97	97	61	36	14.1	12.05	25.1 10 - 170
2008	97	103	64	36	9.73	4.67	29.6 12 - 200
2009	96	102	64	35	16.8	5.6	27.9 11 - 180
2010	97	103	65	35	17.5	6.59	27.4 10 - 200
2011	100	100	65	36	18.8	9.14	27.3 10 - 200
2012	100	99	63	36	15.67	4.12	[c]

Source: ERG 2003 through 2011.

[a] Individual canister measurements are presented in the source documents (ERG 2003 – 2011)

pCi/m^2s = picocuries per square meter per second

LTP = Large Tailings Pile

STP = Small Tailings Pile

LLD values for each measured value are given in the source documents (ERG 2003 – 2011)

[b] No measured values

[c] gamma exposure-rate measurements not made

Table 18.1-1 Summary of 2011 Total Closure Cost Estimates

Task	Subtotal Costs $	Total Costs $
PHYSICAL RECLAMATION COSTS		
Tailings Facility Closure/Reclamation	14,280,695	
Other On-Site Demolition	186,771	
Total Physical Reclamation Costs		**14,467,467**
LONG-TERM CARE AND MAINTENANCE		
Water Treatment		
• General	1,330,881	
• Tailings Water Management	658,376	
• Groundwater Management	1,168,027	
• Reverse Osmosis Plant Operations	6,291,398	
• In-Situ Biotesting & Remediation	0	
• Evaporation System Management	1,659,984	
• Irrigation Program Operation	1,361,335	
Total Long-Term & Maintenance Costs		**12,470,001**
Monitoring/Regulatory		
• General	1,520,000	
• Air/Weather Monitoring	63,218	
• Radiation Monitoring	209,735	
• Settlement Monument Monitoring	9,000	
Total Monitoring/Regulatory Costs		**1,801,963**
Holding		
• Land	276,000	**276,000**
Security and Maintenance		
• Land and Structures	24,000	**24,000**
Severance and Relocation		
• Severance and Relocation	0	**0**
General and Administration		
• Salaries and Benefits	5,170,186	
• General Office Costs	75,000	
• Occupancy Costs	66,000	
• Communication Costs	191.400	
• Data Processing Costs	72,600	
• Taxes, Licenses and Fees	9,900	
• Insurance	158,400	
• Travel and Accommodation	0	
• Professional Fees	90,000	
• Outside Services	150,000	
Total General and Administration Costs		**5,983,486**
Total Long-Term Care and Maintenance Costs		**20,555,440**
• Total Income		0
Total Expenses Less Income		**35,022,907**
• 15% contingency fee per NUREG-1620 Appendix C		5,253,436
• NRC Long-Term Maintenance/Surveillance Fee		**816,851**
Total With Contingency & Long-Term Surveillance Fee		**41,093,194**

Table 18.1-2 Summary of 2011 Physical Reclamation Costs

Description	Unit	Quantity	Unit Cost $[a]	Total Cost $
FACILITY DECOMMISSIONING				
Mill Decommissioning & Demolition		Complete		0
GROUNDWATER RESTORATION				
Groundwater Restoration (Operations & Monitoring)	YR			0
Reverse Osmosis (RO) Treatment Plant Operation	YR			0
Well Abandonment	EA			0
Groundwater Restoration Subtotal	-	-	-	0
INTERIM STABILIZATION OF TAILINGS				
Interim Cover Maintenance	Included in ongoing groundwater restoration operating costs			
TAILINGS IMPOUNDMENT AREA RESTORATION				
Large Tailings Pile Closure				
• Settlement Monitoring	-	-	-	-
• Borrow Area Investigation	Acre	400	153.32	61,328
• Clear and Grub Borrow Areas	Acre	240	1,454.42	349,060
• Radon Barrier Material: Haul & Replace	CY	770,000	5.09	3,919,654
• Rock Cover Material: Haul & Replace	CY	87,000	5.21	453,415
• Construction QA/QC	Month	7	66,660.79	466,626
• Revegetation of Borrow Areas	Acre	240	1,696.52	407,237
Large Tailings Pile Closure Subtotal	-	-	-	**5,657,319**
Pond Closure				
• Dewatering and/or Water Treatment (allowance)	LS	1	60,600.72	60,601
• Removal of Sediment – Placement in EP-1	CY	80,000	4.61	368,452
• Removal of Liners & Piping – Placement in EP-1	SY	86,000	1.09	93,810
• Excavate Underlying Impacted Soil	CY	37,500	3.64	136,352
• Remove/Regrade Earthen Berms	CY	122,000	1.21	147,866
• Confirmation Sampling	Acre	25	969.61	24,240
• Import Fill Placement & Grading	CY	50,000	3.51	175,742
• Revegetation	Acre	25	1,696.82	42,421
Pond Closure Subtotal	-	-	-	**1,049,483**
Small Tailings Pile Closure				
• Clear and Grub Borrow Areas	Acre	105	1,454.42	152,714
• Prepare & Grade Tailings Pile Surface	CY	170,000	2.36	401,783
• Radon Barrier Material: Haul & Placement	CY	340,000	5.27	1,792,569
• Rock Cover Material: Haul & Placement	-	-	-	-
o Top of Impoundment	CY	32,000	5.33	170,652
o Impoundment Side Slopes	CY	28,000	7.58	212,103
• Construction QA/QC	Month	4.5	66,660.79	299,974
• Revegetation of Borrow Areas	Acre	105	1,696.82	178,166
Small tailings Pile Closure	-	-	-	**3,207,959**
RADIOLOGICAL SURVEY & ENVIRONMENTAL MONITORING				
Radon Flux Measurements on Tailings Piles (post-closure)	LS	1	47,268.56	**47,269**
Demolition of Remaining Facilities				
Reverse Osmosis (RO) Plant Demolition				
• Demolition of Plant – Placement in EP-1	LS	1	166,651.97	166,652
• Backfill/Regrade Demolition Area	CY	1,500	3.64	5,454
• Revegetation	Acre	2.5	1,696.82	4,242
REVERSE OSMOSIS PLANT DEMOLITION SUBTOTAL	-	-	-	**176,348**
Office/Shop Area Demolition				
(office-truck shop, warehouse bldg. & related buildings in administration compound)				
• Demolition of Buildings	LS	1	84,841.00	84,841
• Demolition of Water Tanks	EA	2	18,180.21	36,360
• Removal of yard gravel – placement in EP-1	CY	4,000	4.24	16,968
• Backfill/regrade demolition area	CY	1,500	3.64	5,454
• Revegetation	Acre	5	1,696.82	8,484

