# Second Five-Year Review Report

## For
## Homestake Mining Company Superfund Site
## Cibola County, New Mexico

**September 2006**

**Region 6**
**United States Environmental Protection Agency**
**Dallas, Texas**

**FIVE-YEAR REVIEW**
**Homestake Mining Company Superfund Site**
**EPA ID# NMD007860935**
**Cibola County, New Mexico**

This memorandum documents the United States Environmental Protection Agency's (EPA's) performance, determinations, and approval of the Homestake Mining Company Superfund Site (Site) second five-year review, provided in the attached Second Five-Year Review Report prepared by the U. S. Army Corps of Engineers, Albuquerque District on behalf of the EPA.

## Summary of Five-Year Review Findings

The remedy being implemented at the Site is considered protective of human health and the environment in the short term; some further action is necessary to ensure continued protection of human health and the environment in the long term. Currently, exposure pathways, through consumption of impacted ground water that could result in unacceptable risk are being controlled. The reclamation and remediation activities performed to date are restricting emissions of radiological constituents and monitoring is in place to ensure that U. S. Nuclear Regulatory Commission (NRC) standards are being met during the ongoing remedial activities. Ground water remediation is ongoing, and expansion and improvements have been made to the ground water restoration program since the completion of the first five-year review in 2001.

The ground water collection and injection system appears to contain the contaminated ground water and has been effective in reducing ground water contaminant concentrations within the impacted aquifers. An alternate water supply was provided to the residents of neighboring communities in 1985 whose private water wells were adversely impacted by the ground water contamination. New private residential wells have recently been identified as being used for primary drinking water sources and these residents are being targeted as potential candidates for connection to Milan City water in order to eliminate them from possible exposure to contaminated water. The tailings flushing and dewatering system is reducing the source of the ground water contamination. A second ground water remediation system consisting of ground water collection and irrigation has been implemented to address ground water contamination off site. The Site is well maintained and remedial actions performed at the Site have reduced contaminant levels on site as well as plume size reduction and containment. No deficiencies are noted that impacts the current protectiveness of the remedy. It is

noted, however, that while the neighboring community is known to be connected to the municipal water supply for potable water, effective and enforceable institutional controls are not in place at this time to restrict ground water use for primary drinking water and unrestricted use may be occurring within the affected area for irrigation, gardening, livestock watering or other non-drinking purposes. However, the EPA, New Mexico Environment Department (NMED), and NRC are currently working together to establish enforceable institutional controls to prevent the consumption of ground water by residents in the Subdivisions. In addition, the EPA and NMED have sampled residential wells and are working with Agency for Toxic Substances and Disease Registry (ATSDR) to determine any hazard from the use of impacted ground water for purposes other than primary drinking water, such as for irrigation, livestock watering and gardening. The Homestake Mining Company (HMC) has re-evaluated the expected timeframe for completing ground water restoration, and is in the process of providing revised projections to the agencies. Finally, the air monitoring results currently meet the NRC's dose equivalent criterion, and EPA has evaluated the air monitoring data and has determined that levels are below EPA guidance.

**Actions Needed**

Implement effective and enforceable institutional controls to restrict the use of impacted residential ground water wells for potable water supply by the local residents until the restoration objectives for ground water have been documented as being met. If the off site ground water collection and irrigation treatment system is considered a part of the Site ground water restoration program and is incorporated into the ground water Corrective Action Program (CAP) and the Discharge Plan (DP)-200, the NRC and NMED may need to include additional monitoring requirements to demonstrate the effectiveness of irrigation treatment in maintaining standards in the underlying ground water. When the ground water cleanup levels, based on the proposed background concentrations, for the multiple aquifer units are approved, new Points of Compliance (POCs) for the upper and middle Chinle aquifers and the mixing zone should be established. Thus, with these changes, some form of ground water CAP would need to be maintained until the ground water cleanup levels are attained at the specified POCs in all of the regulated aquifer units.

**Determinations**

I have determined that the remedy for the Homestake Mining Company Superfund site is protective of human health and the environment, and will remain so provided the action items identified in this Five-Year Review Report are addressed as described above.

for Sam Coleman

Samuel Coleman, P.E.
Director, Superfund Division
U.S. Environmental Protection Agency, Region 6

9-26-06
Date

## CONCURRENCES

SECOND FIVE-YEAR REVIEW
Homestake Mining Company Superfund Site
EPA ID# NMD007860935

By: _____ Date: 9/14/06
Sairam Appaji, U.S. EPA
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By: _____ Date: 09/21/06
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By: _____ Date: 5/2./06
Donald Williams, U.S. EPA
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By: _____ Date: 5/21/06
Wren Stenger, U.S. EPA
Chief, Louisiana/New Mexico Branch

By: _____ Date: 09/25/06
Mark Peycke, Chief
Office of Regional Counsel, Superfund Branch

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## Tables



## Attachments

# List of Acronyms

| | |
|---|---|
| ACM | Asbestos Containing Material |
| ALARA | As Low As is Reasonably Achievable |
| AOC | Administrative Order on Consent |
| ARARs | Applicable or Relevant and Appropriate Requirements |
| AVM | AVM Environmental Service Inc. |
| bgs | Below Ground Surface |
| CAP | Corrective Action Plan |
| CDE | Committed Dose Equivalent |
| CEDE | Committed Effective Dose Equivalent |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| CFR | Code of Federal Regulations |
| cm | centimeter |
| COC | Constituent of Concern |
| DOE | United States Department of Energy |
| DP | Discharge Plan |
| EDE | Effective Dose Equivalent |
| EPA | United States Environmental Protection Agency |
| gpm | gallons per minute |
| HMC | Homestake Mining Company |
| IC | Institutional Control |
| MCL | Maximum Contaminant Level |
| MOU | Memorandum of Understanding |
| mg/l | milligrams per liter |
| mrem/yr | millirems per year |
| NCP | National Oil and Hazardous Substances Pollution Contingency Plan |
| NESHAPs | National Emissions Standards for Hazardous Air Pollutants |
| NMED | New Mexico Environment Department |
| NMEID | New Mexico Environment Improvement Division |
| NMWQCC | New Mexico Water Quality Control Commission |
| NPL | National Priorities List |
| NRC | United States Nuclear Regulatory Commission |
| O&M | Operation and Maintenance |
| OSWER | Office of Solid Waste and Emergency Response |
| OUs | Operable Units |
| pCi/g | picoCuries per gram |
| pCi/l | picoCuries per liter |
| $pCi/m^2/s$ | picoCuries per square meter per second |
| POC | Point-of-Compliance |
| Ra-226 | Radium-226 |
| Rn-222 | Radon-222 |
| RI/FS | Remedial Investigation/Feasibility Study |
| RO | Reverse Osmosis |
| ROD | Record of Decision |
| SDWA | Safe Drinking Water Act |
| Site | Homestake Mining Company Superfund Site |
| TBCs | To Be Considered |
| TDS | Total Dissolved Solids |
| TEDE | Total Effective Dose Equivalent |

# List of Acronyms

| | |
|---|---|
| Th-230 | Thorium-230 |
| tpd | tons per day |
| uCi/ml | microCuries per milliliter |
| U-nat | natural uranium |
| USACE | U. S. Army Corps of Engineers |
| WL | Working Level |

## Executive Summary

The second five-year review of the Homestake Mining Company Superfund site (Site), located in Cibola County, New Mexico, was completed in September 2006. The results of this second five-year review indicate that the remedy being implemented is protective of human health and the environment in the short-term, and is expected to be protective in the long-term if certain follow up actions are performed. Exposure pathways, including consumption of impacted ground water and exposure to radiological emissions that could result in unacceptable risk are currently being controlled. In 1985, an alternate water supply was provided to the residents of neighboring communities whose private water wells were adversely impacted by the ground water contamination. New private residential wells have recently been identified as being used for primary drinking water sources and these residences are being targeted for connection to Milan City water in order to eliminate possible exposure to contaminated water. Additionally, the reclamation and remediation activities performed at the Site to date are restricting radiological emissions. Overall, the remedial actions performed appear to be functioning as designed, and the Site has been maintained appropriately. Significant expansion and improvements have been made to the ground water restoration program since completion of the first five-year review in September 2001, including the installation of additional tailings flushing and dewatering wells, the addition of another Reverse Osmosis (RO) water Treatment Unit and associated expansion of the ground water collection and injection system, and the expansion of the collection wells and irrigation treatment system to address off site contaminated ground water plumes.

Four issues as described below were noted during the second five-year review that do not directly impact the protectiveness of the remedy at this time:

1. In 1985 an alternate drinking water supply was provided for the community, however, based on recent surveys additional residents whose wells are in the affected area are targeted for alternate water supply.
2. There is a need to establish legally enforceable, effective institutional controls restricting the potential use of contaminated ground water by local residents and ensuring that they are connected to the alternate drinking water supply previously implemented.
3. The ground water restoration that is ongoing downgradient of the mill site is not covered under the licensing agreement or the New Mexico Environment Department (NMED)

discharge permits and needs to be included so that specific objective/monitoring requirements can be established.

4. When the revised ground water cleanup levels, based on the proposed background concentrations supported by U. S. Environmental Protection Agency (EPA) and NMED, are approved by the U. S. Nuclear Regulatory Commission (NRC), new Points of Compliance (POCs) for the upper and middle Chinle aquifers and the mixing zone should be established. With these changes, some form of ground water Corrective Action Program (CAP) would need to be implemented until the ground water cleanup levels are attained at the specified POCs in all of the regulated aquifer units. However, it is likely that when these cleanup levels are met, some constituents could be at concentrations above the applicable MCL in various aquifer units, since the cleanup levels based on the background concentrations are above the MCLs.

The Site includes the Homestake Mining Company's (HMC) former uranium mill site and those portions of the underlying ground water aquifers that have been contaminated by seepage from waste byproduct materials (tailings) disposed at the mill site. The uranium mill ceased operating in 1990 and was decommissioned and demolished as part of the mill site reclamation work required under the NRC Source Materials License No. SUA-1471 (License SUA-1471). The mill site is currently comprised of two former tailings impoundments, a tailings flushing and dewatering system, ground water collection and injection system, the RO Plant, two collection ponds, two lined evaporation ponds, off site contaminated ground water collection and irrigation treatment system, and associated equipment and structures. Seepage from the two tailings impoundments has resulted in the contamination of the underlying ground water aquifers with radiological and non-radiological contaminants and associated constituents, including uranium, thorium-230, radium-226 plus radium-228, selenium, vanadium, molybdenum, sulfate, chloride, nitrate and total dissolved solids (TDS).

The Site remediation activities have been divided into three distinct phases or operable units (OUs). The first operable unit (OU1) is the restoration of ground water that is contaminated by tailings seepage. The second operable unit (OU2) consists of the long-term stabilization of the tailings, surface reclamation, and the decommissioning and closure of the mill. The third and final operable unit (OU3) addresses indoor and outdoor radon concentrations in residential areas adjacent to the mill site.

HMC commenced the OU1 remedial activities in 1977 by operating a state-approved ground water collection and injection system at the mill site. Initially, fresh water and treated water were injected into the San Mateo Alluvial aquifer at wells located at or within the boundary of the mill site to reverse the natural flow of ground water back towards the collection wells located near the large tailings impoundment. In 1984 the injection and collection system was expanded to include the Upper Chinle aquifer well CW5. Modifications have been made over time, including discontinuing injection in some of the downgradient alluvial wells and expanding injection closer to the collection wells as restoration has progressed. Injection of San Andres fresh water into Middle Chinle well CW14 was started in December 1997. Fresh-water injection into well CW14 was started in December 1997 and was expanded to wells CW30 and CW46 in 2004 in order to establish a reversal of the flow of Middle Chinle water back toward the alluvial subcrop. In addition, Middle Chinle wells 498, CW44 and CW45 are included in the off-site ground water collection and irrigation system to prevent northward movement of alluvial water that recharges the Middle Chinle on the south side of Felice Acres.

The ground water from the collection wells is piped either to the RO plant for treatment and subsequent re-injection into the aquifer or to one of two lined evaporation ponds for evaporative treatment. This system has undergone several operating adjustments since the first five-year review in year 2001, including the installation of additional ground water injection and collection wells, and addition of another 300 gallons per minute (gpm) RO Treatment Unit to increase ground water treatment capacity of the RO Treatment Plant from 300 gpm to 600 gpm starting in 2006, and a series of toe drains, injection and collection wells within the large tailings impoundment to flush and dewater the tailings. About one billion gallons of contaminated ground water were recovered by the collection wells, tailings wells and the toe drains since the first five-year review, bringing the recovered ground water volume to over four billion gallons since 1977.

This ground water restoration program is being implemented pursuant to requirements set forth in the NRC License SUA-1471 and a ground water CAP incorporated therein, and the NMED ground water discharge plans (DP-200 and DP-725). The DP-200 includes the requirements for ground water corrective action, while the DP-725 is specifically for discharge of contaminated ground water to the evaporation ponds. Ground water cleanup standards are established by both the NRC, pursuant to License SUA-1471, and the NMED, pursuant to the DP-200.

HMC is also implementing a secondary ground water collection and irrigation system to remediate those portions of the contaminant plumes which have migrated beyond the mill site. This secondary system is not currently a required part of the CAP or DP-200. However, HMC intends to incorporate these activities into the ground water CAP for NRC approval following approval of the proposed Site background concentrations. It is also being incorporated into the DP-200 as part of a renewal process and is currently under review by the NMED.

In 1983, the EPA and HMC signed an Agreement and Stipulation, which required HMC to provide for the extension of the Village of Milan municipal water system to four residential subdivisions located south and southwest of the mill site (hereinafter the "Subdivisions") which were in the affected area of ground water contamination. The Agreement also required HMC to pay for the residents' use of that water supply for a period of ten years. At that time, the EPA elected not to require any additional response actions to remediate the ground water since HMC was already implementing the state-approved plan.

The connection of the Subdivisions' residences to the Village of Milan's water supply was completed in 1985 and HMC paid for the residents' water use until 1995. The EPA has since released HMC from its obligations under that Agreement. Although the residences have permanent connections to alternate water supplies, there are currently no enforceable institutional controls in place to restrict the use of ground water by the local residents.

Recent surveys in 2005 and 2006 found approximately 15 residences within or near the Subdivisions that have wells that are used for primary drinking water sources. Although uranium concentrations in two of the private wells used for drinking water are slightly above the EPA's drinking water Maximum Contaminant Levels (MCL), the concentrations are lower than the Site background concentrations supported by the EPA and NMED which are expected to be approved by the NRC. Ground water in the San Mateo Alluvium and Chinle aquifers down gradient of the Site has been affected by the Site activities and uranium concentrations in portions of these aquifers still exceed the current ground water cleanup levels. Consequently, the EPA, NMED, NRC and HMC are working to prevent future use of impacted ground water as a primary source of drinking water by these residents. The remedy is still considered protective in the short-term. However, continued follow up action is needed to eliminate the potential for future use of ground water in the affected areas of contamination by local residents and landowners.

The OU2 remedial activities involve the stabilization of the tailings impoundments, surface reclamation, and decommissioning of the mill. The soil contaminated by windblown tailings was excavated and disposed in the large tailings impoundment. Beginning in 1993, the mill facility was decontaminated, demolished, and parts were either disposed in place or placed in the large tailings impoundment. A radon barrier and an erosion-protection cover were constructed on the sides of the large tailings impoundment, and an interim soil cover was constructed on its top and on the small tailings impoundment.

No other significant tailings and surface soil reclamation activities were performed during the Second five-year review period, except maintenance of the interim radon barrier on the top of the large tailings impoundment. Tailings dewatering and use of evaporation ponds for treatment of collected water during the ongoing ground water restoration activities is necessary. The final phase of reclamation of the tailing impoundments and evaporation ponds will be implemented following completion of the ground water restoration program. A final radon barrier and erosion control cover will be constructed on top of the large impoundment after the tailings are dewatered. A final radon barrier will also be constructed on the small tailings impoundment once the ground water restoration is completed, and the remaining facilities are dismantled and disposed therein. HMC has revised its schedule and estimates that the tailings and evaporation pond reclamation will be completed by 2017. The OU2 remedial activities are being implemented by HMC under the direction of the NRC, pursuant to requirements set forth in License SUA-1471. After the reclamation and closure activities are completed at the mill site, the NRC will terminate License SUA-1471 and portions of HMC's property will be turned over to the U.S. Department of Energy (DOE) for long-term care in perpetuity. At that time, it is expected that all areas outside the portion of HMC's property that will be deeded to the DOE will be released by the NRC for unrestricted use.

The OU3 remedial activities addressed indoor and outdoor radon concentrations in the Subdivisions adjacent to the mill site. This OU was addressed by a Record of Decision (ROD), signed in September 1989. The EPA's decision was to take no further action.

The ROD also stipulated that the NRC and the EPA would sign a formal agreement outlining each agency's regulatory responsibilities at the Site. In December 1993, a Memorandum of Understanding (MOU) was signed by the NRC and the EPA that designated the NRC as the lead federal agency for

all remedial and reclamation activities at the Site. The EPA would monitor all such activities and review and comment directly to the NRC. The EPA was responsible for assuring that the activities to be conducted under the NRC's regulatory authority would allow attainment of applicable or relevant and appropriate requirements (ARARs) under the CERCLA, as amended, for the affected areas outside the mill site boundary.

The ground water restoration program is a long-term response action that has been ongoing since 1977. To date, HMC has yet to attain the cleanup standards established by the NMED or the NRC for this Site. However, since ground water restoration began, monitoring results have shown that the concentrations of the contaminants have generally decreased over time in many of the monitoring wells and that concentrations of contaminants within portions of the impacted aquifers have been reduced to below the corresponding NMED supported background concentrations. These decreases in concentration demonstrate the effectiveness of the ground water collection/injection system in moving portions of the contaminant plumes back toward the collection wells and, hence, preventing further migration of contamination off the mill site.

HMC submitted the results of an updated ground water background concentrations study (Background Study) to the NRC and NMED. The Background Study provides for a more statistically valid representation of background concentrations than was originally calculated for the Site. Following extensive review, comments and additional information, the NMED, on August 18, 2005, wrote a letter of support for the revised ground water background concentrations as the ground water cleanup levels for the Site. The revised ground water cleanup levels are for constituents within a specific aquifer unit that has background concentrations higher than the appropriate regulatory numerical standards. These revised ground water cleanup levels will be incorporated into a revision of DP-200 once the NRC formally approves them. According to the NMED letter, the revised ground water cleanup levels are applicable only within the Site boundary, and are subject to revision in the event any new information becomes available that may warrant re-evaluation. On September 27, 2005, the EPA notified NRC of the NMED supported revision of the ground water cleanup levels based on the proposed background concentrations, and indicated that these levels will be used as criteria for the Site ground water clean up. At the time of this five-year review process, the NRC is in the final stages of reviewing the ground water cleanup levels, and is likely to approve and incorporate the revised ground water cleanup levels into the License SUA-1471. HMC intends to revise the

ground water CAP to incorporate the revised ground water cleanup levels and submit it to the NRC for approval.

Recently, HMC performed ground water flow and transport modeling based on the progress and conditions at the Site, and has estimated that the ground water restoration program will be completed by 2015. This projection is based on the assumptions that a third evaporation pond is constructed to allow further expansion of the ground water collection and injection system, that the ground water cleanup levels recently supported by NMED and EPA (awaiting final approval by NRC) for each aquifer unit will apply to both on-site and off-site ground water, and that the NRC will approve the proposed ground water cleanup levels.

Based on this five-year review, it appears that the remedial actions originally set forth in the ROD and other decision documents (NRC License No. SUA-1471, ground water CAP, HMC 1991 Reclamation Plan with 10/93 Revision, and the NMED DP-200 and DP-275) for this Site are being implemented as planned, including the various modifications to the ground water restoration program. The remedy involving the decommissioning and reclamation of the mill site, including the decommissioning and dismantling of the mill, soil remediation, long-term stabilization of the tailings, and closure, is considered protective of human health and the environment in the short-term because the waste has been contained under the temporary radon barrier that limits emissions of radiological constituents into ambient air and protects it from erosion. Follow up action is necessary to monitor the continuing remediation of the tailings and installation of the final cover to ensure long-term protectiveness.

The remedy involving the ground water is also considered protective of human health and the environment in the short-term because the ground water collection and injection system appears to be effective in preventing further off-site migration of contaminants and in partially restoring portions of the affected aquifers, and because an alternate water supply from the Village of Milan has been, or will be provided to residents with wells screened within the affected aquifers. Follow up actions in the form of institutional controls and the establishment of clear procedures for attaining and maintaining performance and compliance standards are necessary to ensure long-term protectiveness.

# Five-Year Review Summary Form

## SITE IDENTIFICATION

**Site name (from WasteLAN):** Homestake Mining Company

**EPA ID (from WasteLAN):** NMD007860935

**Region:** EPA Region 6 | **State:** NM | **City/County:** Cibola County

## SITE STATUS

**NPL Status:** ☒ Final ☐ Deleted ☐ Other (specify):

**Remediation status (choose all that apply):** ☐ Under Construction ☒ Operating ☐ Complete

**Multiple OUs?** ☒ Yes ☐ No | **Construction completion date:** NA

**Has site been put into reuse?** ☐ Yes ☒ No (Portions of the site)

## REVIEW STATUS

**Reviewing agency:** ☒ EPA ☐ State ☐ Tribe ☐ Other Federal Agency:

**Author:** EPA Region 6, with support from U.S. Army Corps of Engineers, Albuquerque District

**Review period:** 2001 through August 2005

**Date(s) of site inspection:** April 26, 2006

**Type of review:**
☐ Statutory
☒ Policy
☐ Post-SARA ☐ Pre-SARA ☐ NPL-Removal only
☐ Non-NPL Remedial Action Site ☐ NPL State/Tribe-lead
☒ Regional Discretion

**Review number:** ☐ 1 (first) ☒ 2 (second) ☐ 3 (third) ☐ Other (specify):

**Triggering action:**
☐ Actual RA Onsite Construction ☐ Actual RA Start
☐ Construction Completion ☒ Recommendation of Previous Five-Year Review Report
☐ Other (specify): Request from State

**Triggering action date (from WasteLAN): 9/27/06**

**Due date (five years after triggering action date): 9/27/06.**

## Five-Year Review Summary Form

**Deficiencies:**

No deficiencies were noted that currently impact the protectiveness of the remedy. It was noted, however, that while the neighboring community is known to be connected to the municipal water supply for potable water, institutional controls have not been put in place to restrict ground water use, and unrestricted use may occur within the affected area for irrigation or other domestic purposes. In addition, the procedures to determine and verify that the ground water restoration objectives will be met within an expected timeframe do not appear to be clearly defined and might benefit from a ground water modeling effort.