Table 18.1-2 Summary of 2011 Physical Reclamation Costs

Description	Unit	Quantity	Unit Cost $[a]	Total Cost $
Office/Shop Area Demolition Subtotal	-	-	-	**152,108**
Project Management – Consulting/Engineering Support				
Large Tailings Pile Closure				
• Final Design & Contract Document Preparation	LS	1	42,942.63	43,633
• Project Management & Construction Oversight	Month	7	45,328.33	322,396
• Prepare Completion Report	LS	1	42,942.63	43,633
LTP Project Management Subtotal				**409,661**
Final Closure & Demolition (RO Plant, Ponds, STP)				
• Final Design & Contract Document Preparation	LS	1	52,359.02	52,359
• Project Management & Construction Oversight	Month	8.5	46,056.54	391,481
• Prepare Completion Report	LS	1	52,359.02	52,359
STP Project Management Subtotal	-	-	-	**496,199**
Shop Area Demolition				
• Final Design & Contract Document Preparation	LS	1	5,817.87	5,818
• Project Management & Construction Oversight	Month	0.5	46,056.54	23,028
• Prepare Completion Report	LS	1	5,817.67	5,818
Shop Area Project Management Subtotal	-	-	-	**34,664**
TOTAL				**11,231,009**

Notes:
a Current Year
LS – Lump Sum
CY – Cubic Yard
SY – Square Yard
YR – Year
EA - Each

Table 18.1-3 Summary of Proposed 2012 Total Closure Cost Estimates

Task	Subtotal Costs $	Total Costs $
PHYSICAL RECLAMATION COSTS		
Tailings Facility Closure/Reclamation	15,186,352	
Other On-Site Demolition	192,235	
Total Physical Reclamation Costs		**15,378,567**
LONG-TERM CARE AND MAINTENANCE		
Water Treatment		
• General	2,581,961	
• Tailings Water Management	1,647,784	
• Groundwater Management	9,103,825	
• R.O. Plant Operations	11,600,934	
• Expanded RO Water Treatment	6,959,134	
• Alternate Remediation Testing	510,570	
• Evaporation System Management	4,360,541	
• Irrigation Program Operation	1,714,622	
Total Long-Term & Maintenance Costs		**38,479,370**
Monitoring/Regulatory		
• General	2,720,000	
• Air/Weather Monitoring	160,364	
• Radiation Monitoring	408,408	
• Settlement Monument Monitoring	50,000	
Total Monitoring/Regulatory Costs		**3,338,772**
Holding		
• Land	460,000	**460,000**
Security and Maintenance		
• Land and Structures	40,000	**40,000**
Severance and Relocation		
Severance and Relocation	0	**0**
General and Administration		
• Salaries and Benefits	10,111,178	
• General Office Costs	165,000	
• Occupancy Costs	143,000	
• Communication Costs	341.000	
• Data Processing Costs	143,000	
• Taxes, Licenses and Fees	3,300	
• Insurance	264,000	
• Travel and Accommodation	260,000	
• Professional Fees	150,000	
• Outside Services	250,000	
Total General and Administration Costs		**11,830,478**
Total Long-Term Care and Maintenance Costs		**54,148,619**
• Total Income		0
Total Expenses Less Income		**69,527,206**
• 15% contingency fee per NUREG-1620 Appendix C		10,429,081
• NRC Long-Term Maintenance/Surveillance Fee		**840,746**
Total With Contingency & Long-Term Surveillance Fee		**80,797,033**