**Recommendations and Follow-up Actions:**

To ensure the continued protectiveness of the ongoing remedy, it is recommended that institutional controls be put in place to restrict the use of ground water by local residents or landowners in areas affected by ground water contamination from the Site. Complete ATSDR's planned health hazard assessment for use of ground water for irrigation, gardening and livestock watering. Also recommended is the development of clear requirements to determine when the cleanup goals for ground water have been met, and post-closure monitoring requirements to be implemented once the ground water remedy is complete, to verify that recontamination does not occur. When the ground water cleanup levels, based on the proposed background concentrations, are approved, new Points of Compliance for the other aquifer units at the Site should be established. The off site ground water collection and irrigation system should be incorporated into the Site ground water restoration program and include performance monitoring requirements to determine effectiveness of remediating the ground water plume off site. The public site repository at New Mexico State University (NMSU) branch campus in Grants, New Mexico should be assessed for completeness of the documents and updated if necessary in order to provide the public with a means to access all site specific data and information.

**Protectiveness Statement(s):**

The remedy involving the decommissioning and reclamation of the mill site, including the decommissioning and dismantling of the mill, soil remediation, long-term stabilization of the tailings, and closure, is considered protective of human health and the environment in the short-term because the waste has been contained under the temporary radon barrier that limits emissions of radiological constituents into ambient air and protects against erosion. Follow up action is necessary to monitor the continuing remediation of the tailings and installation of the final cover to ensure long-term protectiveness. The remedy involving the ground water is also considered protective of human health and the environment in the short-term because a ground water collection and injection system is in place which appears to have already been effective in preventing further migration of contaminants and in partially restoring portions of the affected aquifers, and because an alternate water was provided within the affected area in 1985, and the recently identified residents who may be using ground water for primary drinking water sources are targeted for alternate water supply.

(Continued next page)

**Protectiveness Statement(s), Continued**

Follow up action in the form of institutional controls and the establishment of clear procedures for attaining and maintaining performance and compliance standards and the completion of ATSDR's health hazard assessment is necessary to ensure long-term protectiveness.

**Other Comments:**

The site appears to be well maintained, and the operators are effectively implementing and maintaining the system as designed and installed. The various parties involved with the site cleanup are the NRC, the NMED, HMC and the EPA.

## I. Introduction

The U.S. Environmental Protection Agency (EPA) has conducted a second five-year review of the remedial action implemented at the Homestake Mining Company Superfund Site (Site), located near the Village of Milan, Cibola County, New Mexico. This second five-year review of the Site covers the period from 2001 to 2005. The purpose of this review is to determine whether the remedy at the Site is protective of human health and the environment. The methods, findings, and conclusions of this review are documented in this Five-Year Review Report. In addition, five-year review reports identify issues found during the review, if any, and recommendations to address them. AVM Environmental Services, Inc. (AVM) of Grants, New Mexico, under contract with U. S. Army Corps of Engineers (USACE), Albuquerque District, provided support for this second five-year review. This five-year review was conducted consistent with the Office of Solid Waste and Emergency Response (OSWER) Directive 9355.7-03B-P, June 2001 (EPA 2001), *Comprehensive Five-Year Review Guidance,* which replaced and superceded all previous guidance on conducting five-year reviews.

The EPA conducted this five-year review pursuant to Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 121 and the National Contingency Plan (NCP). CERCLA Section 121 states:

> *If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented. In addition, if upon such review it is the judgement of the President that action is appropriate at such site in accordance with section [104] or [106], the President shall take or require such action. The President shall report to the Congress a list of facilities for which such review is required, the results of all such reviews, and any actions taken as a result of such reviews.*

The Agency interpreted this requirement further in the NCP; 40 CFR §300.430(f)(4)(ii) states:

> *If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after the initiation of the selected remedial action.*

This five-year review is conducted as a matter of EPA policy for remedial action, that upon completion, will not leave hazardous substances, pollutants, or contaminants on site above levels that allow for unlimited use and unrestricted exposure, but requires five or more years to complete.

This second five-year review report summarizes:

- Site background information;
- Remedial action activities;
- Performance and operational monitoring results;
- Site inspection and interviews;
- Data review; and
- Remediation progress and status at the Site.

The information summarized in this report was obtained from the Site Record of Decision (ROD), U. S. Nuclear Regulatory Commission (NRC) License SUA-1471 for the Site, New Mexico Environment Department (NMED) Discharge Plans DP-200 and DP-725 for the Site, NRC-approved ground water Correction Action Program (CAP), the first five-year review report (September 2001), semi-annual environmental monitoring reports, 2005 Annual Ground Water Monitoring /Performance Review Report for Homestake Mining Company (HMC) Grants Project, and other relevant documents. Attachment I lists all documents that were reviewed for this second five-year review.

### II Site Chronology

A chronology of significant Site events and dates is included in Table 1.

## III. Background

This section describes the physical setting of the Site, including a description of the land use and resource use, history of contamination at the Site, initial response actions taken at the Site, and the basis for taking actions.

## Table 1
## Site Chronology

| Date | Event |
|---|---|
| 1958 | Uranium mining mill operations began at the HMC site. |
| 1961 | Ground water contamination first observed at the site. |
| 1974 | The State of New Mexico signed an agreement with the NRC authorizing the state to regulate uranium milling activities under the Atomic Energy Act. |
| 1974- 1975 | The NMEID and the EPA conducted a study of the impacts of mining activities in the Grants Mineral Belt on area ground water and surface water. |
| 1977 | Ground water remediation activities at the site began. |
| 1981 | The NMEID approved discharge plan DP-200 for the HMC site. |
| August 1983 | A study of Radon levels in the area was released. |
| September 1983 | The HMC site was placed on the NPL. |
| November 1983 | EPA and HMC signed a Consent Decree that required HMC to provide an alternate water supply to homes in four subdivisions south of the site. |
| April 1985 | HMC completed connections for the alternate water supply. |
| June 1986 | The State of New Mexico returned regulatory authority for uranium mills to the NRC. |
| June 1986 | The Phase II Feasibility Study was completed. |
| June 30, 1987 | EPA issued an Administrative Order on Consent (AOC) to HMC to conduct an RI/FS for the radon operable unit. |
| October 1987 - January 1989 | HMC conducted RI/FS for the radon operable unit. |
| July 1989 | RI/FS reports issued for the radon operable unit. |
| September 15, 1989 | HMC submitted Corrective Action Plan for ground water remediation to the NRC. |
| September 27, 1989 | EPA signed ROD for the radon operable unit that determined no further action was necessary. |
| November 1989 | All activities required under 1983 Consent Decree were completed. |
| 1990 | Uranium milling operations at the site ceased. |
| September 1993 | Reclamation activities to clean up soils and decommission the mill began. |
| October 1993 | Reclamation Plan submitted to NRC. |
| December 14, 1993 | Memorandum of Understanding signed by EPA Region 6 and NRC Region IV detailing each agency's responsibilities and authority at the HMC site. |
| July 1994 | EPA released HMC from 1983 Consent Decree. |
| December 1995 | Demolition of the mill and surface reclamation activities at the site were completed. |
| January 1999 | NRC approved the soil cleanup and mill reclamation. |
| March 2002 | Second RO Unit added to the Treatment Plant to increase RO treatment capacity from 300 to 600 gpm. |
| May 2005 | Expansion of ground water collection and irrigation system for off site ground water plume remediation completed. |
| August 18, 2005 | NMED accepted proposed Site ground water background concentrations for each aquifer unit. |
| September 2005 | NMED performs sampling of residential wells at nearby subdivisions. |
| September 27, 2005 | EPA approves revised Site ground water background concentrations for each aquifer unit. |

## III.A Physical Characteristics

The Site is located in Cibola County, New Mexico, approximately 5.5 miles north of the Village of Milan, at the intersection of Highway 605 and Country Road 63, as shown in the Site Location Map provided as Figure 1 in Attachment II. The Site includes the uranium mill site and the impacted portions of the underlying ground water aquifers, known locally as the San Mateo alluvial aquifer and the Upper, Middle and Lower Chinle aquifers. HMC operated the uranium mill from 1958 until 1990. The mill was decommissioned and demolished from 1993 to 1995. The mill site is currently comprised of two former tailings impoundments (one large and one small impoundment), a ground water extraction and injection system, tailings flushing and dewatering system, a Reverse Osmosis (RO) water treatment plant, two collection ponds, two lined evaporation ponds for evaporative treatment and disposal of contaminated ground water, associated equipment and structures, and an office building, as shown in Figure 2. Figure 2 also shows four irrigation systems as a part of the off - site ground water remediation effort. The only current mill site operations are related to the operation and maintenance (O&M) of the continuing ground water remedy (EPA 2006).

The large tailings impoundment covers an area of about 170 acres and is approximately 85 - 100 feet high. It contains an estimated 21 million tons of mill tailings. The small tailings impoundment covers an area of about 40 acres and is 20 - 25 feet high. It contains approximately 1.2 million tons of mill tailings. Seepage from the two tailings impoundments has resulted in the contamination of the underlying ground water aquifers with radiological and non-radiological contaminants, including uranium, thorium-230, radium-226 and radium-228, selenium, molybdenum, sulfate and Total Dissolved Solids (TDS).

The Site is situated on alluvium (deposited by flowing water) within the San Mateo Creek drainage basin. The alluvium extends to depths of over 120 feet in places and consists primarily of sandy silt deposits that are covered by eolian (windblown) sands. Beneath the alluvium is an 800-foot thick interval of interbedded sandstone and shale units comprising the Chinle Formation, which is in turn underlain by the San Andres Limestone. The Chinle sandstone and shale units are tilted or inclined and come into direct contact with (*i.e.*, subcrop with) the overlying alluvium in certain areas of the Site (*see also* Geologic Cross-Section, Figure 3).

Five aquifer units exist beneath the Site. The upper aquifer is the San Mateo alluvial aquifer. Ground water flow in the alluvial aquifer is generally from the northeast to the southwest. The Chinle Formation underlies the alluvium. Three separate sandstone units exist within the Chinle Formation at the site. The sandstone units are separated by shale units and are referred to locally as the Upper, Middle, and Lower Chinle aquifers. The Chinle formation is tilted and dips toward the east such that the Upper Chinle sandstone aquifer subcrops or directly contacts a portion of the overlying alluvium within and near the Site. The Middle and Lower Chinle aquifers subcrop beneath the overlying alluvium to the east and south of the Site. The ground water within sandstone units of the Chinle Formation is recharged from the alluvium within the subcrop zone, which has resulted in contamination of the Chinle aquifers from the overlying impacted alluvial aquifer. The deepest aquifer at the Site is the San Andres aquifer. This aquifer is at a depth of approximately 1,000 feet below ground surface (bgs) at the Site. The San Andres aquifer, the most important regional aquifer in this area, has not been impacted by the Site (Hydro-Engineering 2006).

The Site geology and hydrology are complicated by two faults in the Chinle Formation, which trend northeast/southwest through the Site. They are identified in Site-related documents as the West Fault and East Fault. The West Fault extends under the Murray Acres subdivision and along the western perimeter of the large tailings impoundment. The East Fault extends under the Felice Acres and Broadview Acres subdivisions, the small tailings impoundment and the eastern perimeter of the large tailings impoundment. Ground water gradients and flow directions in the Chinle aquifers appear to be affected by the two faults and highly permeable zones associated with those faults (Hydro-Engineering 2006).

### III.B Land and Resource Use

The major land use immediately proximal to the Site consists of residential development. There are five residential subdivisions located south and southwest of the mill site: Felice Acres, Broadview Acres, Murray Acres, Pleasant Valley Estates, and Valle Verde as shown in Figure 2. Land near the Site is also used for agricultural and livestock purposes. Further south and west of these Subdivisions, most of the land is used for agricultural and livestock purposes, with some isolated residences. Much of the land immediately surrounding the mill site to the north, east and west has been acquired over the years by HMC, and this property has not been put into use, except for installation of some

infiltration trenches as a part of the ground water restoration program to the west of the mill site. HMC has also acquired some of the land south of the Subdivisions, and some of this land has been put to use for agricultural purposes. HMC is currently operating an off site irrigation system consisting of about 394 acres as a part of the ongoing ground water restoration and cleanup program.

The Alluvial Aquifer, and the Upper, Middle and Lower Chinle Aquifers have been used in the past as a domestic water supply for private wells maintained by the local residents (Hydro-Engineering 2006 & NMED 2006). Pursuant to the 1983 Agreement between HMC and the EPA, HMC financed the extension of the Village of Milan's municipal water supply to the residences of the Subdivisions and made payments to the Village of Milan for the residents' water usage over a period of ten years. The extension of the water supply was completed in 1985 (EPA 2006). A recent expanded survey conducted by HMC identified 12 residences in the Valle Verde subdivision that are not supplied by the Village of Milan water supply and the private wells at these residences are used as the primary source of drinking water. Private wells at two of these residences exceed Maximum Contaminant Level (MCL) for uranium. The "Report on the 2005 Residential Well Sampling Event Near the Homestake Mining Company Uranium Mill Superfund Site" by NMED sampled six private wells at residences that are not supplied by the Village of Milan water supply. Three of these private wells were located in the Valle Verde subdivision and uranium concentrations in two of these wells slightly exceeded the MCL for uranium. The other three private wells sampled by NMED at residences not connected to the Village of Milan water supply were located approximately 3 miles southwest of the Site. Uranium and selenium concentrations in these three wells were below the MCLs, although sulfate concentrations in these wells exceeded the secondary drinking water standard.

## III.C History of Contamination

Uranium milling operations at the Site began in 1958 under a license issued by the Atomic Energy Commission. Operations were originally conducted by two distinct partnerships, the Homestake-Sapin Partners with a milling capacity of 1,750 tons per day (tpd) and the Homestake-New Mexico Partners with a milling capacity of 750 tpd. The Homestake-New Mexico Partnership dissolved in 1961, and the property was ultimately acquired by the Homestake-Sapin Partners. The milling operations were combined and expanded to bring the operating capacity to 3,400 tpd. The name of the partnership was changed in 1968 to United Nuclear-Homestake Partners. In 1981, Homestake

Mining Company purchased United Nuclear Corporation's interest, and the name changed to Homestake Mining Company - Grants. On December 4, 2001, HMC merged with Barrick Gold Corporation, and is a wholly owned subsidiary of the Barrick Gold Corporation (NRC 2002).

Uranium milling operations involved an alkaline leach-caustic precipitation process to extract and concentrate uranium oxide from uranium ores. Waste byproducts from the milling operations were either disposed above ground in the two tailings impoundments or recycled back into the milling process. The tailings are composed of a uranium-depleted sand fraction and a fine fraction (slimes). The sand fraction was used for building the sides and internal dikes of the impoundment, while the slimes were allowed to collect in the center of the impoundment. To minimize wind and water erosion, the tailings were moistened with water and stabilized with rocks, erosion blankets, and chemical agents that form a crust on the surface of the sands (EPA 1989).

The contamination of ground water occurred as a result of the leaching or seepage of radiological and non-radiological contaminants and associated constituents from the tailing impoundments downward through the underlying soils and into the ground water. The primary contaminants and constituents of concern that are present in the ground water at the Site are uranium, selenium, radium-226 + radium-228, thorium-230, chromium, molybdenum, vanadium, sulfate, chloride, nitrate, and total dissolved solids (TDS) (Hydro-Engineering 2006).

The contamination of soil resulted from windblown tailings that were carried from the tailings impoundments and deposited mostly in the northeast of the tailings impoundments, the prominent downwind direction, on the surface soil surrounding the mill site (ERG 1995). Radium-226 was the primary contaminant of concern present in the soil. Soil cleanup of radiological constituents other than radium-226 was considered, but cleanup criteria were not proposed because levels of those constituents in excess of radium-226 were not anticipated from the alkaline process used at the mill. Some uranium measurements were performed, but most of the mill yard, where yellowcake, uranium ore concentrate and spills were likely, was treated as a disposal area (CH2MHill 2001). Much of the mill's operating equipment and buildings were also contaminated as a result of the milling operations (CH2MHill 2001).

## III.D Initial Response

The State of New Mexico signed an agreement with the NRC in 1974 that granted the State of New Mexico the authority to regulate uranium milling activities (*i.e.*, became an "Agreement State"). The State of New Mexico then issued a radioactive materials license to HMC for the uranium mill. In 1974 and 1975, the New Mexico Environmental Improvement Division (NMEID), now the NMED, and the EPA conducted a survey of the impact of uranium mining and milling activities in the area on surface and ground water quality. As a result of this investigation, it was discovered that private water wells in two of the subdivisions were contaminated with the heavy metal selenium (EPA 1989).

**Operable Unit No. 1.** Based on the discovery of elevated selenium in the ground water, NMEID and HMC agreed to a ground water protection plan in 1976. HMC began implementing this plan in 1977 through the installation and operation of a line of ground water injection wells near the southern portion of the mill site boundary adjacent to the Subdivisions and a series of ground water collection wells close to the tailings impoundments and evaporation ponds (CH2MHill 2001 and Hydro-Engineering 2006). Beginning in 1975, HMC also provided bottled water to residents of the Subdivision upon request.

HMC was issued a state-required ground water discharge plan (DP-200) by the NMED in 1981, which modified and approved the original ground water protection plan (now named the ground water restoration program) in accordance with the requirements set forth in the New Mexico Water Quality Control Commission (NMWQCC) Regulations (EPA 1989).

The Site was placed on the National Priorities List (NPL) in September 1983, primarily due to the ground water contamination found in residential wells. In December 1983, the EPA and HMC entered into an Agreement and Stipulation (Agreement) requiring HMC to secure alternate permanent water supplies for all existing and planned residents in the Subdivisions and to pay for the residents' water usage for ten years (EPA 2006). In complying with the Agreement, HMC financed the extension of the Village of Milan's municipal water supply to the Subdivisions. The water connections were completed in 1985. HMC made payments to the Village of Milan for the water used by the residents of the Subdivisions until 1995, a period of ten years (EPA 2006).

At the time of the Agreement, the EPA elected not to require additional response actions under CERCLA to remediate ground water contamination at the Site since HMC was already implementing the state required program. In 1986, the NRC re-asserted regulatory authority of uranium milling operations in New Mexico, at the request of the Governor of the State of New Mexico (*i.e.*, became a "Non-Agreement State" associated with uranium milling activities). Since that time, the ground water remedial activities have been regulated by the NRC pursuant to License SUA-1471, the NMED pursuant to DP-200, and by the EPA through the CERCLA process. In 1989, HMC submitted a CAP for ground water remediation to the NRC for incorporation into License SUA-1471, by amendment.

**Operable Unit No. 2.** Since 1986, HMC's milling operation and disposal of solid waste byproducts (uranium mill tailings) have been regulated by the NRC pursuant to License SUA-1471. After milling operations ceased in 1990, the activities for mill decommissioning, surface reclamation and remediation, stabilization of the tailings impoundments, and site closure have been performed under the direction of the NRC.

**Operable Unit No. 3.** HMC entered into an Administrative Order on Consent with the EPA in June 1987 to conduct a Remedial Investigation/Feasibility Study (RI/FS) to evaluate the extent of indoor and outdoor radon levels in the adjacent Subdivisions and determine whether such levels, if any, were attributable to HMC's milling and tailings operations at the mill site. This became known as the Radon Operable Unit (OU). HMC conducted the RI/FS from October 1987 to January 1989. Based on the results of the RI/FS, the EPA issued a ROD in September 1989 requiring no further action on the Radon OU. Although elevated indoor radon concentrations were discovered in a few houses in the Subdivisions, it was determined that there was no definitive correlation between the radon concentrations and the proximity of each of those homes to the mill site. The source of the elevated radon levels was determined by the EPA to be local, native, non-impacted soil (EPA 1989).

The ROD also stipulated that the NRC and the EPA would sign a formal agreement outlining each agency's responsibilities at the Site. This resulted in the signing of the Memorandum of Understanding (MOU) in December 1993. The MOU stipulated that the NRC was the lead federal agency primarily responsible for oversight of the remedial and reclamation activities at the mill site. The EPA would monitor all such activities and provide review and comment directly to the NRC. The EPA was responsible for assuring that the activities to be conducted under the NRC's regulatory

authority would allow attainment of applicable or relevant and appropriate requirements (ARARs) under CERCLA, as amended, for the areas outside of the mill site (EPA 1993).

### III.E Basis for Taking Action

The basis for taking action in each media include detection of the following constituents:

| Ground Water | Soil | Uranium Mill Tailings |
|---|---|---|
| Uranium | Ra-226 | Radon-222 emission |
| Selenium | Th-230 | |
| Molybdenum | | |
| Vanadium | | |
| Chromium | | |
| Ra-226 + Radium 228 | | |
| Thorium-230 | | |
| Sulfate | | |
| Chloride | | |
| Nitrate | | |
| TDS | | |

Initial response at the Site was taken due to concern associated with exposure to indoor radon levels in nearby homes. Additional response actions at the Site were taken to address exposure to residents in the Subdivisions to contaminated ground water with radiological and non-radiological constituents. Other potential exposures at the Site included exposure to uranium by-product contaminated surface soil, buildings, equipment, and radon emissions to ambient air from the tailing impoundments.

## IV. Remedial Actions

The documents that detail the remedial decisions for the Site are the 1989 ROD (EPA/ROD/R06/050, 1989), the NRC Source Material License SUA-1471, NRC-approved Reclamation Plan for the Site, NRC-approved Ground water CAP for the Site, and the NMED-approved Discharge Plans DP-200 and DP-725.

## IV.A Remedy Objectives

The remedial actions performed at the Site after it was placed on the NPL are summarized in this Report. The remedial action objectives for ground water restoration (OU1) are defined in the NRC License SUA-1471 and NRC-approved ground water CAP, the NMED DP-200, and the 1983 Agreement between the EPA and HMC. The remedial action objectives for decommissioning the mill, surface reclamation, long-term stabilization of the tailings and closure (OU2) are defined in the NRC License SUA-1471. Since the ROD for Radon (OU3) called for no further action, no remedial action objectives were set for this operable unit under CERCLA (EPA 1989). In general, the objectives of the remedial activities are to:

(1) limit radon emissions from the tailings impoundments;
(2) remediate contamination in soil that resulted from windblown tailings;
(3) remediate ground water to levels stipulated in the NRC License SUA-1471 and the NMED DP-200;
(4) dewater the large tailings impoundment to remove this area as a continuing source of ground water contamination; and
(5) prevent the consumption of contaminated ground water by residents in the Subdivisions.

## IV.B Remedy Selection

Remedy selection at the Site has been based on the procedures specified by the NRC, the NMED, and the 1983 Agreement between the EPA and HMC. The ground water CAP describes the remediation plan approved by the NRC for contaminated ground water at the mill site. The DP-200 contains the NMED approved ground water restoration plan for the Site. Also, the NRC License SUA-1471, as amended, defines the plans for mill decommissioning, surface reclamation, long-term stabilization of the tailings impoundments and closure of the mill site.

In summary, the major components of the remedy employed at the Site include the following:

- Decontamination of the mill facilities and equipment.
- Demolition of the mill facilities and equipment.

- Burial of contaminated debris and asbestos containing materials (ACM) in the out slope of the large tailings impoundment.
- Burial of uncontaminated debris and equipment in pits on the mill site.
- Excavation of surface soil contaminated with windblown tailings and burial in the out slope of the large tailings impoundment.
- Construction of a final radon barrier on the two tailings impoundments to minimize radon emissions and reduce erosion.
- Dewatering the large tailings impoundment to remove contaminated ground water and control the source area of the ground water contamination.
- Provision of an alternate and permanent water supply for residents of the Subdivisions and finance the cost of residents' water use for a period of ten years.
- Operation of a ground water collection and injection system to reverse ground water flow back toward the collection wells adjacent to the tailings impoundments with treatment of the collected ground water by reverse osmosis for re-injection or by evaporation, and tailings flushing and dewatering.

## IV.C Remedy Implementation

This section describes remedy implementation for each of the two operable units requiring remediation.

### Operable Unit No. 1 - Ground Water Restoration.

HMC implemented the state-approved ground water restoration program in 1977. The ground water restoration program was modified on September 15, 1989 to incorporate the ground water CAP approved by the NRC, as modified by the RO system described in the January 15, 1998 submittal to the NRC. The current program consists of a ground water collection/injection system for the San Mateo Alluvial aquifer and the Upper and Middle Chinle aquifers, tailings collection wells within the tailings impoundment, a tailings impoundment toe drain, an RO Treatment Plant, and two evaporation ponds as shown in Figure 2.

Fresh water is injected into the Alluvial Aquifer and the Upper and Middle Chinle aquifers to reverse natural gradients in order to flush contaminants from the impacted portions of the aquifer. Fresh water and treated water are injected into the San Mateo Alluvial aquifer at wells located along or near the south and southwest boundary of the mill site, between the Subdivisions and the tailings impoundments, to reverse the natural flow direction of the ground water away from the residences and back towards the tailings impoundments. Modifications have been made over time, including discontinuing injection in some of the downgradient alluvial wells and expanding injection closer to the collection wells as restoration has progressed. The injection and collection system was expanded to include the Upper and Middle Chinle aquifers. Also, upgradient collection at well P1 was added in 1993 to help maintain the reversal of flow in the alluvial aquifer and to prevent any contamination of upgradient flows.

The collected ground water is pumped to either the RO plant for treatment and aquifer re-injection or to the two collection ponds. The water in the collection ponds is then piped to one of two lined evaporation ponds for disposal along with RO treatment brines. Evaporation of water at the ponds is enhanced through spraying. Fresh water for injection is obtained from the San Andres Limestone aquifer and from product water that has been treated at the RO plant. (Hydro-Engineering 2006).

Since the last five-year review, HMC has performed several operating modifications or adjustments to improve the ground water restoration system under the oversight of the NMED and the NRC. Additional injection wells have been periodically installed closer to the tailings impoundments as the ground water has been restored downgradient. Additional injection and collection wells in the large tailings impoundment (tailings wells) have been installed and a series of toe drains have been constructed along the perimeter of the impoundment to aid in the flushing and dewatering of the tailings impoundment. HMC has also added a number of fresh water infiltration trenching systems south of the tailings impoundment. Since the last five-year review, a second RO Unit was added to increase the treatment of contaminated ground water collected from 300 gallons per minute (gpm) to 600 gpm. During 2005, the RO units treated an approximate average of 280 gpm of contaminated ground water. The RO treatment of collected contaminated ground water is expected to further increase starting in 2006. HMC is planning to construct another evaporation pond to increase the evaporative treatment capacity for collected ground water. In addition to the components of the remedy listed above, HMC has been investigating options to optimize the operations and enhance the

rate of ground water remediation at the Site. HMC was testing bioremediation techniques to enhance the removal of contaminants from the large tailings impoundment; however, HMC suspended the bioremediation testing during the review period. HMC intends to resume the bioremediation testing to enhance remedial efforts.

HMC is operating a second ground water restoration system to remediate those portions of the ground water contaminant plumes, which have migrated off the mill site and are beyond the influence of the primary ground water collection and injection system. This system includes extraction of affected ground water, which is outside the capture zone of the on site ground water extraction system, and land application treatment using an irrigation system. Initially the off-site ground water restoration system was comprised of 13 collection wells and two irrigation systems located south and southwest of the Subdivisions. Since the last five-year review, the off-site ground water restoration system has been expanded to four irrigation systems with ground water collection at 35 wells in 2005. The collection wells extract contaminated ground water by pumping, thereby gradually reducing the contaminant levels within the aquifer provided that the upgradient source of the contamination from the tailings seepage is effectively contained by the ground water collection/injection system at the mill site. The four irrigation systems consist of two center pivot spray irrigation systems and two flood irrigation locations. The irrigation systems provide land application treatment of the collected contaminated ground water. This second off-site ground water system consisting of irrigation is not currently part of the NRC approved CAP. In its November 2, 2000 correspondence to NMED (NRC 2000), NRC indicated that NRC is required to ensure that byproduct material at NRC licensed mill tailings impoundments, is managed in a manner that will provide for protection of ground water from radiological and non-radiological hazards associated with this material, whether the constituents are within the licensed site boundary or outside the licensed boundary. Therefore, the off-site ground water system may be considered a part of the Site ground water restoration program, and NRC and HMC intend to incorporate it into the ground water CAP. The irrigation system is also not a part of the current NMED approved DP-200. The off-site ground water restoration system has been included in the renewal process for DP-200 and is currently under review by the NMED.

Currently, the ground water restoration program includes approximately 50 ground water collection wells, 120 treated and fresh water injection wells, 150 tailings injection wells for flushing, 287

tailings dewatering wells, tailings impoundment toe drains, 35 off site irrigation system supply wells, fresh water infiltration system, RO Treatment Plant, and two evaporation ponds as shown in Figure 2.

Pursuant to the 1983 Agreement between HMC and the EPA, HMC financed the extension of the Village of Milan's municipal water supply to the residences of the Subdivisions and made payments to the Village of Milan for the residents' water usage over a period of ten years. The extension of the water supply was completed in 1985 (EPA 1989). Since the last five-year review, a survey conducted by HMC (Hydro-Engineering 2006) reports that there are approximately 39 residences that are on the Village of Milan Water Supply System, and 12 residences are not connected to the Village of Milan Water System and are using their private wells for domestic water supply. The recent NMED survey (NMED 2005) identified six residences that are not connected to the Village of Milan Water System and are using their private wells for domestic water supply. Three of the six residences identified by the NMED survey are to the south near the village of Milan and are not included in the HMC survey. EPA, NRC, NMED, and HMC are working to address the 15 residences that are currently not connected to the Village of Milan Water System.

**Operable Unit No. 2 - Mill Decommissioning, Surface Soils and Tailings Reclamation.** The decommissioning of the mill facilities and remediation of soil contaminated with windblown tailings occurred in two phases. The first phase involved the reclamation of all milling facilities and equipment not needed for the continued operation of the ground water restoration system. The first phase also included excavation of surface soil contaminated with windblown tailings and disposal on the mill site. The mill decommissioning and reclamation and the cleanup of the contaminated soil was conducted under the NRC-approved reclamation plan (CH2MHill 2001).

These activities began in 1992 with the removal of ACM from the mill facilities. All ACM was assumed to be contaminated with radiological constituents and was disposed of on the mill site. The ACM was placed in a disposal cell at the toe of the original out slope of the large tailings impoundment. After removal and disposal of the ACM, the mill components were tested for radiological contamination prior to demolition. Highly contaminated materials were dismantled and disposed in the large tailings impoundment. Other components exhibiting lower levels of contamination were decontaminated, dismantled, and/or broken down and disposed in pits within the mill area or on the east out slope of the large tailings impoundment. Mill structures were demolished,

crushed to reduce volume and void space, and disposed in pits within the mill area or in the small tailings impoundment. The burial pits were filled in five-foot lifts. Following placement of each lift of material, the pits were filled with a sand-cement slurry grout up to the level of that lift to fill in the remaining void space. This process was then repeated up to four feet bgs. The remaining four feet were filled with soil to the original grade. An average of two feet of contaminated soil were removed from the mill area and placed in the tailings impoundments. A few items exhibiting low levels of contamination were decontaminated to NRC standards and released from the mill site for unrestricted use. This work occurred from November 1993 until March 1995 (CH2MHill 2001).

HMC performed cleanup of radiological contamination at the mill site from 1988 to 1995, including the cleanup of soil contaminated with radium-226 from windblown tailings. The cleanup criteria were based on the NRC requirements of the Code of Federal Regulations (CFR), Title 10, Part 40, Appendix A, Criterion 6, which are repeated in the EPA requirements specified in 40 CFR Part 192. These regulations include a cleanup standard for radium-226 in the top 15 centimeters (cm) of soil of 5 picoCuries/gram (pCi/g) above background and 15 pCi/g above background for each 15-cm depth increment below the top 15 cm. The background level for radium-226 at the mill site was established as 5.5 pCi/g. Therefore, the cleanup standards were 10.5 pCi/g for the top 15 cm of soil and 20.5 pCi/g for each succeeding 15-cm depth increment.

Soil contaminated with radium-226 above these levels was excavated and placed on the outslope of the large tailings impoundment prior to the placement of the final radon barrier on the perimeter of the impoundment and the interim soil cover on top of the impoundment. The depth of the soil excavation ranged between zero and up to about five feet. Confirmatory sampling showed that the cleanup standard for radium-226 in soil was achieved. Fill materials taken from other areas at or near the mill site were used as backfill. The NRC approved the cleanup of the contaminated soil and the decommissioning of the mill in January 1999 (NRC 1999).

For final reclamation each tailings impoundment will be covered with a final radon barrier. HMC submitted the final radon barrier designs to the NRC in June 1995, and the NRC approved the designs in October 1995. The final radon barrier designed for the large tailings impoundment will consist of a soil cover with a variable thickness between 3.8 feet and 8.5 feet comprised of clayish sand. The soil cover for the small tailings impoundment will be approximately fourteen (14) feet thick and

comprised of similar materials. A rock cover will be placed on top of each radon barrier to protect against erosion. The rock covers will be approximately 6 - 9 inches thick. The final barrier was placed on the out slopes of the large tailings impoundment after the first phase of reclamation was completed. A one-foot thick interim soil cover was also constructed on its top and on the small tailings impoundment to protect against erosion.

No other significant tailings and surface soil reclamation activities were performed during this review period, except maintenance of the interim radon barrier on top of the large tailings impoundment. Tailings dewatering and use of evaporation ponds for treatment of collected water during the ongoing ground water restoration activities are necessary. The final phase of reclamation of the tailing impoundments and evaporation ponds will be implemented following completion of the ground water restoration program.

The final phase of reclamation will include the construction of the final radon barrier on the top of the large tailings impoundment and on the small tailings impoundment. The completion of the final radon barrier and all other reclamation activities to secure the large tailings impoundment is scheduled for 2013, after the tailings are dewatered. The completion of the final radon barrier and all other reclamation activities for containment of the small tailings impoundment are scheduled for September 2017, after completion of the ground water restoration. Prior to barrier placement on the small tailings impoundment, the collection ponds and Evaporation Pond No. 2, and No. 3 (to be constructed) will be dismantled, the liners decontaminated, and all materials placed in Evaporation Pond No.1. All remaining soil contamination at the mill site will be excavated and placed in Evaporation Pond No. 1, along with any remaining site structures and equipment that will not be decontaminated for offsite use. Evaporation Pond No. 1 is currently scheduled for reclamation in 2017. The final phase of reclamation cannot be started until the ground water restoration program is completed.

### IV.D Operations and Maintenance

Since the NRC is the lead Federal agency for the Site, the Site does not have an O&M Plan typically required under CERCLA. Required O&M activities at the Site are stipulated in the NRC license SUA-1471 and the NMED discharge permits DP-200 and DP-725. O&M activities are also specified in a number of internal documents kept at the Site.

The O&M activities include:

- Operation, maintenance, and monitoring of the ground water injection and collection wells and associated piping.
- Operation and maintenance of the large tailings impoundment flushing and dewatering system using collection and injection wells within the tailings pile and toe drains.
- Maintenance of the final radon barrier and interim covers on the large and small tailings impoundments.
- Operation and maintenance of the RO plant, collection ponds, and evaporation ponds.
- Ground water sampling and monitoring.
- Air monitoring.
- Maintenance of air monitoring stations and ground water monitoring wells.
- Operation and maintenance of the collection wells and the spray irrigation and flood irrigation components of the off site ground water restoration system.

HMC personnel are at the Site daily during the week performing O&M activities. Daily and weekly inspections are conducted to verify the condition of the components of the two ground water restoration systems, including the RO Water Treatment plant and the collection and evaporation ponds. The ground water restoration and treatment/disposal systems are also monitored by computer, and the systems are capable of calling HMC personnel at home during non-working hours if a problem occurs. Monitoring of collected water is performed as a part of the operation and maintenance. Total volume of ground water collected and quantities of constituents removed by the contaminated ground water collection and tailings dewatering systems from 1978 to 2005 are shown in Table 2. The collection wells, tailings wells and the toe drains have recovered over one billion gallons of contaminated ground water during this review period, and over four billion since 1977 (Hydro-Engineering, 2006).

The O&M costs are not determined in any of the reporting or decision documents for the Site. The NRC License SUA-1471 contains a condition requiring HMC to provide a financial surety to cover the cost to implement the remaining reclamation and closure activities. During the Site inspection, the HMC representative stated that it costs approximately $3.5 million to operate the facility annually. Given the fact that operations at the Site have varied from one year to the next and that HMC

continues to investigate methods to enhance and accelerate the rate of ground water restoration, it is likely that annual O&M costs may increase.

## V. Progress Since the Last Five-Year Review

As discussed earlier, HMC has expanded the ground water restoration program significantly during this review period, which included additional collection and injection wells, additional tailings flushing and dewatering wells, fresh water infiltration trenches, increasing the RO treatment capacity from 300 to 600 gpm, and expanding the irrigation system to address impacted ground water off site. In the First-Five Year Review Report (September 2001), the remedy involving the ground water restoration (OU-1) was considered protective of human health and the environment in the short-term. A ground water collection and injection system was in place, and was determined to be effective in preventing further migration of contaminants and in partially restoring portions of the affected aquifers. Also, an alternate water supply was provided to residences with private water supply wells located within the affected area. Recently identified residences that may be using their wells for primary drinking water sources are targeted for connection to the alternate water supply. The remedy consisting of the decommissioning of mill and tailings and soil reclamation (OU-2) was also considered protective of human health and the environment in the short-term because the waste was contained under the temporary radon barrier that limits emissions of radiological constituents into ambient air and provides protection from erosion.

The first five-year review report (September 2001) identified some issues and recommended follow-up actions, which if implemented, will ensure that the remedial actions performed remain protective of human health and the environment in the future. These identified recommendations and any actions taken during the second five-year review period are described below:

1. Ground water concentrations for uranium exceed the current ground water cleanup levels at all of the five subdivisions down gradient of the Site (Hydro-Engineering 2006). Also, ground water concentrations for selenium exceed the current ground water cleanup levels at or near some subdivisions. Recent surveys conducted by HMC (Hydro-Engineering 2006) and NMED (NMED 2005) found that a total of approximately 15 residences in and adjacent to the Valle Verde subdivisions are not supplied by the Village of Milan water supply, and the private wells at the

**Table 2**

## Ground Water Collected and Constituents Removed
### (Reproduced from Hydro-Engineering 2006)

| YEAR | SOURCE | TOTAL VOLUME PUMPED (GAL) | SULFATE (SO4) CONC. AMT. (MG/L) | (LB) | URANIUM (U) CONC. AMT. (MG/L) | (LB) | MOLYBDENUM (MO) CONC. AMT. (MG/L) | (LB) | SELENIUM (SE) CONC. AMT. (MG/L) | (LB) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1978 | G.W. | 27670033 | 5200 | 1200620 | 35 | 8081 | 40 | 9236 | 2 | 462 |
| 1979 | G.W. | 46371629 | 5200 | 2012095 | 35 | 13543 | 40 | 15478 | 2 | 774 |
| 1980 | G.W. | 39385860 | 5200 | 1708978 | 35 | 11503 | 40 | 13146 | 2 | 657 |
| 1981 | G.W. | 91613183 | 5200 | 3975155 | 35 | 26756 | 40 | 30578 | 2 | 1529 |
| 1982 | G.W. | 159848025 | 5200 | 6935910 | 35 | 46684 | 40 | 53353 | 2 | 2668 |
| 1983 | G.W. | 167018540 | 5200 | 7247043 | 35 | 48778 | 40 | 55746 | 2 | 2787 |
| 1984 | G.W. | 203258522 | 5200 | 8819519 | 35 | 59362 | 40 | 67842 | 2 | 3392 |
| 1985 | G.W. | 194074421 | 5200 | 8421015 | 35 | 56680 | 40 | 64777 | 2 | 3239 |
| 1986 | G.W. | 199326030 | 5200 | 8648886 | 35 | 58214 | 40 | 66530 | 2 | 3326 |
| 1987 | G.W. | 180881740 | 5200 | 7848576 | 35 | 52827 | 40 | 60374 | 2 | 3019 |
| 1988 | G.W. | 166460826 | 5200 | 7222843 | 35 | 48615 | 40 | 55560 | 2 | 2778 |
| 1989 | G.W. | 175780800 | 5200 | 7627243 | 35 | 51337 | 40 | 58671 | 2 | 2934 |
| 1990 | G.W. | 164378919 | 5200 | 7132508 | 35 | 48007 | 40 | 54865 | 2 | 2743 |
| 1991 | G.W. | 171497720 | 5200 | 7441397 | 35 | 50086 | 40 | 57242 | 2 | 2862 |
| 1992 | G.W. | 128398849 | 4925 | 5276234 | 27.2 | 29134 | 35.9 | 38419 | 1.60 | 1718 |
| 1992 | TOE | 8544670 | 12117 | 864006 | 53.2 | 3793 | 106.5 | 7595 | 1.73 | 123 |
| 1993 | G.W. | 115795020 | 5011 | 4841203 | 28.1 | 27130 | 45.4 | 43885 | 1.47 | 1425 |
| 1993 | TOE | 18357680 | 12117 | 1856262 | 53.2 | 8150 | 106.5 | 16315 | 1.73 | 265 |
| 1994 | G.W. | 98294087 | 4423 | 3624762 | 26.0 | 21146 | 27.3 | 22349 | 1.42 | 1162 |
| 1994 | TOE | 18337680 | 12117 | 1854240 | 53.2 | 8141 | 106.5 | 16299 | 1.73 | 264 |
| 1995 | G.W. | 108306398 | 3256 | 2942827 | 16.1 | 14553 | 19.2 | 17355 | 1.65 | 1491 |
| 1995 | TOE | 17711370 | 11370 | 1680500 | 54.6 | 8069 | 94.4 | 13952 | 2.25 | 332 |
| 1995 | TAILS | 5905740 | 8191 | 403680 | 36.1 | 1778 | 89.7 | 4420 | 0.15 | 7 |
| 1996 | G.W. | 122064160 | 3899 | 3967919 | 20.9 | 21225 | 26.8 | 27259 | 1.92 | 1950 |
| 1996 | TOE | 15431810 | 11537 | 1484295 | 46.4 | 5970 | 105.0 | 13509 | 1.29 | 166 |
| 1996 | TAILS | 9181390 | 9434 | 722129 | 40.2 | 3077 | 108.0 | 8236 | 0.18 | 14 |
| 1997 | G.W. | 94465562 | 4955 | 3836678 | 26.9 | 20892 | 33.4 | 25887 | 3.17 | 2456 |
| 1997 | TOE | 12029390 | 11094 | 1113808 | 41.8 | 419 | 100.0 | 10040 | 0.81 | 81 |
| 1997 | TAILS | 21292900 | 10284 | 1827575 | 45.8 | 8139 | 92.4 | 16420 | 0.14 | 25 |
| 1998 | G.W. | 74459130 | 5088 | 3161866 | 29.6 | 18385 | 34.8 | 21625 | 1.85 | 1151 |
| 1998 | TOE | 10321780 | 9870 | 850257 | 42.5 | 3665 | 95.2 | 8203 | 0.73 | 63 |
| 1999 | G.W. | 117752408 | 3363 | 3305027 | 16.6 | 16314 | 14.8 | 14545 | 2.06 | 2024 |
| 1999 | TOE | 8809890 | 11560 | 849976 | 54.3 | 3993 | 106.0 | 7794 | 0.46 | 34 |
| 1999 | TAILS | 120550 | 9420 | 9478 | 40.9 | 41 | 111.5 | 112 | 0.19 | 0 |
| 2000 | G.W. | 146609842 | 3358 | 4108868 | 18.8 | 23004 | 20.6 | 25206 | 1.94 | 2374 |
| 2000 | TOE | 8032870 | 9734 | 652590 | 58.6 | 3929 | 118.0 | 7911 | 0.34 | 23 |
| 2000 | TAILS | 12446810 | 9710 | 1008685 | 37.8 | 3927 | 127.0 | 13193 | 0.30 | 31 |
| 2001 | G.W. | 144925056 | 2770 | 3350438 | 19.6 | 23707 | 21.4 | 25884 | 1.65 | 1996 |
| 2001 | TOE | 9606280 | 9935 | 796529 | 43.1 | 3455 | 95.7 | 7673 | 0.78 | 63 |
| 2001 | TAILS | 31465370 | 8688 | 2281555 | 34.6 | 9086 | 89.2 | 23425 | 0.19 | 50 |
| 2002 | G.W. | 201357360 | 2748 | 4618092 | 14.9 | 25040 | 16.7 | 28065 | 1.23 | 2067 |
| 2002 | TOE | 17975520 | 9210 | 1381718 | 33.4 | 5011 | 88.7 | 13307 | 0.76 | 114 |
| 2002 | TAILS | 17817840 | 7670 | 1140588 | 23.5 | 3495 | 40.8 | 6067 | 0.12 | 18 |
| 2003 | G.W. | 177727419 | 2417 | 3585168 | 13.8 | 20470 | 15.5 | 22991 | 0.73 | 1083 |
| 2003 | TOE | 28418871 | 9457 | 2243048 | 35.6 | 8444 | 78.9 | 18714 | 4.35 | 1032 |
| 2003 | TAILS | 8890076 | 9800 | 727126 | 28.0 | 2078 | 92.0 | 6826 | 0.30 | 22 |
| 2004 | G.W. | 154422720 | 2272 | 2931913 | 11.3 | 14633 | 16.6 | 21386 | 0.79 | 1017 |
| 2004 | TOE | 26720928 | 8007 | 1787722 | 31.9 | 7115 | 67.6 | 15102 | 2.78 | 622 |
| 2004 | TAILS | 44745696 | 6360 | 2377848 | 23.1 | 8637 | 60.9 | 22769 | 0.20 | 75 |
| 2005 | G.W. | 130810679 | 2478 | 2705346 | 11.8 | 12883 | 15.5 | 16922 | 0.59 | 644 |
| 2005 | TOE | 20704320 | 8228 | 1421784 | 43.5 | 7517 | 87.5 | 15120 | 2.63 | 454 |
| 2005 | TAILS | 45685786 | 4389 | 1673497 | 18.7 | 7130 | 56.3 | 21467 | 0.18 | 69 |
| SUM G.W. | | 3,802,954,938 | | 138,498,130 | | 868,988 | | 1,015,176 | | 55,728 |
| SUM TOE | | 179,594,419 | | 15,993,167 | | 62,637 | | 141,293 | | 2,727 |
| SUM TAILS | | 197,552,158 | | 12,172,162 | | 47,387 | | 122,935 | | 311 |
| COMBINED SUM | | 4,180,101,515 | | 166,663,459 | | 979,012 | | 1,279,405 | | 58,765 |