Table 18.1-4 Summary of Proposed 2012 Physical Reclamation Costs

Description	Unit	Quantity	Unit Cost $[a]	Total Cost $
FACILITY DECOMMISSIONING				
Mill Decommissioning & Demolition				0
Groundwater Restoration				
Groundwater Restoration (Operations & Monitoring)	YR			0
Reverse Osmosis (RO) Treatment Plant Operation	YR			0
Well Abandonment	EA			0
Groundwater Restoration Subtotal	-	-	-	0
INTERIM STABILIZATION OF TAILINGS				
Interim Cover Maintenance	Included in ongoing groundwater restoration operating costs			
TAILINGS IMPOUNDMENT AREA RESTORATION				
Large Tailings Pile Closure				
• Settlement Monitoring	-	-	-	-
• Borrow Area Investigation	Acre	400	157.80	63,122
• Clear and Grub Borrow Areas	Acre	240	1,496.96	359,271
• Radon Barrier Material: Haul & Replace	CY	770,000	5.24	4,034,313
• Rock Cover Material: Haul & Replace	CY	87,000	5.36	46,678
• Construction QA/QC	Month	7	66,610.76	480,275
• Revegetation of Borrow Areas	Acre	240	1,746.46	419,149
Large Tailings Pile Closure Subtotal	-	-	-	**5,822,808**
Pond Closure				
• Dewatering and/or Water Treatment (allowance)	LS	1	62,373.472	62,373
• Removal of Sediment – Placement in EP-1	CY	80,000	4.74	379,230
• Removal of Liners & Piping – Placement in EP-1	SY	86,000	1.12	96,554
• Excavate Underlying Impacted Soil	CY	37,500	3.74	140,340
• Remove/Regrade Earthen Berms	CY	122,000	1.25	152,191
• Confirmation Sampling	Acre	25	997.97	24,949
• Import Fill Placement & Grading	CY	50,000	3.62	180,883
• Revegetation	Acre	25	1,746.46	43,661
Pond Closure Subtotal	-	-	-	**1,080.183**
Small Tailings Pile Closure				
• Clear and Grub Borrow Areas	Acre	105	1,496.96	157,181
• Prepare & Grade Tailings Pile Surface	CY	170,000	2.43	413,536
• Radon Barrier Material: Haul & Placement	CY	340,000	5.43	1,845,006
• Rock Cover Material: Haul & Placement	-	-	-	-
o Top of Impoundment	CY	32,000	5.49	175,181
o Impoundment Side Slopes	CY	28,000	7.80	218,307
• Construction QA/QC	Month	4.5	68,610.76	308,748
• Revegetation of Borrow Areas	Acre	105	1,746.46	183,378
Small Tailings Pile Closure	-	-	-	**3,301,799**
Radiological Survey & Environmental Monitoring				
Radon Flux Measurements on Tailings Piles (post-closure)	LS	1	48,651.27	**48,651**
Demolition of Remaining Facilities				
Reverse Osmosis (RO) Plant Demolition				
• Demolition of plant – placement in EP-1	LS	1	171,526.90	171,527
• Backfill/Regrade Demolition Area	CY	1,500	3.74	5,614
• Revegetation	Acre	2.5	1,746.46	4,366
Reverse Osmosis Plant Demolition Subtotal	-	-	-	**181,507**
Office/Shop Area Demolition				
(office-truck-shop, warehouse bldg. & rel. building in admin. Compound)				
• Demolition of buildings	LS	1	87,322.78	87,323
• Demolition of Water Tanks	EA	2	18,712.03	37,424
• Removal of yard gravel – placement in EP-1	CY	4,000	4.37	17,465
• Backfill/regrade demolition area	CY	1,500	3.74	5,614
• Revegetation	Acre	5	1,746.46	8,732

Table 18.1-4 Summary of Proposed 2012 Physical Reclamation Costs

Description	Unit	Quantity	Unit Cost $[a]	Total Cost $
Office/Shop Area Demolition Subtotal	-	-	-	**156,557**
Project Management – Consulting/Engineering Support				
Large Tailings Pile Closure				
• Final Design & Contract Document Preparation	LS	1	44,908.86	44,909
• Project Management & Construction Oversight	Month	7	47,403.80	331,827
• Prepare Completion Report	LS	1	44,908.86	44,909
LTP Project Management Subtotal				**421,644**
Final Closure & Demolition (RO Plant, Ponds, STP)				
• Final Design & Contract Document Preparation	LS	1	53,890.63	53,891
• Project Management & Construction Oversight	Month	8.5	47,403.80	402,932
• Prepare Completion Report	LS	1	53,890.63	53,891
STP Project Management Subtotal	-	-	-	**510,714**
Shop Area Demolition				
• Final Design & Contract Document Preparation	LS	1	5,987.85	5,988
• Project Management & Construction Oversight	Month	0.5	47,403.80	23,702
• Prepare Completion Report	LS	1	5,987.85	5,988
Shop Area Project Management Subtotal	-	-	-	**35,,678**
TOTAL				**11,559.541**

Notes:
a Current Year
LS – Lump Sum
CY – Cubic Yard
SY – Square Yard
YR – Year
EA - Each