NOTE: Average concentrations for 1978 to 1991 were used in calculating the quantities of constituents removed. Concentrations from the collection wells have gradually decreased from 1978 through 1991.
G.W. = Ground water; TOE = Toe drains on edge of tailings; TAILS = Large tailings collection wells

residences are used for domestic water supplies. Although these wells were not sampled by HMC, it appears from the well locations that three of these wells may have been included in the recent survey conducted by NMED (2006). Two alluvial wells in the Valle Verde subdivision, Wells RW6 and RW7, identified in the NMED survey as currently used for domestic water supply have dissolved uranium concentrations of 0.0395 and 0.0467 milligrams per liter (mg/l), which are slightly above the EPA's 0.03 mg/l drinking water MCL. Sulfate concentrations in these wells were also above the secondary drinking water standard (NMED 2006). However, the uranium and sulfate concentrations in these wells are lower than the background concentrations for the alluvium. Thus, the ground water in these private alluvial wells may not be impacted by the Site, as uranium concentrations are well below the proposed background concentrations. One Lower Chinle well located west of the Valle Verde subdivision (Well RW20) was also identified in the NMED Survey as currently used for domestic water supply. Although the uranium concentration in this well was below the EPA drinking water MCL, the nitrate concentration exceeded the MCL and sulfate concentration exceeded the secondary drinking water standards but was below the proposed background concentrations for the Lower Chinle (NMED 2006). Given the location of this well and the relatively low levels of uranium and sulfate, the ground water at this well does not appear to have been impacted by the Site and the elevated nitrate concentrations could be from nearby agricultural and domestic sources.

Three other wells completed in the Lower Chinle aquifer reported to be used as the primary drinking water source by the home owners in the NMED survey are located far to the south in Sections 9 and 16 of T11N, R10W. Although these wells are identified as Lower Chinle wells in the survey, they appear to be located south of the subcrop of the Lower Chinle sandstone. Sulfate concentrations in two of these wells exceed the secondary drinking water standards but were below all the proposed background sulfate concentrations established for the alluvium and the Chinle aquifers (NMED 2006). Given their location and analysis results, the ground water in these three wells does not appear to have been impacted by the Site. In the NMED survey, 28 other private wells were identified and sampled at residences, where the drinking water supply was provided by the Village of Milan. The draft report (NMED 2006) indicates that EPA's drinking water MCL for uranium was exceeded in 19 of these 28 wells. Uranium concentrations in the surveyed wells ranged from 0.01 mg/l to 0.849 mg/l.

Based on the discussion with NRC, NMED, EPA and HMC, residents in the affected areas and whose wells have been impacted are targeted to be connected to the Village of Milan water supply system. The municipal water supply will assure continued protectiveness. The EPA, NMED, NRC and HMC continue to work at preventing future use of impacted ground water by nearby residences as a primary source of drinking water.

A second round of residential well sampling was conducted by EPA and NMED in May 2006. Results from this sampling event will provide additional information regarding water quality at those wells. NMED and EPA indicated that the sampling results will be made available to owners of the corresponding residences, and in addition, a summary of the sampling results will be included in the Site's administrative record.

2. Institutional controls are necessary to ensure long-term protectiveness. To ensure the continued protectiveness of the ongoing remedy, it was recommended that institutional controls be put in place to restrict the use of ground water by local residents and landowners in those areas affected by ground water contamination.

   Although homeowners have access to water supply from the village of Milan, effective and enforceable institutional controls have not been established to restrict the use of impacted ground water by local residents for drinking water supply. At this time the EPA, NRC and NMED are actively working towards developing institutional controls.

3. Establishment of clear procedures for attaining and maintaining performance and compliance standards is necessary to ensure long-term protectiveness. The first five-year review report recommended development of clear requirements for determining when the cleanup goals for ground water will be met and the development of post-closure monitoring requirements to be implemented once the ground water remedy is complete, to verify that recontamination does not occur.

   HMC is required to periodically submit financial surety information to the NRC, together with project milestone schedules. The First-Five Year Review indicated that HMC expected to complete the ground water restoration program by 2008. Based on progress at the Site during this

review period, it is unlikely that the ground water cleanup levels will be attained by 2008. During the April 26, 2006 interview with the HMC representatives and the Site inspection, the HMC representative provided a revised working draft project schedule, which HMC will submit to NRC as required by their license requirement. The revised schedule indicates that the ground water restoration program will be completed by 2015. This projection was developed in 2005 using ground water flow and transport modeling (MODFLOW and MT3D) for the Site. It assumes that a third evaporation pond will be constructed to allow further expansion of the ground water collection and injection system, that the most recent NMED and EPA ground water cleanup levels for each aquifer unit will apply to both on-site and off-site ground water, and that the NRC will approve these proposed ground water cleanup levels.

Regarding the post closure monitoring concerns raised in the first 5-year review, a long-term surveillance plan, which includes ground water monitoring, is required when the Site reclamation activities are completed and the Site is transferred to U. S. Department of Energy (DOE) for long-term surveillance. The NRC reviews and approves the long-term surveillance plan prior to the license termination following completion of all reclamation activities, including ground water remediation, in accordance with the NRC's license SUA-1471 requirements. HMC expects to transfer the Site over to DOE in 2017.

4. The continuing remediation of the tailings and installation of the final cover on the tailings impoundment is necessary to ensure long-term protectiveness. A follow up action in the form of a risk evaluation was recommended to confirm the residual contaminant levels will be sufficiently protective under CERCLA (i.e. generally meet the $10^{-4}$ to $10^{-6}$ risk range and hazard index of less than one). A full risk assessment may not be necessary; however, a preliminary evaluation should first be done using existing air monitoring data to determine whether a full risk assessment is necessary.

   A radon barrier and interim soil cover were constructed for both tailings impoundments prior to the first 5-year review period. In addition to maintenance of the interim radon barrier and annual radon flux emission monitoring, no significant tailings and surface soil reclamation activities were performed during the second five-year review period. Tailings dewatering and closure of the evaporation ponds is necessary before the final remediation of the tailings and installation of

the radon cover can be completed. The final phase of reclamation of the tailing impoundments and evaporation ponds is scheduled to be completed in 2017 after the ground water restoration program has been completed.

HMC performs air monitoring and calculates dose from airborne radionuclides to the nearest residence. The total effective dose equivalent (TEDE) for 2005 calculated by HMC in their 2005 monitoring report were 68.7 and 48.7 (millirem per year (mrem/yr), including radon committed effective dose equivalent (CEDE), for two monitoring stations (HMC#4 and HMC#5) located within 100 yards of the nearest residence. If radon is excluded from the calculation, the TEDE is 12.4 mrem/yr at HMC#4 and 17.3 TEDE at HMC #5. (Radon dose is excluded because it decays rapidly and would overestimate the risk if included in the calculation.) These levels are below the 25 mrem/yr limit. The EPA has evaluated the air monitoring data and has determined that radionuclide levels are below those presenting an actionable risk under EPA guidelines.

## VI. Five-Year Review Process

This five-year review was conducted in accordance with the EPA's Comprehensive Five-Year Review Guidance, dated June 2001 (EPA 2001). Interviews with relevant parties, a Site inspection, and a review of applicable data and documentation covering the period of 2001-2005 were conducted. The findings of the review are described in the following sections.

### VI.A Administrative Components

The EPA initiated the five-year review for this Site in April 2006. The USACE was tasked by the EPA to perform the technical components of the review. The USACE retained AVM Environmental Services, Inc. of Grants, New Mexico to conduct technical components of the five-year review. The EPA Region 6 Remedial Project Manager for this Site, Sairam Appaji, led the review. The review team included: Natver Patel, AVM Environmental Services, Inc.; Doug Bruner, USACE Albuquerque District; Jake Ingram, NMED Ground Water Quality Bureau, Superfund Oversight Section; Jerry Schoeppner, NMED Mining and Environmental Compliance Section; and Paul Michalak, NRC, Fuels Cycle Facilities Branch, Division of Fuel Cycle Safety and Safeguards. Alan Cox from HMC and his

staff also supported the review team, providing information related to the Site and assistance during the Site inspection. The components of the review included Community Involvement, Document Review, Data Review, Site Inspection, Interviews, and development of the Five-Year Review Report (Report), as described below.

### VI.B Community Involvement

Upon completion of this second five-year review, the Review Report will be placed in the information repository maintained for this Site at the New Mexico State University Grants Library, located at 1500 Third Street in Grants, New Mexico, and at the EPA Region 6 office in Dallas, Texas. Public notice will be issued announcing completion of the five-year review and the availability of the Report in the information repositories.

### VI.C Document Review

This five-year review includes a review of relevant documents, including the NRC-approved ground water CAP, the NMED discharge plan 200, the NRC License SUA-1471 and amendments, ground water monitoring and performance review reports and related monitoring data, and the Draft NMED Residential Well sampling report. Documents that were reviewed are listed in Attachment 1.

### VI.D Data Review

Ground water monitoring data obtained during the 5-year review period includes ground water quality analyses, ground water levels, and the volumes of ground water collected, injected, and treated for on-going ground water remediation operations at the Site. In addition, data have also been obtained from settlement monitoring for the large tailings impoundment, weather monitoring, air monitoring, and leak-detection monitoring for the evaporation ponds. The ground water quality data, ground water level data and air monitoring data and associated reports and studies were reviewed for this five-year review.

The soil cleanup and mill reclamation activities were completed in 1995 and approved by the NRC in 1999. The cleanup levels associated with these actions were approved as meeting applicable

regulatory requirements. HMC documented achievement of these cleanup levels during the cleanup activities (NRC 1999). HMC performs annual radon flux emission monitoring on top of the large tailings impoundment as required by the NRC License SUA-1471, and HMC maintains the interim radon barrier on top of the impoundment to ensure that the radon emission rate meets the NRC's standard. Discussed below are the ground water monitoring and the air monitoring data and information reviews associated with ongoing remedial activities at the Site.

**Ground Water Monitoring Review**

Ground water monitoring at the Site began in 1977 and continued during the review period. Since that time, over 625 wells have been installed at the Site for ground water injection, collection, and/or monitoring purposes. Most of these wells are completed within specific aquifer units although several of the wells are screened in more than one aquifer unit. Aquifers that are monitored include the San Mateo alluvial aquifer, the Upper, Middle, and Lower Chinle aquifers, and the San Andres aquifer.

The NMED, in a letter dated August 18, 2005 to the EPA, supported revision of the cleanup levels established in NMED DP-200 for the San Mateo alluvial aquifer, for the Upper, Middle, and Lower Chinle aquifers and for the mixing zone where the ground water from the alluvial aquifers mixes with the Chinle aquifer unit. According to the NMED letter, these revised ground water cleanup levels are applicable only to cleanup within the Site boundaries. The revised cleanup levels for each aquifer unit and the mixing zone were based on a study of background concentrations conducted by HMC and submitted to the NRC and the NMED in 1999. NMED stated its support for the Site ground water background concentrations by letter of August 18, 2005, corrected on November 23, 2005, as the revised ground water cleanup levels within the Site.

With the exception of uranium, these ground water cleanup criteria were established only for the constituents having background concentrations that exceeded water-quality standards set forth in the NMWQCC Regulations. The ground water standards of the NMWQCC regulations still apply as cleanup criteria within the Site, including molybdenum (1.0 mg/l), combined radium-226 + radium-228 (30 picocuries per liter (pCi/l)), and chloride (250 mg/l). Although the current uranium standard of 5.0 mg/l in NMWQCC regulation is above the cleanup level established by the background study,

the revised NMWQCC Regulation uranium standard of 0.03 mg/l becomes effective on June 1, 2007. The EPA's MCL for uranium is 0.03 mg/l. Consequently, the revised uranium cleanup levels in the San Mateo Alluvial aquifer, the mixing zone, and the Upper and Middle Chinle aquifers are based on background since the background uranium concentrations in these aquifers exceed the EPA drinking water MCL for uranium.

The NRC-approved ground water CAP established ground water protection standards (cleanup levels) for the Site, at the Point of Compliance (POC) in the San Mateo Alluvium for chromium (0.06 mg/l), molybdenum (0.03 mg/l), selenium (0.10 mg/l), vanadium (0.02 mg/l), uranium (0.04 mg/l), thorium-230 (0.3 pCi/l), and combined radium-226 + radium-228 (5.0 pCi/l). The NRC CAP has established three POC wells: S4, D1, and X (see Figure 2 for alluvial well and POC locations). These NRC standards are different from the standards established by the NMED. The NMED standards apply throughout the entire site. A comparison of the Site cleanup standards for the San Mateo alluvial aquifer is presented in Table 3. The current NRC ground water cleanup levels in License SUA-1471 are based on background concentrations from a single well (Well P) collected over a two month period from December 1988 to February 1989 (NRC 1989).

**Table 3**
**Site Ground Water Standards for Alluvial Aquifer**

| Constituent | NRC (License SUA-1471) Ground Water Protection Standards | NMED DP-200 Ground Water Cleanup Levels | Proposed Site Ground Water Cleanup Levels [1] Based on Background (95% UTL), (NMED and EPA Supported) |
|---|---|---|---|
| Uranium, mg/l | 0.04 | 5.0 [2] | 0.16 |
| Selenium, mg/l | 0.10 | 0.12 | 0.32 |
| Molybdenum, mg/l | 0.03 | 1.0 [3] | 1.0 [3] |
| Vanadium, mg/l | 0.02 | ---- | ---- |
| Chromium | 0.06 | ---- | ---- |
| Ra-226 + Ra-228, pCi/l | 5.0 | 30.0 | 30.0 |
| Th-230, pCi/l | 0.30 | ---- | ---- |
| Sulfate, mg/l | N/A | 976 | 1500 |
| Chloride, mg/l | N/A | 250 | 250 |
| TDS, mg/l | N/A | 1770 | 2734 |
| Nitrate Nitrogen, mg/l | N/A | 12.4 | 12 |

Note (1) Pending NMED renewal of DP-200
(2) A uranium standard of 0.03 mg/l becomes effective June 2007.
(3) Irrigation Standard

HMC submitted the Background Study, an analysis of background water quality, and subsequent information to the NRC for review. The Background Study used numerous sampling results (between 27 and 192 sampling results depending upon the constituent of interest and the saturated unit) collected over a ten year period from 1995 to 2005. The HMC submittal requests revision of the NRC ground water cleanup levels that apply at POCs based on the 95% upper tolerance limit for background concentrations calculated in the Background Study. It is expected that the NRC approval of the revised water quality standards will include the establishment of new POCs for the upper and middle Chinle aquifers and the mixing zone (NRC interview April 19, 2006). It is noted that EPA and NMED have reviewed the Background Study and have supported the HMC proposed Site ground water cleanup levels. HMC intends to revise the ground water CAP following NRC's approval of the proposed ground water cleanup levels based on the background concentrations.

Uranium and selenium are the most widespread contaminants present at the Site, and their distributions are very similar. Therefore, the ground water monitoring data review presented in this Report will focus on uranium concentrations and distributions within each aquifer unit. For more information, refer to HMC's annual report entitled "2005 Annual Monitoring Report / Performance Review for Homestake Mining Company's Grants Project, Pursuant to NRC License SUA-1471 and Discharge Plan DP-200", March 2006 (Hydro-Engineering, 2006).

The ground water monitoring data and site geology indicate that the San Mateo alluvial aquifer is directly impacted by contamination from tailings seepage at the mill site and that elevated concentrations of Contaminants of Concern (COCs) occur in the Upper, Middle and Lower Chinle aquifers near their subcrops with the overlying alluvial system. (Hydro-Engineering 2006).

**San Mateo Alluvial Aquifer.** The primary aquifer of concern is the San Mateo alluvial aquifer. This is the aquifer that is most contaminated and was previously used by residents in the Subdivisions for potable water. However, contamination is also present in the Upper, Middle and Lower Chinle aquifers at the Site. One of the objectives of the ground water restoration program is to reverse the natural ground water gradients at the site to move contamination away from the Subdivisions and towards the collection wells. Fresh water is injected into the San Mateo alluvial aquifer and the Upper and Middle Chinle aquifers. Contaminated ground water is collected from the San Mateo alluvial aquifer and the Upper Chinle aquifer.

Figure 5 is a contour map of the water elevations in the Fall of 2005 for the San Mateo and Rio San Jose alluvial aquifers. Also shown are areas where the San Mateo alluvium is not saturated. The map shows the effect of ground water collection and injection on the hydraulic gradients and flow directions within the alluvium beneath the mill site. The natural southwest ground water flow direction has been reversed in an area between the tailings impoundments and the northern edge of the Subdivisions, thereby creating a capture zone for recovering contaminated ground water and preventing the further migration of contaminants off the mill site (Hydro-Engineering 2006). Figure 6 shows the locations of monitoring wells in the San Mateo alluvial aquifer used for documenting current ground water quality conditions and trends in contaminant concentrations over time.

Figure 7 is an iso-concentration map of uranium in the San Mateo alluvial aquifer. The map highlights the locations where uranium concentrations exceed the proposed Site cleanup criterion of 0.16 mg/l that was supported by the NMED and the EPA, and is still awaiting final approval by NRC. The areas of highest uranium concentrations occur beneath or near the tailings impoundments. Two separate, narrow, and elongated uranium plumes extend from the tailings impoundments to the west and south as shown in Figure 7. The uranium plume to the west of the impoundments extends beneath the northern portion of Pleasant Valley Estates subdivision, past Valle Verde. Concentrations decline with distance from the tailings impoundment, with further declines in uranium concentrations where the San Mateo alluvial aquifer joins the Rio San Jose alluvial aquifer. The southward-extending uranium plume appears to originate beneath the east perimeter of the small tailings impoundment and follows Highway 605 past the Broadview Acres and Felice Acres subdivisions. Beyond the Felice Acres subdivision the plume bends toward the west along a separate and constrictive zone as depicted by the alluvial aquifer limits in Figure 7. There is also an isolated area within the Murray Acres subdivision where the uranium levels exceed the proposed background level.

An examination of uranium concentration trends provided in the 2005 Annual Report (Hydro-Engineering, 2006) show that uranium concentrations within these plums is either stable or declining with the exception of a segment of the southward extending plume, where the plume bends toward the west. Uranium concentrations in three of the five wells monitored in this segment (862, 876 and 869) show increasing trends in uranium concentrations (see Figure 8). Uranium concentrations have remained below the proposed background level with no increasing trend in Well 631, which is located

downgradient of the wells 862, 876 and 869. Uranium concentrations in wells upgradient of this segment also show no increasing trends and have actually declined in Well 496 as shown in Figure 9. Furthermore, sulfate, chloride, TDS and selenium concentrations did not show increasing trends in wells 862, 876 and 869. Thus, the increase in uranium concentrations in wells 862, 876 and 869 may not reflect a long-term trend but could be due to changing flow paths resulting from injection and extraction at nearby wells. Additional monitoring of these wells over time will be needed to determine the concentration trend in these wells and in downgradient well 631.

In the first five-year review report, increasing trends in uranium concentrations were reported for Well 802 located in the northeast corner of the Murray Acres subdivision. Uranium concentrations have declined in Well 802 over this 5-year review period such that the overall trend is down as shown in Figure 10. The uranium concentrations at all three POC wells, S4, D1, and X, have continued to decline as indicated in Figures 11, 12 and 13.

Overall, the decrease in concentrations in most of the wells located in areas of fresh-water injection demonstrate the effectiveness of the collection/injection system in (1) moving those portions of the contaminant plumes under the mill site back toward the collection wells, and (2) preventing the further migration of contamination off the mill site and toward the Subdivisions.

**Upper Chinle Aquifer**. Figure 14 is a contour map of the water elevations in the Fall of 2005 for the Upper Chinle sandstone. This Figure shows the subcrop of this unit with the alluvium. The Upper Chinle aquifer does not exist to the west and south of the subcrop area. A blue dot pattern is used to show the limits of the Upper Chinle aquifer. This figure also shows the location of the West and East Faults. The blue arrows on Figure 14 show the direction of ground water flow, which is influenced by location of the ground water extraction and fresh-water injection wells shown in the Figure. Upper Chinle wells CW4R, CW5, CW13, CW25 and 944 are shown in cyan blue to denote that these are fresh-water injection wells. Upper Chinle wells CE2, CW3, 929 and 934 were pumped as a source of flushing water for the Large Tailings Pile in 2005 and are shown in orange. Well CW18 is also shown in orange because this well was used as a supply for fresh-water injection starting in late September of 2002 but was not used continuously after May of 2004.

The location of Upper Chinle wells is shown on Figure 15 along with the iso-concentration plots of uranium in the Upper Chinle aquifer. Uranium concentrations in the Upper Chinle aquifer exceed the proposed background concentration of 0.18 mg/l within the mixing zone location at the Large Tailings Impoundment and at the mixing zone location within the Felice Acres subdivision as shown in Figure 15. Uranium concentrations also exceed the proposed background concentration of 0.09 mg/l in the Upper Chinle for several hundreds of feet beyond the mixing zone within the Felice Acres subdivision and between the mixing zone and extraction well CW3 in the vicinity of the Large Tailings Impoundment. An examination of uranium concentration trends provided in the 2005 Annual Report (Hydro-Engineering 2006) for the Upper Chinle show that uranium concentrations are either stable or declining in all wells except well CW-3 as shown in Figure 16. Uranium concentrations have increased substantially in this well because this well has been pumped as a source of flushing water through the mixing zone at the Large Tailings Impoundment. Selenium concentrations in the Upper Chinle aquifer have exceeded the mixing zone background concentration of 0.14 mg/l at well CW54 located within the Felice Acres subdivision. Selenium also exceeded the non-mixing zone background of 0.06 mg/l at extraction well CW3 located adjacent to the Large Tailings Impoundment.

**Middle Chinle Aquifer**. Figure 17 shows the Middle Chinle wells and water level measurements and water level contours of the Middle Chinle aquifer for the Fall of 2005. This figure shows the positions of the East Fault and West Fault and locations where the Middle Chinle aquifer exists and where the Middle Chinle aquifer subcrops beneath both saturated and unsaturated alluvium. There is significant displacement across the West Fault. The limited portion of the Middle Chinle aquifer that exists west of the West Fault functions as two separate ground water systems, with different water levels and flow directions. West of the fault the flow is toward the alluvial subcrop. East of the West Fault, the hydraulic gradient in the Middle Chinle aquifer is generally in a northeast direction toward the collection wells, except for localized mounding near injection Wells CW14, CW30 and CW46.

Figure 18 provides isoconcentration plots of uranium in the Middle Chinle aquifer during 2005. The map also depicts the boundaries of the aquifer, including where it subcrops beneath the overlying San Mateo alluvium deposits. The map shows one area within the Middle Chinle and two areas within the mixing zone of the Middle Chinle aquifer, where the uranium concentrations in 2005 were above the corresponding background concentrations. The uranium concentrations in the mixing zone located

within the southwestern portion of Felice Acres in the vicinity of collection wells CW44, CW45 and 498 exceeded the estimated background concentration of 0.18 mg/l. The uranium concentrations in the Middle Chinle aquifer north of the mixing zone within portions of the Felice Acres and Broadview Acres subdivisions also exceeded the estimated Middle Chinle background concentration of 0.07 mg/l. These elevated concentrations are a result of flow from the saturated portion of the alluvial aquifer into the Middle Chinle aquifer within the subcrop zone.

Uranium concentrations in the Middle Chinle aquifer wells CW35 and WR25 located west of the West Fault also exceeded the mixing-zone proposed background concentration of 0.18 mg/l. An examination of uranium concentrations trends provided in the 2005 Annual Report (Hydro-Engineering 2006) show that uranium concentrations within the Middle Chinle aquifer are relatively stable, except for declining trends in two wells, CW44 and CW45, and slight increases in two wells, well 434 and well 493, as shown in Figures 19 and 20, respectively. Middle Chinle wells CW44 and CW45 are collection wells located in the area of higher uranium concentrations in the mixing zone within the southern portion of the Felice Acres subdivision. The declines in concentration are the result of flushing of this portion of the aquifer with water from nearby injection wells CW30 and CW46. Middle Chinle wells 434 and 493 are located in the Middle Chinle aquifer north of the mixing zone within Broadview Acres and east of Felice Acres, respectively. The slight increase in uranium concentrations in two wells may not be a long-term trend but could be due to changing flow paths resulting from injection and extraction at nearby wells. Additional monitoring of these wells over time will be needed to determine the concentration trend in these two wells.

**Lower Chinle Aquifer**. Figure 21 shows the Lower Chinle wells and water level measurements and water level contours for the Fall of 2005. This figure shows the positions of the East Fault and West Fault and locations where the Lower Chinle aquifer exists and where the aquifer subcrops beneath both saturated and unsaturated alluvium. Flow west of the West Fault in the Lower Chinle is from the subcrop area toward the northeast. The flow in the Lower Chinle between the two faults is in a north and northwest direction from the subcrop area toward the West Fault. This potentiometric surface indicates preferential flow along a more permeable zone adjacent to the West fault because water levels are higher west of the West Fault. Lower water-level elevations occur in the Lower Chinle around irrigation supply well CW29 due to pumping from this well during the irrigation season.

Figure 22 provides isoconcentration plots of uranium in the Lower Chinle aquifer during 2005. The map also depicts the faults and locations where the aquifer subcrops beneath the overlying alluvium. The map shows one area within the mixing zone of the Lower Chinle aquifer between the two faults, where the uranium concentrations in year 2005 were above the corresponding mixing zone background concentration of 0.18 mg/l. The uranium concentrations in the Lower Chinle adjacent to the mixing zone also exceeded the estimated Lower Chinle background concentration of 0.03 mg/l. The uranium concentrations in one Lower Chinle aquifer well (Well 832) located west of the West Fault also exceeded the estimated Lower Chinle background concentration of 0.03 mg/l. The uranium concentration in this well of 0.08 mg/l does not appear to be Site related because the well is located west of the West Fault where the water levels are higher than in the portion of the Lower Chinle aquifer located east of the West Fault.

An examination of uranium concentrations trends provided in the 2005 Annual Report (Hydro-Engineering 2006) show that uranium concentrations are relatively stable, except for a slight increase in well CW29. This increase is apparently the result of contributions of water from the mixing zone due to pumping from this well during the irrigation season. Fluctuations in uranium concentrations in wells CW42 and 653 are likely the result of changing flow paths resulting from periodic extraction from wells 653, 538 and CW-29 for irrigation use. Additional monitoring of these wells over time will be needed to determine whether the irrigation extraction is effective at reducing uranium concentrations within the surrounding portion of the Lower Chinle aquifer.

**Air Monitoring Data**

HMC submits semi-annual environmental monitoring reports to the NRC as required by 10 CFR 40.65. The reports include calculations of annual effective dose equivalent to individual members of the public. HMC currently monitors ambient air quality at six locations along the perimeter of the mill site, and at one background location for airborne natural uranium (U-nat), radium-226 (Ra-226), thorium-230 (Th-230), radon-222 (Rn-222), and direct gamma exposure rate. Figure 23 shows where each air monitoring station is located. The nearest residence to the Site is located within 100 yards of sampling locations HMC #4 and HMC #5. Therefore, exposure at both of these monitoring stations is considered, and the monitoring location with the highest exposure is used by HMC for calculating dose to the maximum exposed individual member of the public.

The semi-annual environmental monitoring reports for July – December for each year submitted to the NRC contain airborne radionuclide concentrations and direct gamma radiation exposure rate monitoring results, and a summary of the annual effective dose equivalent for inhalation of these radionuclides and from direct gamma radiation exposure at those monitoring stations. This summary compares the data from the background sample location to the data from the sample from the nearest residence locations (HMC #4 and HMC #5) that contained the highest levels of each constituent. Ten semi-annual environmental monitoring reports from 2001 to 2005 were available for this five-year review.

Table 4 and Table 5 present the direct gamma exposure rate, Rn-222, U-nat, Ra-226, and Th-230 for 2005 at all monitoring points during 2005. The report contains a TEDE assessment based on the sum of the CEDE for inhalation of radionuclides, CEDE for exposure to Rn-222, and the dose equivalent for exposure to direct radiation. The values at the background location are subtracted out to obtain the TEDE.

In addition, HMC calculates the dose at 100% and 75% occupancy period for residential scenarios. HMC uses 75% occupancy duration, as recommended in NUREG/CR-5512, for demonstrating compliance with the NRC's 100 mrem/yr standard. Table 6 presents each of these parameters for air monitoring station HMC #4 and HMC #5 during 2001 to 2005.

The air monitoring data show no radon emissions above the EPA recommended indoor air level of 4.0 pCi/l, and the TEDE is below the NRC criterion (with exemption) of 100 mrem/yr. However, it should be noted that the Site air monitoring data are for outdoor air concentrations, and the EPA's recommended 4.0 pCi/l limit is for indoor air concentration. In addition, HMC performs annual radon flux emission measurements on the interim radon cover on the tailing impoundments. HMC performs necessary maintenance of the interim cover and complies with the 20 $pCi/m^2/s$ radon flux emission standard.

## Table 4

## Rn-222 and Direct Gamma Radiation Exposure Rate Monitoring Results, 2005

| Monitoring Point | Rn-222 Concentration (uCi/ml)[1] | | Direct Gamma Radiation Exposure Rate (mrem/6 months) | |
|---|---|---|---|---|
| | Dec-June | June-Dec | Jan-June | July-Dec |
| HMC #1 | 1.20E-09 | 1.50E-09 | 10 | 17 |
| HMC #2 | 1.80E-09 | 1.50E-09 | 21 | 24 |
| HMC #3 | 9.00E-10 | 1.20E-09 | 15 | 18 |
| HMC #4 | 1.80E-09 | 2.00E-09 | 17 | 24 |
| HMC #5 | 1.40E-09 | 1.70E-09 | 20 | 24 |
| HMC #6 | 1.40E-09 | 1.60E-09 | 21 | 18 |
| HMC #7 | 1.30E-09 | 1.30E-09 | - | - |
| HMC #16[2] | 1.20E-09 | 1.10E-09 | 12 | 16 |

Notes: (1) uCi/ml (microcuries per milliliter)
(2) HMC #16 is considered background monitoring point for radon and direct gamma radiation exposure

## Table 5
## Airborne Radionuclide Monitoring Results, 2005

| Monitoring Point | 2005 Quarter | U-nat (uCi/ml) | Th-230 (uCi/ml) | Ra-226 (uCi/ml) |
|---|---|---|---|---|
| HMC #1 | 1st | 1.10E-16 | <1.0E-16 | <1.0E-16 |
| | 2nd | 1.96E-15 | <1.0E-16 | <1.0E-16 |
| | 3rd | 2.04E-15 | <1.0E-16 | <1.0E-16 |
| | 4th | 1.07E-15 | <1.0E-16 | <1.0E-16 |
| HMC #2 | 1st | <1.0E-16 | <1.0E-16 | <1.0E-16 |
| | 2nd | 1.75E-15 | 1.13E-16 | <1.0E-16 |
| | 3rd | 1.55E-15 | <1.0E-16 | <1.0E-16 |
| | 4th | 6.08E-16 | <1.0E-16 | 3.42E-15 |
| HMC #3 | 1st | 2.67E-16 | <1.0E-16 | <1.0E-16 |
| | 2nd | 1.38E-14 | 1.33E-16 | <1.0E-16 |
| | 3rd | 6.98E-15 | <1.0E-16 | <1.0E-16 |
| | 4th | 2.82E-15 | <1.0E-16 | 1.20E-14 |
| HMC #4 | 1st | 1.42E-16 | <1.0E-16 | <1.0E-16 |
| | 2nd | 8.93E-15 | <1.0E-16 | <1.0E-16 |
| | 3rd | 8.36E-15 | <1.0E-16 | <1.0E-16 |
| | 4th | 3.60E-15 | <1.0E-16 | <1.0E-16 |
| HMC #5 | 1st | 1.50E-16 | <1.0E-16 | <1.0E-16 |
| | 2nd | 2.15E-14 | 1.40E-16 | <1.0E-16 |
| | 3rd | 1.35E-14 | 1.12E-16 | <1.0E-16 |
| | 4th | 3.31E-15 | <1.0E-16 | <1.0E-16 |
| HMC #6 | 1st | <1.0E-16 | <1.0E-16 | <1.0E-16 |
| | 2nd | 2.81E-15 | <1.0E-16 | 4.66E-16 |
| | 3rd | 2.60E-15 | <1.0E-16 | <1.0E-16 |
| | 4th | 6.52E-16 | <1.0E-16 | <1.0E-16 |
| HMC #8 | 1st | 9.61E-15 | <1.0E-16 | <1.0E-16 |
| | 2nd | 1.33E-14 | 1.95E-16 | 1.45E-16 |
| | 3rd | 1.94E-14 | 1.72E-16 | <1.0E-16 |
| | 4th | 9.61E-15 | 1.60E-16 | 2.09E-15 |

HMC # 6 is the background monitoring station

**Table 6**
**Total Effective Dose Equivalent at Monitoring Stations HMC#4 and HMC#5**

| Monitoring Point | Year | Occupancy Duration | CEDE – Inhalation of Radionuclides Mrem/yr[1] | CEDE - Rn-222 mrem/yr [1] | Dose Equivalent – Direct Radiation mrem/yr [1] | TEDE mrem/yr [1] |
|---|---|---|---|---|---|---|
| HMC #4 | 2001 | 100% | <2.2 | <59.6 | 21.3 | 81.3 |
| | | 75% | <1.7 | <45.0 | 16.0 | 62.7 |
| | 2002 | 100% | 2.8 | 65.2 | 18.0 | 84.0 |
| | | 75% | 1.1 | 49.0 | 13.5 | 63.6 |
| | 2003 | 100% | 2.1 | 79.8 | 13.0 | 94.9 |
| | | 75% | 0.8 | 60.0 | 10.0 | 70.8 |
| | 2004 | 100% | 3.8 | 10.0 | 0 [2] | 13.8 |
| | | 75% | 1.5 | 7.5 | 0 [2] | 9.0 |
| | 2005 | 100% | 3.4 | 74.9 | 13.0 | 91.3 |
| | | 75% | 2.6 | 56.3 | 9.8 | 68.7 |
| HMC #5 | 2001 | 100% | 2.2 | 59.9 | <21.3 | 83.4 |
| | | 75% | 1.7 | 45.0 | <16.0 | 62.7 |
| | 2002 | 100% | 6.7 | 39.9 | 1.1 | 47.7 |
| | | 75% | 4.0 | 30.0 | 0.8 | 34.8 |
| | 2003 | 100% | 3.3 | 79.8 | <10.0 | 93.1 |
| | | 75% | 1.7 | 60.0 | <7.5 | 69.2 |
| | 2004 | 100% | 14.3 | 10.0 | 0 [2] | 24.3 |
| | | 75% | 9.4 | 7.5 | 0 [2] | 16.9 |
| | 2005 | 100% | 7.1 | 39.9 | 16.0 | 63.0 |
| | | 75% | 5.3 | 30.0 | 12.0 | 47.3 |

(1) - Net dose from the site (background dose subtracted)
(2) - Both the nearest Residence locations HMC#4 and HMC #5, and the background location were @ 38.0 mrem/yr

## VI.E Site Inspection

A Site inspection was conducted on April 26, 2006 by the USACE for the EPA and by the USACE contractor, AVM of Grants, New Mexico. The Site-inspection checklist is included as Attachment 3. The purpose of the inspection was to assess current Site conditions as they relate to the protectiveness of the remedy.

No significant issues were noted during the Site inspection. The Site appeared to be well maintained and operated. Barbed-wire fencing surrounds the Site, and chain-link fencing surrounds the Site office. Entry to the Site was made at the HMC office located on the northeast corner of the mill site.

The interim radon barrier and protective rock cover on the large tailings impoundment appeared in good condition. There were no signs of bulging, cracking, slumping, or erosion. Numerous injection and collection wells were present on top of the large tailings impoundment, and additional wells were being installed during the inspection. During the inspection, the 351$^{st}$ injection/collection well was being installed on top of the large tailings impoundment. Due to the large number of wells present on site, not every well was directly inspected. However, an injection well with recent modification to control gravity feed injection was inspected.

The area where ACM was disposed in the out slope of the large tailings impoundment was clearly marked. The rock mulch and re-vegetation over the mill disposal area was in very good condition. Forced evaporation was operating in both evaporation ponds at the time of inspection. The RO plant was down for maintenance during the site inspection. The second RO Unit recently installed was observed in the RO Treatment Plant. The RO plant appeared well maintained and in good condition The Lime Batch Plant near the RO Treatment plant was observed, and was found to be clean and organized. Several monitoring, collection and injection wells were observed during the inspection, and appeared to be well maintained. One air monitoring station (Station No. 5), located north of the Murray Acres subdivision was directly inspected, and all components were functioning and appeared in good condition. Overall, the Site generally appeared to be well maintained.

### VI.F Interviews

Interviews for this five-year review were conducted with representatives from the NMED, the NRC, HMC, and the community. Interview Record Forms are provided in Attachment 4. Mr. Alan Cox of HMC was interviewed during the Site inspection on April 26, 2006, at the Site. Mr. George Hoffman of Hydro-Engineering, HMC's consultant, was also present at the interview. Mr. Paul Michalak of NRC Fuels Cycle Facilities Branch, Division of Fuel Cycle Safety and Safeguards, was interviewed by telephone on April 19, 2006. Mr. Jake Ingram of the NMED Ground Water Quality Bureau, Superfund Oversight Section and Mr. Jerry Schoeppner of the NMED Ground Water Quality Bureau,

Mining Environmental Compliance Section were interviewed by telephone April 20, 2006. Mr. Larry Carver, a community member and President of the Murray Acres Irrigation Association, was interviewed on August 8, 2006.

Overall, the responses generated during the interview were very positive for remedial action efforts conducted by HMC. All involved regulatory parties indicated that the ground water remediation is progressing in accordance with their expectations, and that HMC has been proactive in addressing the contamination issues at the Site and communicative and supportive of the NRC, NMED, and EPA requests and requirements. The NRC and NMED representatives mentioned a complaint by a nearby resident regarding odor and residue coming from the Site. The odor issue was followed up by EPA with assistance from NMED with HMC. NMED representatives also mentioned another complaint by residents regarding elevated contaminants in ground water and use of ground water for irrigation, stock watering, gardening and dermal exposure. The NMED and EPA performed residential well sampling in 2005 and 2006, and are working with ATSDR to resolve this issue.

The NMED representatives indicated that the ground water CAP revision may require elimination of potential receptors to the impacted ground water. NMED also indicated that the ground water cleanup timeframe might be questionable. They would like to see more definitive projections on the expected achievement of cleanup standards. HMC has recently performed ground water modeling to estimate the expected ground water restoration timeframe based on progress and current conditions. HMC is in the process of submitting the revised schedule to the NRC and NMED. The regulatory parties interviewed indicated that current available institutional controls to limit current or potential use of contaminated ground water are not legally enforceable in New Mexico. The NMED said several attempts have been made to pass legislation allowing for enforceable institutional controls. Various options, including moratoriums and advisories, are being considered to resolve this issue. The EPA, NRC, NMED, and HMC have discussed the possibility of HMC connecting several residents to the Village of Milan public water supply system who are not currently connected. See Attachment 4 for the interview records.

Mr. Larry Carver, the community member, stated his concern about the prolonged length of timeframe for ground water cleanup. He stated that they were promised in 1983 that the ground water would be restored in 10 years. The remediation at the Site started in 1976. Over 30 years have passed

and still the ground water has not been cleaned up. He said that if the regulatory agencies are concerned about providing safe drinking water, then all residents should be provided with an alternate water supply, not just connection to an alternate water supply. Monthly water bills should be paid until the ground water is cleaned up. He said that until recently, HMC was not communicating well with the community regarding the project. However, since the new Project Manager, Alan Cox, has arrived, HMC has been reasonable in explaining the project. He suggested that a public meeting should be held at least once a year to discuss community issues with the agencies.

## VII. Technical Assessment

The five-year review must determine whether the remedy at a site is protective of human health and the environment. The EPA guidance describes three questions used to provide a framework for organizing and evaluating data and information, and to ensure all relevant issues are considered when determining the protectiveness of a remedy. These questions are assessed for the Site in the following paragraphs. At the end of the section is a summary of the technical assessment.

### VII.A Question A: Is the Remedy Functioning as Intended?

The review of all pertinent documents indicates that the various components of the remedy appear to have been implemented as intended and are functioning as intended. The primary documents that detail the remedial decisions for the Site are the ROD, the NRC License SUA-1471, the NRC-approved Reclamation Plan, the NRC-approved Ground Water CAP, and the NMED-approved discharge plans DP-200 and DP-725. The ROD recommended that no further action be taken to address radon gas emissions in the Subdivisions. The remedy for soil contamination and mill reclamation described by the Reclamation Plan has been implemented. The remaining reclamation work includes the dewatering of the large tailings impoundment and capping of both impoundments with a final radon barrier cover and erosion protection layer. This reclamation work will be completed once ground water restoration is complete. The ground water contamination is being addressed as required by the CAP and DP-200. HMC's latest schedule is to have all portions of the remedy, reclamation and decommissioning completed by 2017, when the facility is expected to be turned over to the DOE.

The mill reclamation and soil cleanup were documented to attain the levels required by the ARARs for the Site. The CAP requires that ground water be restored to the NRC's water-quality standards or approved background standards before the NRC will terminate License SUA-1471 and release the property to the DOE for long-term care, in perpetuity. NMED-approved discharge plan DP-200 and the November 23, 2005 letter of support for the proposed ground water cleanup levels established action levels for each aquifer within the Homestake facility. As indicated in the interview with the NRC project manager, it is expected that the NRC will approve the NMED-approved ground water restoration standards and incorporate these standards in the CAP. This CAP revision is expected to add additional POC wells.

The CAP and DP-200 require injection and collection well systems. The collection system includes pumping of contaminated water from both the tailings pile and the contaminated aquifers. The extracted water is treated by evaporative treatment or in the RO Plant. Reject brine from the RO Plant is disposed in collection ponds. The injection system includes injection of RO treated water and fresh water pumped from deep wells into injection wells and into a system of fresh water infiltration trenches at locations selected to reverse gradients and flush impacted portions of the affected aquifers.

Injection into the San Mateo alluvium in two separate lines of wells across the site forms a water barrier that contains the contaminants and reverses gradients toward the collection wells located near the tailings impoundment. The operation of the ground water collection/injection system has been partially successful at restoring ground water to the approved standards. Monitoring data show that the flow of ground water has been reversed, as intended, from the injection wells located at the mill site boundary back toward the collection wells. The combination of injection wells and the up-stream collection system have gradually moved the contaminated ground-water plume up-stream leaving the restored portions of the aquifer at or below background levels. Although contaminant levels have generally decreased over time, they still exceed the NRC and NMED approved aquifer cleanup standards at the POC wells and in some portions of the aquifers.

In the interviews conducted for this 5-yr review, both the NMED and the NRC expressed some skepticism that HMC will be able to attain the proposed cleanup standards by the current projected completion date of 2008. The skepticism has some technical basis. As indicated in the interview with the NRC and HMC representatives, ground water flow and transport modeling has been performed to

determine a revised date of 2015 for completion of ground water restoration. This projection is based on the assumption that a third evaporation pond will be constructed, that the HMC proposed ground water cleanup levels for each aquifer unit will apply to both on-site and off-site ground water, and that the NRC will approve these proposed ground water cleanup levels.

Although contaminant levels have decreased over time in many wells, concentrations have remained stable in many other wells and have increased in some wells. Two separate contaminant plumes appear to have migrated in the alluvial aquifer beyond the influence of the existing collection/injection system. The first plume is generally located beneath the southern portion of Felice Acres and extends approximately one mile to the southwest. The second plume is located under the northern portion of Pleasant Valley Estates and extends approximately 2.5 miles to the west. Concentration trend data from monitoring wells in both plumes show that uranium concentrations within these plumes are generally stable or declining with the exception of a segment of the first plume located within and south of Felice Acres. Uranium concentrations in three alluvial wells monitored in this segment (862, 876 and 869) show increasing trends. Also, the uranium concentrations remain elevated with no apparent declining trend in alluvial Wells 491 and 497 located within the Felice Acres subdivision. Within the second alluvial plume located west of the large tailings impoundment, uranium concentrations remain elevated with no apparent declining trend in alluvial Wells 886, MR, MO and BC.

Uranium continues to remain at very high concentrations between 10 and 70 mg/l within portions of the alluvial aquifer beneath and immediately west and south of the large tailings impoundment. Although the CAP requires restoration of the uppermost (alluvial) aquifer to ground water cleanup levels at the POC wells located downgradient of the tailings impoundment, it does not require compliance with standards beneath the tailings impoundment. Uranium concentrations also remain elevated in the Upper Chinle beneath and south of the main tailings pile. Although uranium concentrations have declined in Upper Chinle collection well WE2, the uranium concentration has increased from near background to over 2.5 mg/l in Upper Chinle collection Well CE3. The current CAP has not established POC wells for the Upper Chinle.

HMC has continued to seek ways to optimize, expand and enhance the operation of the ground water restoration program. During the 5-year report period, HMC expanded the RO treatment capacity

from 300 to 600 gpm and the rate of injection was increased using product water from the RO plant for injection. According to HMC, a field study was initiated to determine if bioremediation could enhance reduction of contaminant levels in the large tailings impoundment. However, the bioremediation study was suspended and no information on the results of this study was provided in the 2005 Annual Monitoring Report/Performance Review.

HMC has also installed the ground water collection/irrigation system to address those portions of the ground water contaminant plumes that have migrated off the mill site, and are outside the capture zone of the on site ground water collection/injection system. In 2005, ground water was collected from Wells 634, 659, 881, 886, 890, M9, MO, MQ, MR, MS, 482, 483, 490, 491, 496, 498, 538, 541, 631, 647, 648, 649, 653, 657, 658, 687, 862, 996, CW29, CW44 and CW45 and used as irrigation supply. Most of these wells are screened in the alluvium, although four Wells (482, 483,498 and CW44) are completed in both the alluvial and Middle Chinle aquifers; Well 538 is screened in both the alluvial and Lower Chinle aquifers; Well CW29 is screened in both the Middle and Lower Chinle aquifers; and Well CW45 is screened in just the Middle Chinle aquifer.

The 2005 Annual Monitoring Report/Performance Review (Hydro-Engineering 2006) did not address the effectiveness of the ground water collection/irrigation system. Most of the alluvial collection wells are located within the two separate contaminant plumes migrating to the west and to the south of the main tailings impoundment. Uranium concentration trends in nearby alluvial wells do not indicate significant declines in concentrations and concentrations in some wells have increased as described above. Declining trends in uranium concentrations in Middle Chinle aquifer collection wells, CW44 and CW45 indicates some restoration progress in this aquifer, although Well CW44 is screened in both the Alluvial and Middle Chinle Aquifers making it difficult to determine the location and nature of the decline. Also uranium concentrations have increased slightly in nearby Middle Chinle Wells 434 and 493.

### VII.B Question B: Are the Exposure Assumptions, Toxicity Data, Cleanup Levels, and Remedial Action Objectives (RAOs) Used at the Time of the Remedy Selection Still Valid?

There have been no significant changes in physical conditions at the Site that would affect the

protectiveness of the remedy.

**Changes in ARARs and To Be Considered (TBCs).** Since the last five-year review in 2001, there have been no changes in ARARs listed below for the mill tailings and soil remediation. Radon emissions and management of uranium mill tailings standards are set forth in the NRC regulations at 10 CFR Part 40 Appendix A, and the EPA regulations at 40 CFR Part 192:

- The non-operational mill tailings pile and impoundments must have a radon barrier installed that limits release of radon-222 to a level not exceeding 20 picocuries per square meter per second ($pCi/m^2/s$). This standard is designed to be effective for 1000 years, and in any case no less than 200 years. (10 CFR Part 40 Appendix A and 40 CFR Part 192)

- Soil clean-up levels for radium-226 of 5 pCi/g above background, averaged over the upper 15 cm of soil, and 15 pCi/g above background, averaged over each succeeding 15 cm layer below the top 15 cm, have remained the same. While radiological hazards should be controlled for 1,000 years to the extent reasonably achievable, the hazards must be controlled for at least 200 years at a minimum. The existing soil radium standard is used to derive a benchmark dose criterion to radionuclides present in an area. The requirement is to remediate a site such that remaining residual radionuclides would not result in a dose greater than the radium soil standard. (10 CFR Part 40 Appendix A, and 40 CFR Part 192)

- The Radon-222 concentration limit for air, without decay products present of 10 pCi/L, and 0.1 pCi/L with decay products present at the restricted area boundary applicable to the assessment and control of dose to the public have remained the same since the last five-year review (10 CFR Part 20, Appendix B, Table 2).

- The recommended maximum radon level in indoor air is 4.0 pCi/L (EPA 402-K-02-006). Radon decay product concentrations (including background) shall not exceed 0.02 Working Level (WL) and, in any case shall not exceed 0.03 WL (40 CFR Part 192).

- Total effective dose equivalent to an individual member of the public from a licensed operation must not exceed 100 mrem/yr, exclusive of dose from background radiation (10 CFR Part 20.1301)

For ground water, the NRC regulates the radiological contaminants and some of the non-radiological contaminants of concern at the mill site (License SUA-1471 boundary). The NRC's CAP sets the maximum concentrations from Table 5C, Criterion 5, Appendix A to 10CFR Part 40, or Site background concentrations as the ground water cleanup levels to be achieved at certain POC wells for those contaminants (NRC 2005). The current ground water cleanup levels, as specified in the License SUA-1471 are shown in Table 7.

The designated POC wells are S4, D1, and X; they are located within the uppermost (alluvial) aquifer at the mill site, in close proximity to and downgradient from the tailings impoundments.

The NRC does not regulate the four non-radiological constituents; sulfate, chloride, TDS, and nitrate. These constituents are regulated by the NMED over the entire Site, pursuant to DP-200. The current NMED water quality standards in DP-200 are shown in Table 7.

**Table 7**
**Current Ground Water Protection Standards for the Site**

| Constituent | NRC (License SUA-1471) Ground Water Protection Standards | NMED (DP-200) Ground Water Cleanup Levels |
|---|---|---|
| Uranium | 0.04 mg/l (1) | 5.0 mg/l |
| Selenium | 0.10 mg/l (1) | 0.12 mg/l (1) |
| Molybdenum | 0.03 mg/l (1) | 1.0 mg/l (Irrigation) |
| Vanadium | 0.02 mg/l (1) | N/A |
| Chromium | 0.06 mg/l (1) | 0.05 mg/l |
| Radium-226 and Radium-228 | 5.0 pCi/l | 30.0 pCi/l |
| Thorium-230 | 0.30 pCi/l (1) | N/A |
| Sulfate | N/A | 976 mg/l (1) |
| Chloride | N/A | 250 mg/l |
| TDS | N/A | 1770 mg/l (1) |
| Nitrate | N/A | 12.4 mg/l (1) |

Note (1) Established based on Site specific ground water background concentrations

The water quality standard for uranium was revised by the NMWQCC to 0.03 mg/l and is effective on June 1, 2007 for all current and past discharges. In December 2000, EPA established under the

Safe Drinking Water Act at 40 CFR Part 141, an MCL for uranium of 0.03 mg/l. In a letter dated November 23, 2005, the NMED supported the HMC proposed ground water background concentrations (NMED 2005b), listed in Table 8 as the ground water cleanup levels for the Site. The revised ground water cleanup levels are for constituents within a specific aquifer unit that has background concentrations higher than the appropriate regulatory numerical standards.

**Table 8**
**Proposed/Revised Ground Water Cleanup Levels for the Site**

| Constituent | Ground Water Cleanup Levels | | | | |
|---|---|---|---|---|---|
| | Alluvial Aquifer | "Mixing Zone" Aquifer | Upper Chinle Aquifer | Middle Chinle Aquifer | Lower Chinle Aquifer |
| Uranium, mg/l | 0.16 | 0.18 | 0.09 | 0.07 | 0.02 |
| Selenium, mg/l | 0.32 | 0.14 | 0.06 | 0.07 | 0.32 |
| Molybdenum, mg/l | N/A | N/A | N/A | N/A | N/A |
| Sulfate, mg/l | 1500 | 1750 | 914 | 857 | 2000 |
| Chloride, mg/l | N/A | N/A | 412 | 250 | 634 |
| TDS, mg/l | 2734 | 3140 | 2010 | 1560 | 4140 |
| Nitrate, mg/l | 12 | 15 | N/A | N/A | N/A |

The NMED has indicated that these revised ground water cleanup levels will be incorporated into a revision of DP-200. The NMED also indicated that these revised ground water cleanup levels are applicable only within the Site, and are subject to revision in the event any new information becomes available that may warrant re-evaluation. On September 27, 2005, the EPA notified NRC of its approval (EPA 2005) of the NMED revised ground water cleanup levels based on background concentrations and indicated that these levels will be used as criteria for the Site clean up. At the time of this five-year review process, the NRC has not completed its review of the proposed ground water cleanup levels. Consequently, Table 8 is referred to as "Proposed/Revised Ground Water Protection Standards" because these standards, even though supported by NMED, have not been incorporated into DP-200 by the NMED, and have not been approved and incorporated into License SUA 1471 by the NRC during this review.

In addition, several ARARs and guidance or policy requirements that are to be considered (TBCs) were identified for the other operable units of the Site. Differences in the type of contamination and degree of exposure at the various operable units indicate that different standards could apply to different operable units.

One of the ARAR-TBC identified in the first five-year review for the Site was the 10 CFR Part 20 criteria of 25 mrem/yr EDE as the primary standard, with exemptions that could allow cleanup levels as high as 100 mrem/yr EDE (this 100 mrem/yr criterion is the value to which HMC compares their TEDE in their annual report). The EPA determined that the 25 mrem/yr and 100 mrem/yr were equivalent to approximately $5 \times 10^{-4}$ and $2 \times 10^{-3}$ lifetime cancer risk respectively. EPA guidance is to conduct site-specific dose and risk assessments to determine if cleanup values obtained using the new criteria will be protective. According to the EPA guidance, the decision to conduct a risk assessment/dose assessment should be made on a site-specific basis. Also, the EPA has determined that the maximum dose limit under CERCLA is 15 mrem/yr EDE for establishing preliminary remediation goals. The EPA determined that this dose limit corresponds to a risk level of $3 \times 10^{-4}$, which was determined to be, in effect, equivalent to the upper risk range of $1 \times 10^{-4}$ (CH2MHill 2001). The EPA guidance recommends that the levels at 10 CFR Part 20 not be used to establish cleanup levels under CERCLA. This guidance also states that NRC decommissioning should be evaluated by determining if the planned or actual cleanup levels (not the dose limits) will achieve the accepted risk range ($10^{-4}$ to $10^{-6}$) under CERCLA for the reasonably anticipated land use. The guidance also states that NRC decommissioning does not have to be evaluated using all the procedures that would be used under CERCLA (EPA 1997). The EPA has evaluated the air monitoring data and has determined that radiological emission levels are below those presenting cause for concern pursuant to EPA guidance.

**Changes in Exposure Pathways, Toxicity, and Other Contaminant Characteristics.** No new exposure pathways have been identified as a result of this five-year review. There have been no changes in toxicity factors for the contaminants of concern since the first five-year review, although, as described above, the EPA established an MCL for uranium of 0.03 mg/l and the NMWQCC has revised the uranium ground water standard to 0.03 mg/l, effective June 1, 2007.

### VII.C Question C: Has any Other Information Come to Light that Could Call into Question the Protectiveness of the Remedy?

The first five-year review reported that pursuant to the 1983 Agreement between HMC and the EPA, HMC financed the extension of the Village of Milan's municipal water supply to the residences of the

Subdivisions and made payments to the Village of Milan for the residents' water usage over a period of ten years. The recent surveys performed by both the HMC and the NMED identified about 15 homeowners within nearby residential subdivisions having wells that serve as the domestic water supply for the residents.

The NMED September 2005 sampling survey found that uranium concentrations in the four Lower Chinle wells are below the MCL of 0.03 mg/l. Nitrate was above MCLs in one well, RW-20. This Lower Chinle well is unlikely to be impacted by site activities based on the following:

- The well is located west of the west fault,
- The elevated nitrate at the well is an isolated occurrence,
- The other site related constituents at this well are below the proposed background concentrations and corresponding MCLs, and
- The presence of domestic and agricultural activities nearby could result in the elevated nitrate concentration.

The NMED plans to conduct additional testing to verify the source of the nitrate at RW-20.

The NMED September 2005 sampling survey reported dissolved uranium concentrations in two alluvial wells (0.0395 and 0.0467 mg/l), used as the primary drinking water source by the homeowners, slightly above the EPA's 0.03 mg/l drinking water MCLs. However, the uranium concentrations in these wells are below the 0.16 mg/l proposed Site background concentration for the alluvial aquifer as supported by the EPA and NMED. The uranium MCL is based on long-term exposure to a drinking water supply. Short-term exposure to a drinking water supply with a uranium concentration of 0.0467 mg/l would be considered protective under the EPA $10^{-4}$ to $10^{-6}$ risk range. However, lifetime exposure to a drinking water with uranium concentrations of 0.0467 mg/l would approach or exceed the $10^{-4}$ cancer risk level. In the context of remedial measures that can be performed on site to contain or remediate ground water, the remedy could be considered protective in the short-term. However, in the long-term, protectiveness can be achieved by connecting residences in the Subdivisions to the City of Milan municipal water supply and prohibiting consumption of ground water containing concentrations of uranium or other constituents above MCLs. The ATSDR's assessment will determine if the ground water is suitable for other domestic uses.

The HMC survey found 12 residences within or near the Valle Verde subdivision that have wells that are used for domestic water supply. It appears that three of these 12 wells may be the same as three of the six residence wells identified by the NMED survey that are used for domestic water supply. The HMC survey did not identify the source aquifer for these wells or include water quality analysis results for these wells. The ground water source could be from the Chinle or alluvial aquifers or it could be from deeper units. Although the information from these surveys does not call into question the short-term protectiveness of the Remedy, EPA, NMED, NRC and HMC are working to eliminate the use of ground water as drinking water by these residences if concentrations of any constituents exceed MCLs.

### VII.D Technical Assessment Summary

According to the data review, Site inspection, and interviews, the remedial actions selected for this Site appear to have been implemented and continue to function as intended by the decision documents. There have been no changes in the physical Site conditions that would call into question the protectiveness of the remedy. The mill decommissioning and cleanup of windblown tailings-contaminated soil complied with the ARARs, and the objective of the ground water restoration program is to achieve ground water cleanup levels for all contaminants at the POC wells. Although the ground water restoration program has been in operation for almost 25 years, the cleanup standards for ground water have not yet been achieved at the POC wells. The data indicate that a significant portion of the contaminant plume in the alluvial aquifer beneath the mill site has been successfully moved back near to the collection wells, leaving that portion of the aquifer restored, or partially restored. Furthermore, water-quality data show that concentrations of contaminants are generally decreasing over time in many of the Subdivision monitoring wells.

There are two separate contaminant plumes in the alluvial aquifer which extend beyond the mill site and are outside of the influence (*i.e.*, capture zone) of the ground water collection/injection system. HMC is operating a secondary ground water collection and irrigation system to restore those affected areas. So far this system appears to have made some improvements in limited portions of the Middle Chinle but little or no improvement in the alluvial aquifer. HMC has proposed to incorporate the secondary ground water collection and irrigation system into the revised CAP and the DP-200, upon renewal.

The recent surveys performed by HMC and the NMED found that about 15 homes within nearby residential subdivisions have wells that serve as the domestic water supply source for the residents. Uranium concentrations in two alluvial wells identified in the NMED survey as being used as the primary drinking water source were slightly above the EPA's 0.03 mg/l drinking water MCLs. Long-term protection from exposure to uranium in drinking water can be achieved by connecting the residences to the alternate water supply and prohibiting the use of contaminated ground water as a domestic water supply source.

The air monitoring data indicates that the ARARs are being met, including the ROD requirement that radon levels be below 1 pCi/l above background at the site boundary. The TEDE assessment performed for 2005 shows that the Site is near the 15 mrem/yr dose levels used by the EPA as the maximum acceptable level, after the CEDE for radon is subtracted from the TEDE calculation. Radon decays rapidly into daughter products and is a short lived radiological constituent. Due to its short lived nature, the radon dose equivalent may over estimate the actual exposure posed. The EPA does not currently have a promulgated standard based on dose equivalents. The 15 mrem/yr dose equivalent value is stated in the EPA guidance memoranda pertaining to the evaluation of dose equivalent calculations used at NRC sites.

## VIII. Issues

Four issues are identified for this site, as described in the following paragraphs.

**1. Alternate Water Supply.** In 1985 an alternate water supply was provided to residents in the four subdivisions. However, during the recent surveys conducted by EPA, NMED and HMC additional residents were identified in the affected area who are using their private wells. Currently, the regulatory agencies are working with HMC to provide alternate drinking water to these residents.

**2. Institutional Controls for Restricting Use of Ground Water.** Potential for use of the contaminated ground water by local residents or landowners continues to be an important issue at the Site. Although residents of the closest Subdivisions currently use the municipal water supplied by the Village of Milan, the concentrations of some constituents in the San Mateo alluvial aquifer and the Chinle aquifer units within or near these Subdivisions are above the EPA's drinking water MCLs and the NMWQCCR human health standards. Also, the San Mateo alluvial aquifer and the Chinle aquifer unit have been used for potable water supply in the past and are currently used for domestic supply in the Valle Verde subdivision and at more distant locations. At present, there are no institutional controls restricting such use from potentially impacted aquifer units near the Site.

The NMED, as well as the NRC and the EPA are concerned about the potential for local residents and landowners to use ground water in the affected areas of contamination. The regulatory agencies are working together on establishing institutional controls at the Site. In the meantime, the NMED plans to continue using public education and other incentives to encourage subdivision residents to obtain their drinking water supply from the Village of Milan.

Many of the residents that are connected to the Village of Milan public water supply system still use their private wells for irrigation, gardening and live stock watering. The NMED and EPA have provided the sampling data to the ATSDR to evaluate any hazards from this use and will inform the residents of their evaluation. ATSDR's evaluation of the data is expected sometime before the end of 2006.

As discussed previously, recent surveys found that 15 residences at or near the Valle Verde subdivision still have wells that are used for primary drinking water supply. Uranium concentrations in two alluvial wells included in the NMED survey were slightly above the EPA's drinking water MCLs but were below Site background concentrations for the alluvial aquifer. The EPA, NMED, NRC and HMC are working to eliminate primary drinking water use of ground water by these residences if concentrations of any constituents exceed MCLs.

**3. Standards for Ground Water Restoration Beyond the Mill Site.** In 2000, HMC implemented operation of a second ground water restoration system, which was expanded during this review period, to abate contamination which has migrated beyond the boundary of the mill site. This

contamination is outside of the hydraulic influence (*i.e.*, capture zone) of the primary ground water collection/injection system. The second system is comprised of thirty-one collection wells and four irrigation systems (two center pivot spray and two flooding systems). The irrigation systems are used for growing alfalfa for feeding livestock. ATSDR is currently performing an assessment to determine if the ground water can be continued to be used for irrigation and growing alfalfa. This second system is not required, or incorporated as part of the NRC's CAP or the NMED's DP-200. However, HMC intends to incorporate this system into a revised CAP, which will be submitted to the NRC for approval. NMED is in the process of incorporating the secondary remediation system into the forthcoming renewal of the DP-200.

If the off site ground water collection and irrigation system is used as a part of the ground water restoration program and incorporated into DP-200, the NMED may need to include additional performance monitoring requirements to demonstrate the effectiveness of irrigation treatment due to the change in the uranium standard that will become effective in June 2007.

**4. Clean-up Goals above MCLs in Ground Water.** One issue raised by NMED during this five-year review was what happens when cleanup standards are met in the alluvial aquifer. Will HMC be released from their obligation to continue operating the remediation system when some constituents are at concentrations above the applicable MCL and may have the potential to contaminate the underlying Chinle aquifers? Under the current ground water corrective action program, HMC is required to continue operation of the NRC-approved ground water remediation and hydraulic containment until the ground water cleanup levels established in the license are met at the POCs. The current CAP has established three POC wells in the San Mateo Alluvium: wells S4, D1, and X (see Figure 2 for alluvial well and POC locations). The ground water cleanup levels in the current CAP are chromium (0.06 mg/l), molybdenum (0.03 mg/l), selenium (0.10 mg/l), vanadium (0.02 mg/l), uranium (0.04 mg/l), thorium-230 (0.3 pCi/l), and combined radium-226+ radium-228 (5.0 pCi/l). Among these current ground water cleanup levels, only uranium and selenium exceed current drinking water MCLs of 0.03 mg/l and 0.05 mg/l, respectively, and then only slightly. These specified ground water cleanup levels for uranium and selenium were based on background concentrations from a single well (Well P) collected over a two month period from December 1988 to February 1989. HMC completed a Background Study based on numerous sampling results over a ten

year period from 1995 to 2005. Based on this study, HMC has requested revision of the NRC water ground water cleanup levels, as listed in Table 8, that would apply at POCs.

While it is expected that the NRC will approve the proposed ground water cleanup levels, which NMED and EPA have supported, the NRC has indicated that the approval will include the establishment of new POCs for the upper and middle Chinle aquifers and the mixing zone (NRC interview April 19, 2006). Thus, with these changes, HMC would need to maintain some form of ground water CAP until the ground water cleanup levels are attained at the specified POCs in all of the regulated aquifer units. While some of the background based ground water cleanup levels for the Site exceed MCLs, the NRC regulations do not require corrective action to clean-up ground water to below the Commission approved ground water cleanup levels for the Site. Therefore, when HMC meets the ground water cleanup goals specified in the NRC-approved ground water CAP, some COCs at levels above the corresponding MCLs could exist in various aquifer units.

In a letter dated November 2, 2000 to the NMED, the NRC has indicated that in order for the NRC to terminate the license, HMC must address both on-site and off-site ground water contamination from both radiological and non-radiological hazardous constituents from the licensed mill tailings and facilities. EPA conducts five-year reviews as a matter of EPA policy for remedial action at the Site to assure that upon completion, the remedial action will not leave contaminants on site above levels that allow for unlimited use and unrestricted exposure. Therefore EPA's five-year review process and final close out and inspection report should assure that the ground water on site and off site is monitored until ARARs are achieved.

## IX. Recommendations and Follow-up Actions

Based on the five-year review, it appears the remedial actions for the Site originally set forth in the ROD and other decision documents have been implemented as planned, including the various updates to the ground water restoration system, and the remedy appears to continue to be protective of human health and the environment in the short term. To ensure the continued long-term protectiveness of the ongoing remedy, it is recommended that use of ground water as a primary source of drinking water by local residents and landowners in those areas where concentrations exceed MCLs be restricted, regardless of whether the source of contamination is site-related or due to background conditions.

If the off site ground water collection and irrigation treatment system is considered a part of the Site ground water restoration program and is incorporated into the ground water CAP and the DP-200, the NRC and NMED may need to include additional monitoring requirements to demonstrate the effectiveness of irrigation treatment in maintaining standards in the underlying ground water.

When NRC approves the revised water protection standards based on the proposed background concentrations for the multiple aquifer units, new POCs for the upper and middle Chinle aquifers and the mixing zone should be established. With these changes, HMC would need to maintain some form of ground water CAP until the ground water cleanup levels are attained at the specified POCs in all of the regulated aquifer units.

When ATSDR completes its health hazard assessment from use of impacted ground water for consumption other than drinking water use, such as irrigation, gardening, and livestock watering, EPA and NMED should notify community members of the ATSDR's health hazard assessment.

EPA and NMED should assess the public site repository at New Mexico State University (NMSU) branch campus in Grants, New Mexico for completeness of the documents and information. If necessary, the repository should be updated in order to provide the public with a means to access all site specific data and information.

## X. Protectiveness Statement

The remedy involving the decommissioning and reclamation of the mill site, including the decommissioning and dismantling of the mill, soil remediation, long-term stabilization of the tailings, and closure, is considered protective of human health and the environment in the short-term because the tailings (uranium mill byproduct) have been contained under the temporary radon barrier that limits emissions of radiological constituents into ambient air and protects against erosion. Tailings dewatering and use of evaporation ponds for treatment of collected water during the ongoing ground water restoration activities is necessary. The second and final phase of reclamation of the tailing impoundments and evaporation ponds will be implemented following completion of the ground water restoration program.

The remedy involving the ground water is also considered protective of human health and the environment in the short-term because a ground water collection and injection system is in place which appears to have already been effective in preventing further migration of contaminants and in partially restoring portions of the affected aquifers, and because an alternate water supply has been provided to residents within the affected area.

Currently, 15 residences within and near the Subdivisions use ground water as domestic water supply, and EPA, NMED, NRC and HMC are working to eliminate use of ground water by these residences as a primary source of drinking water. Three of these wells have been sampled, and uranium concentrations in two of the private wells are slightly above the EPA's drinking water MCLs, but below the Site proposed background concentrations, as supported by the EPA and NMED. The uranium concentrations in these two private alluvial wells are not definitively impacted by the Site, and may be from other sources or variation in the natural background concentrations. Short-term exposure to a drinking water supply with uranium at concentrations observed in these wells would be considered protective under the EPA $10^{-4}$ to $10^{-6}$ risk range. Therefore, the remedy is still considered protective in short-term. However, in order to assure long-term protectiveness, the on-going efforts to monitor and evaluate the potential risk of ground water use by local residents should continue, options to eliminate potential for local residents and landowners to use ground water when concentrations exceed MCLs, regardless of whether the source of contamination is site-related or due to background conditions, should be explored, and efforts to connect all residences within the affected area to the Village of Milan municipal water system should continue.

## XI. Next Review

The next five-year review, the third for the Site, should be completed on or before September 2011. This review should occur whether or not, in the interim, the Site has been deleted from the NPL. It is the EPA's policy that the five-year review requirement is independent of and unaffected by the process by which sites are deleted from the NPL. If the Site has been deleted or is in the process of being deleted at the time of the next five-year review, the five-year review report should address the status of the deletion action. Five-year reviews will continue as necessary after deletion, based on the recommendation of the next five-year review.

**Attachment 1**

# Documents Reviewed

## Documents Reviewed

CH2MHill HILL (CH2MHill), 2001. *First Five-Year Review Report for Homestake Mining Company Superfund Site, Cibola County, New Mexico.* September 2001

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**Attachment 2**

# Figures

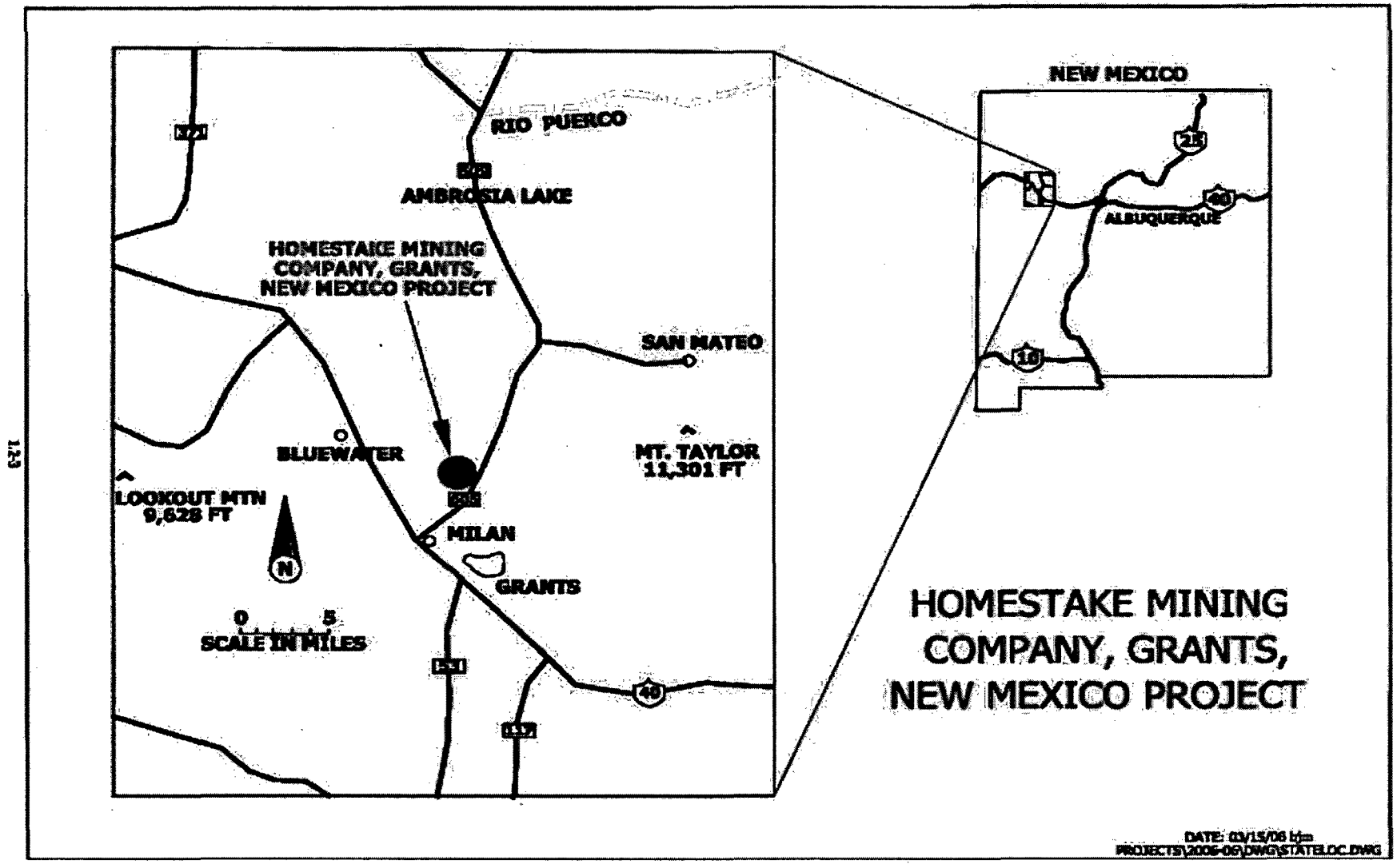



**Figure 1 Site Location Map** (Reproduced from Hydro-Engineering 2006)

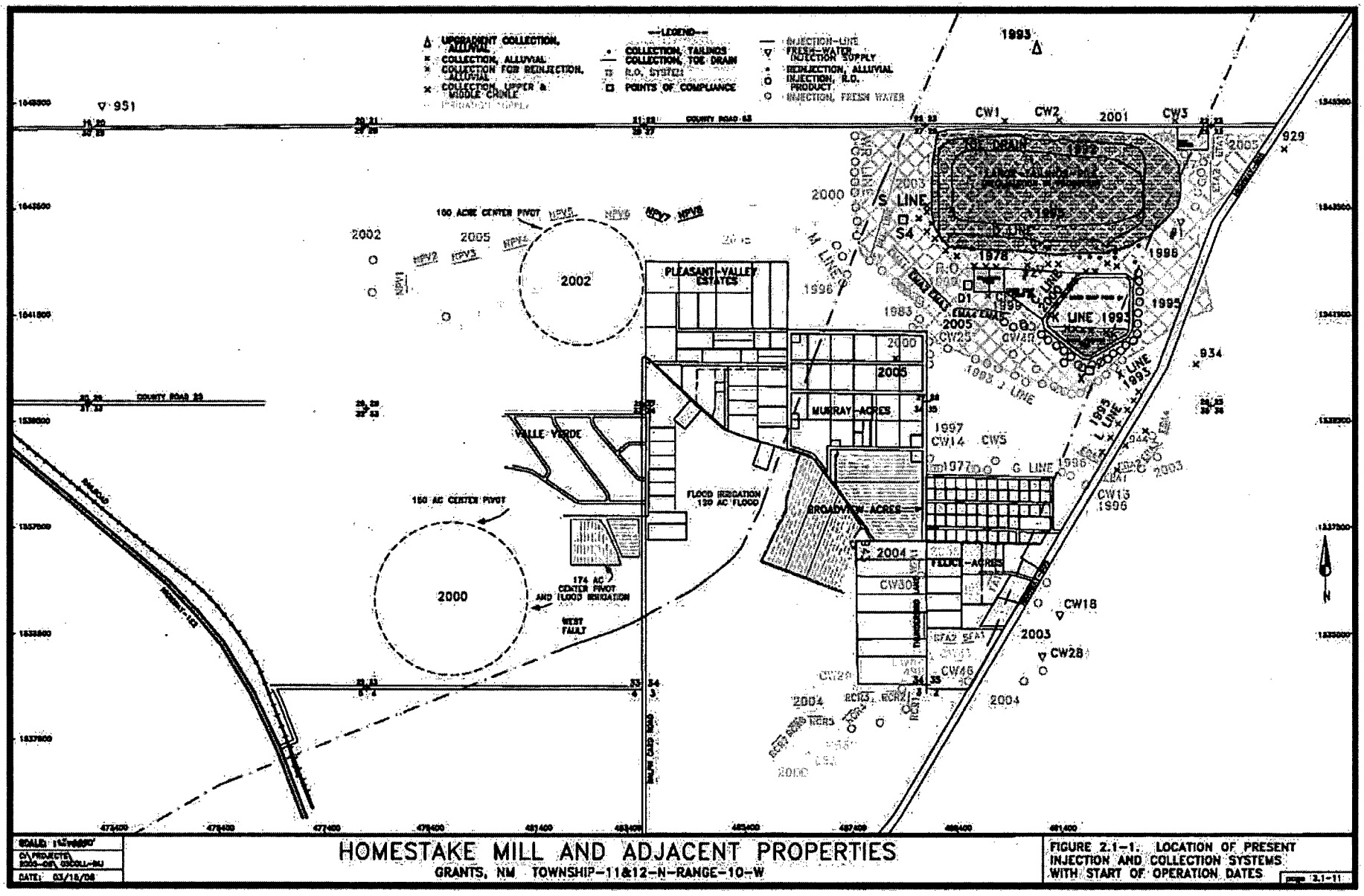



**Figure 2 Site Drawing** (Reproduced from Hydro-Engineering 2006)

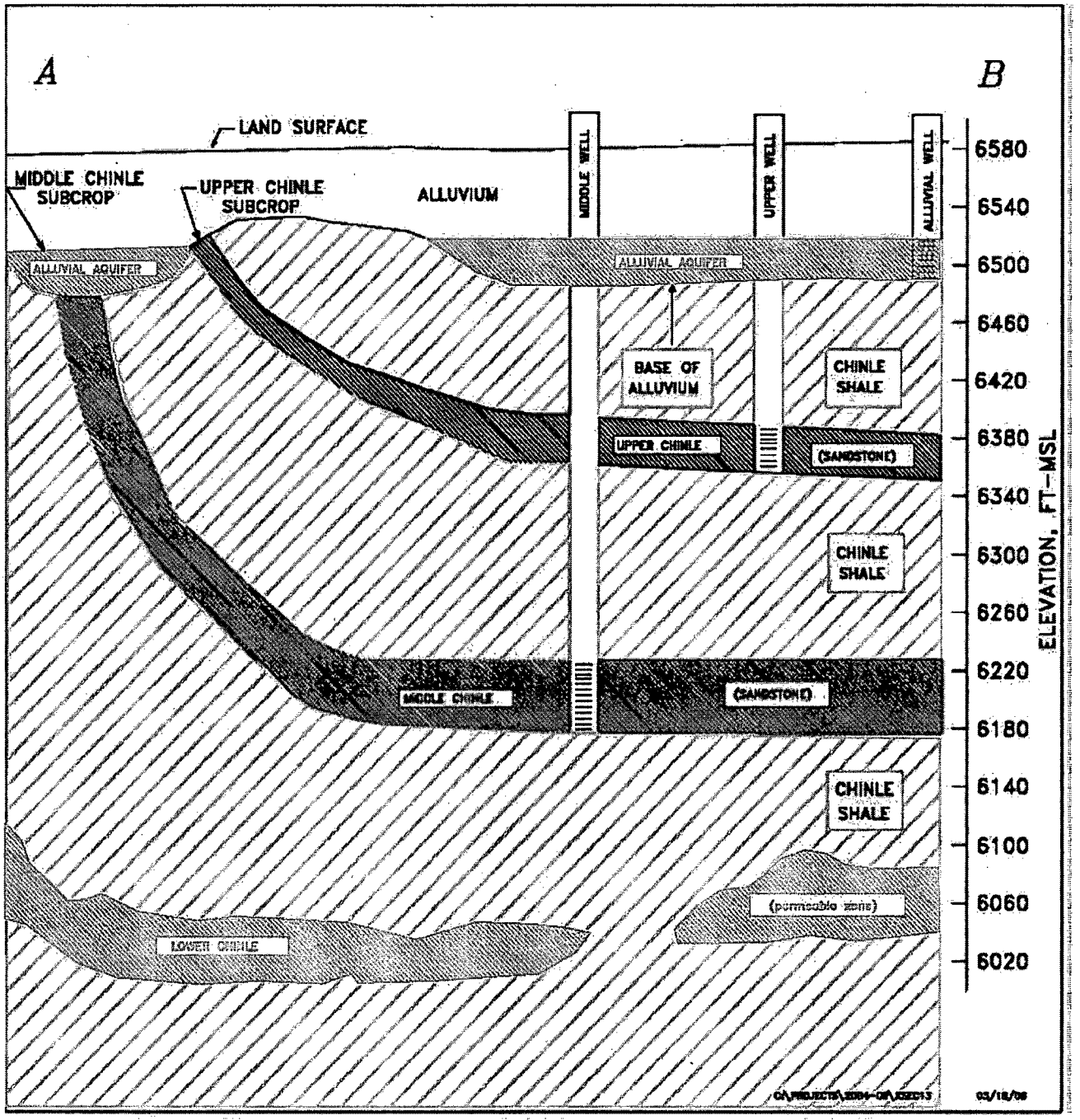



**Figure 3 Typical Geologic Cross Section** (Reproduced from Hydro-Engineering 2006)

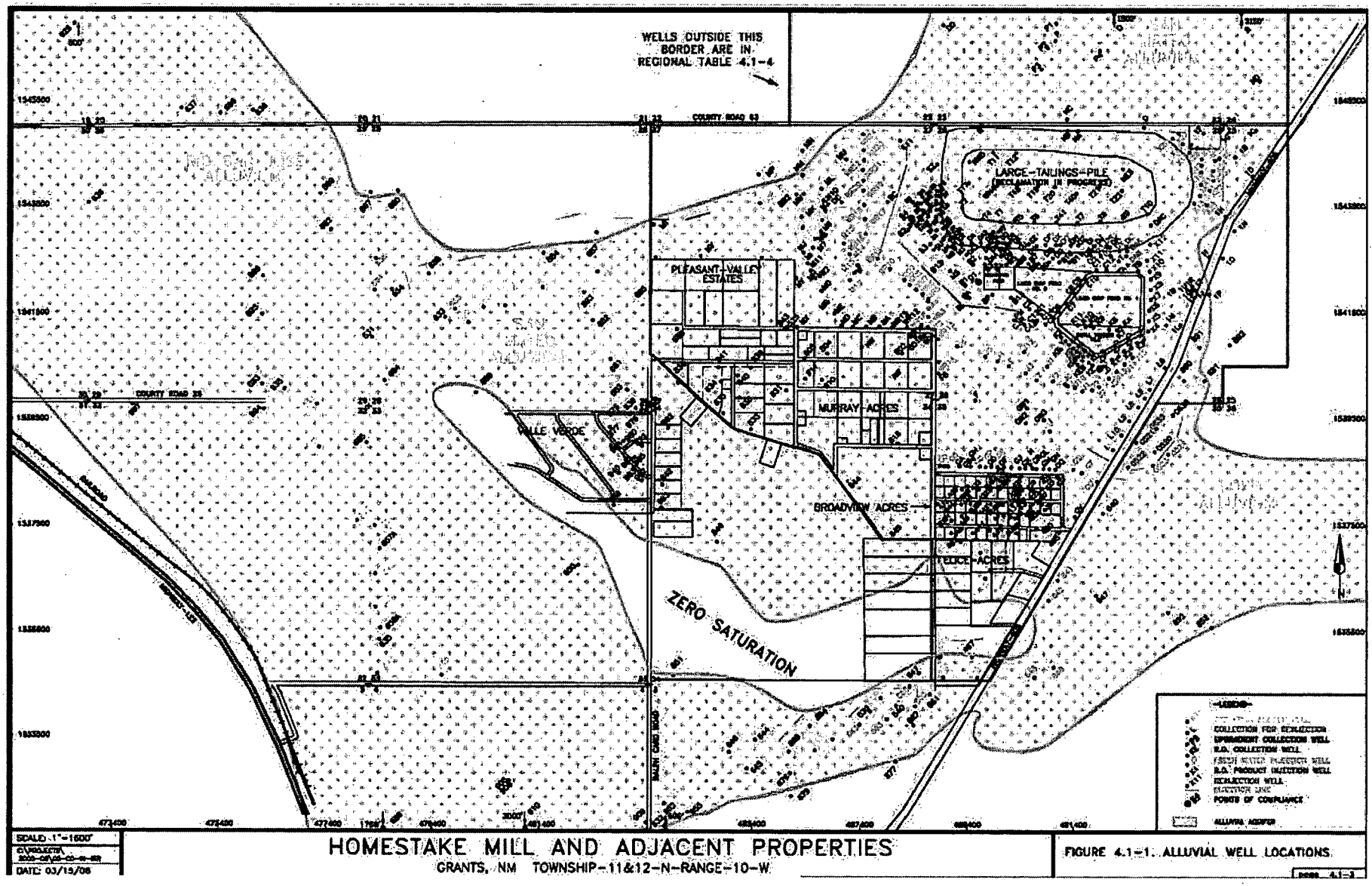



**Figure 4 Alluvial Wells and POC Locations** (Reproduced from Hydro-Engineering 2006)

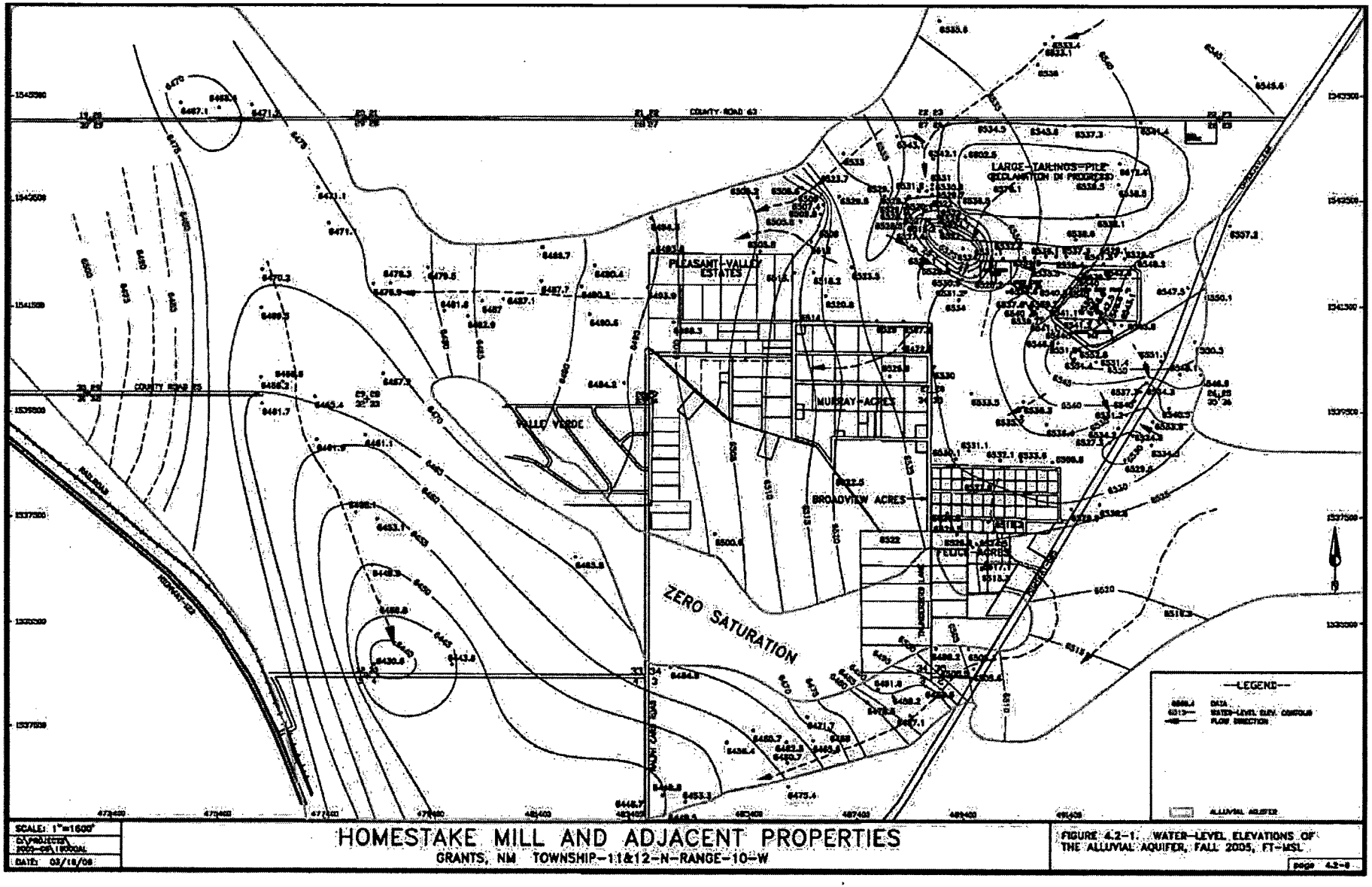



**Figure 5 Water Level Elevations, Alluvial Aquifer** (Reproduced from Hydro-Engineering 2006)

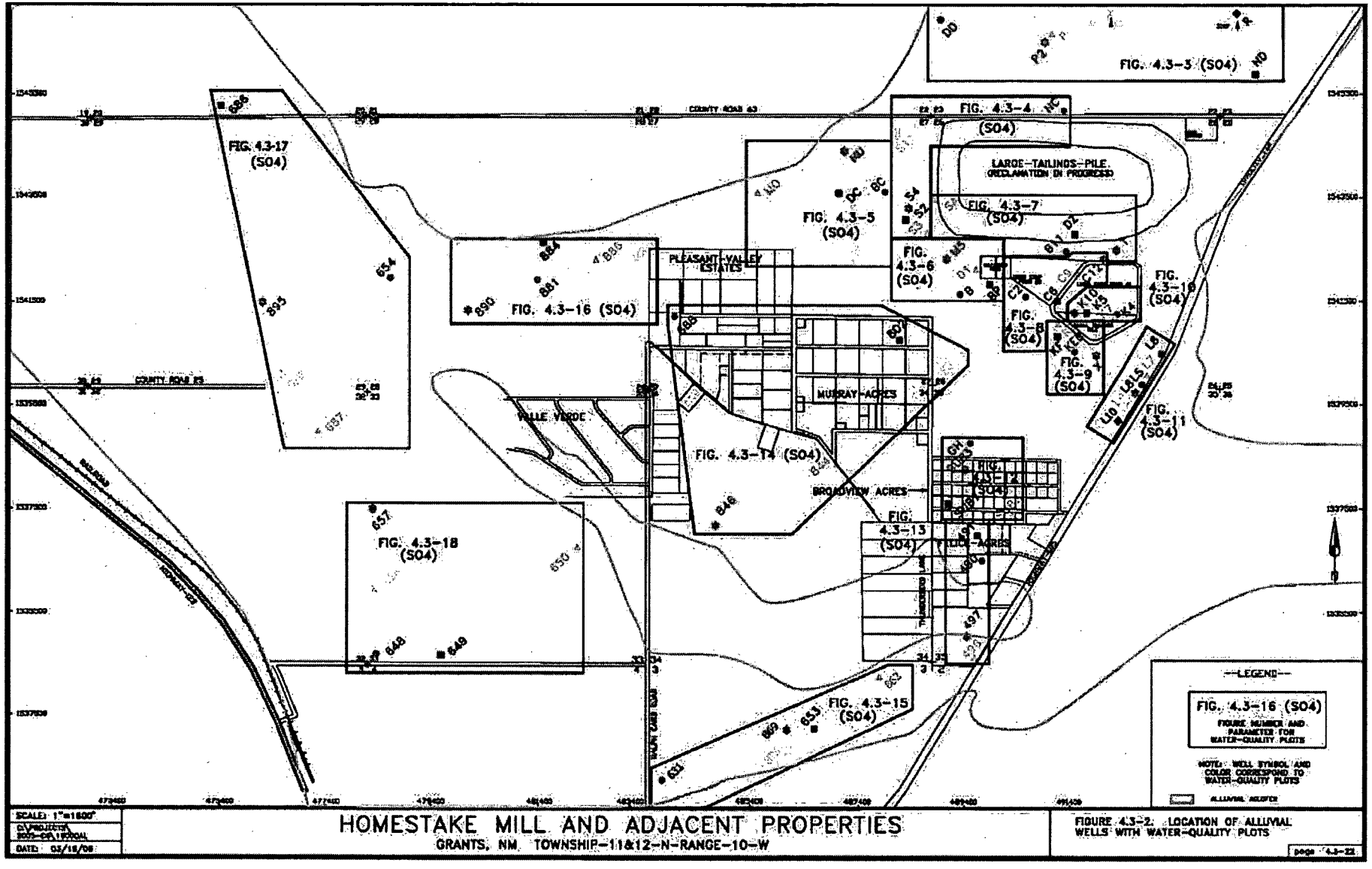



**Figure 6 Location of Alluvial Wells with Water Quality Plots** (Reproduced from Hydro-Engineering 2006)

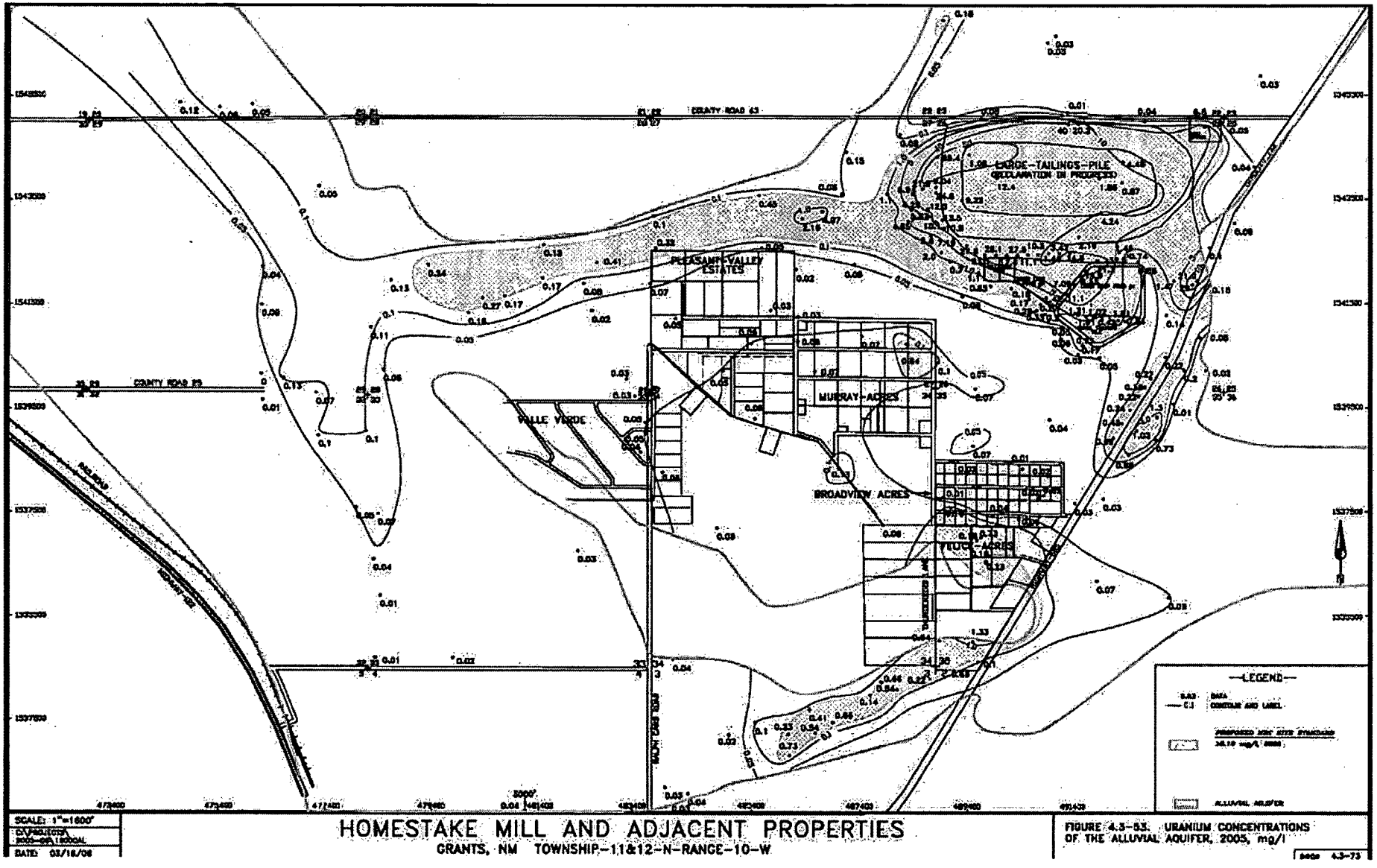



**Figure 7 Uranium Concentrations of the Alluvial Aquifer** (Reproduced from Hydro-Engineering 2006)

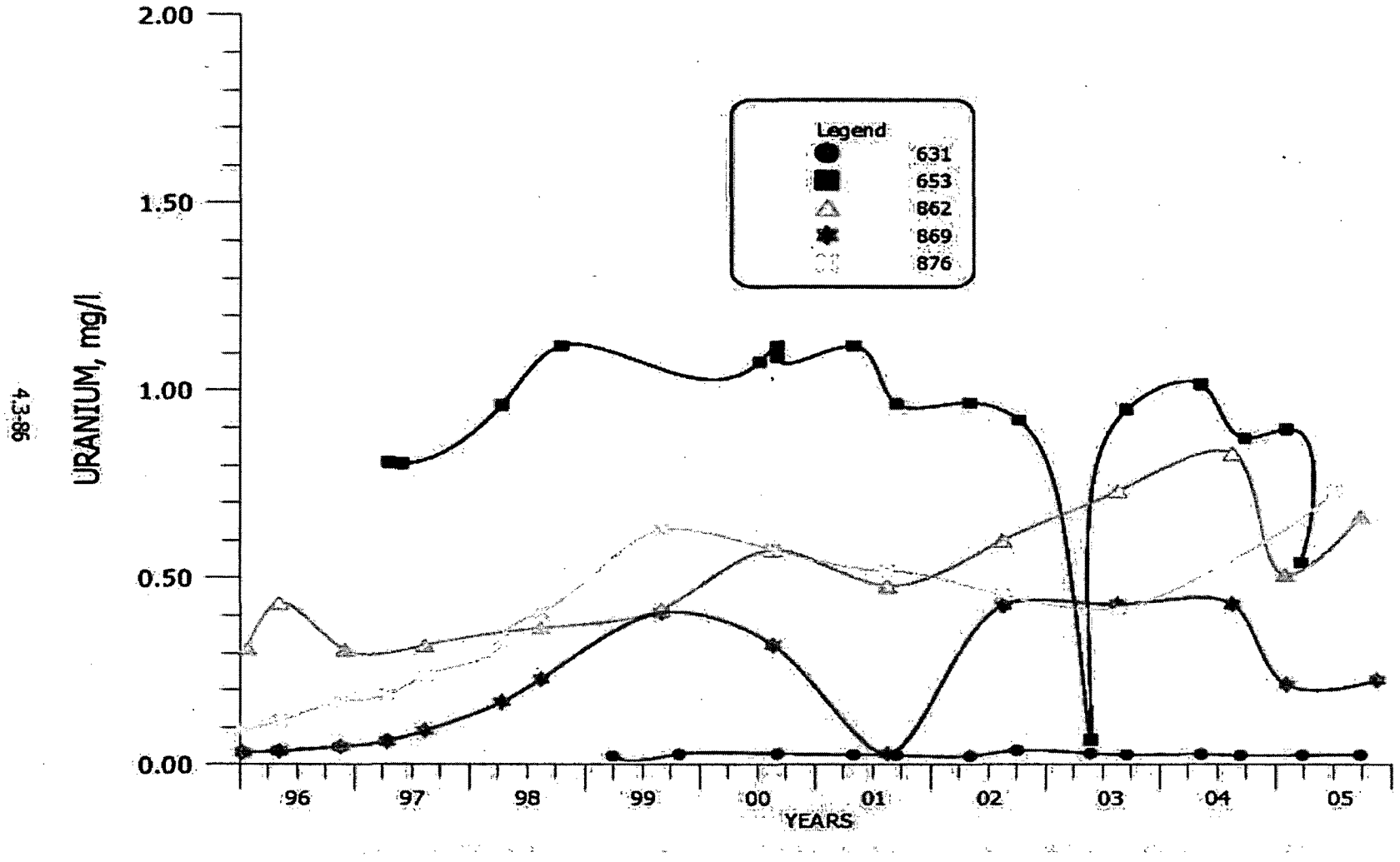



**Figure 8 Uranium Concentrations for Well 631, 653, 862, and 876** (Reproduced from Hydro-Engineering 2006)

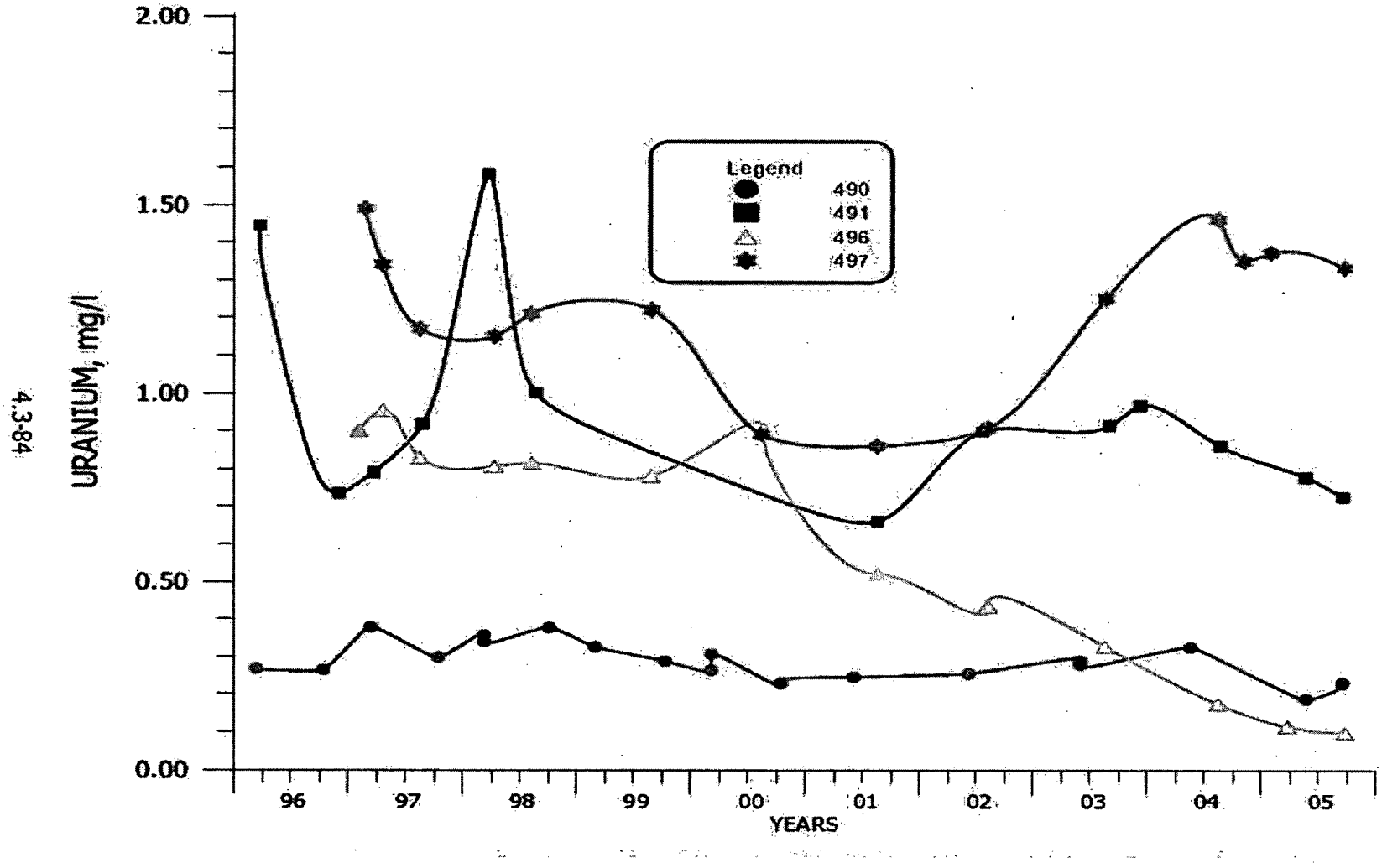



**Figure 9 Uranium Concentrations for Well 496** (Reproduced from Hydro-Engineering 2006)

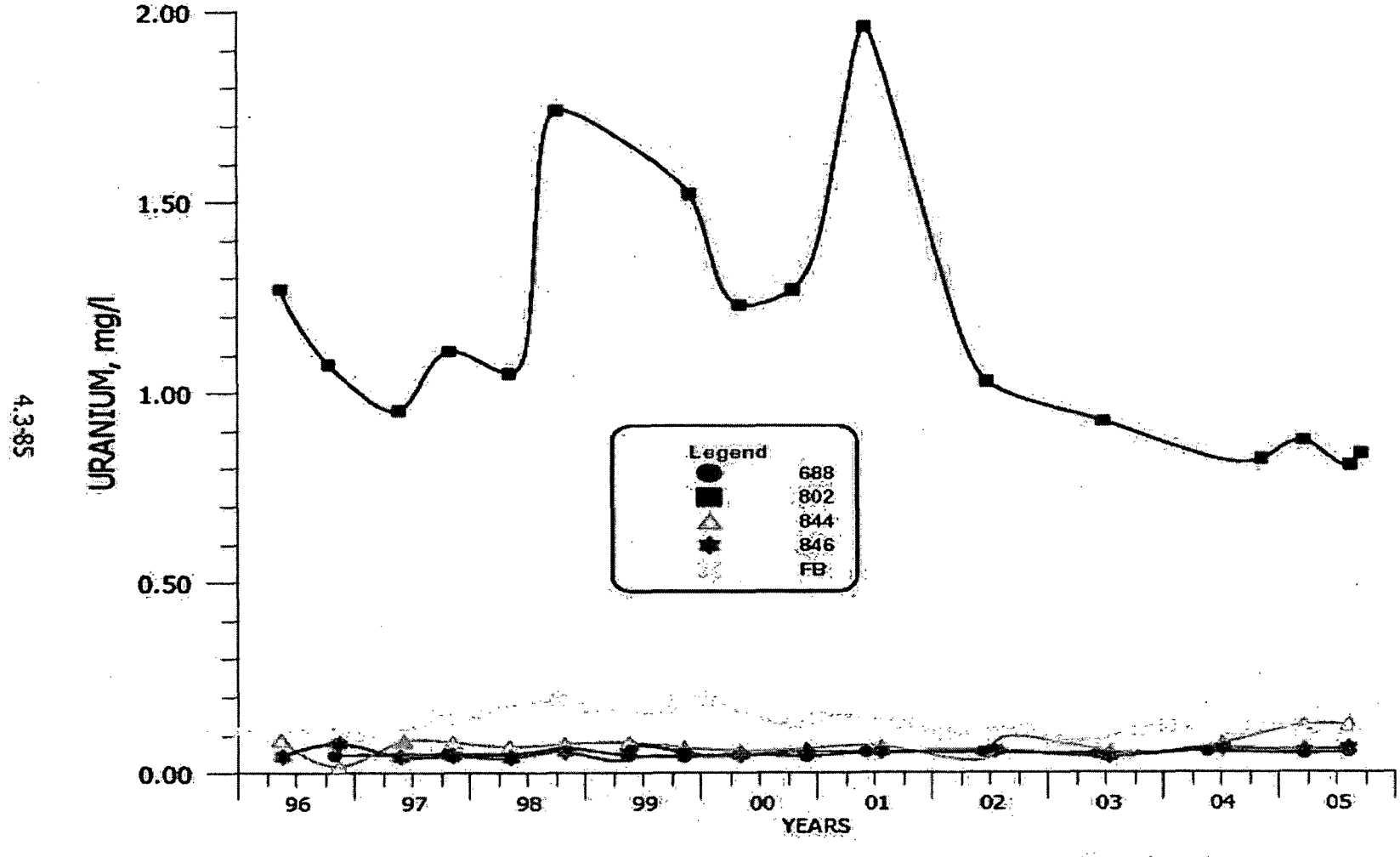



**Figure 10 Uranium Concentrations for Well 802** (Reproduced from Hydro-Engineering 2006)

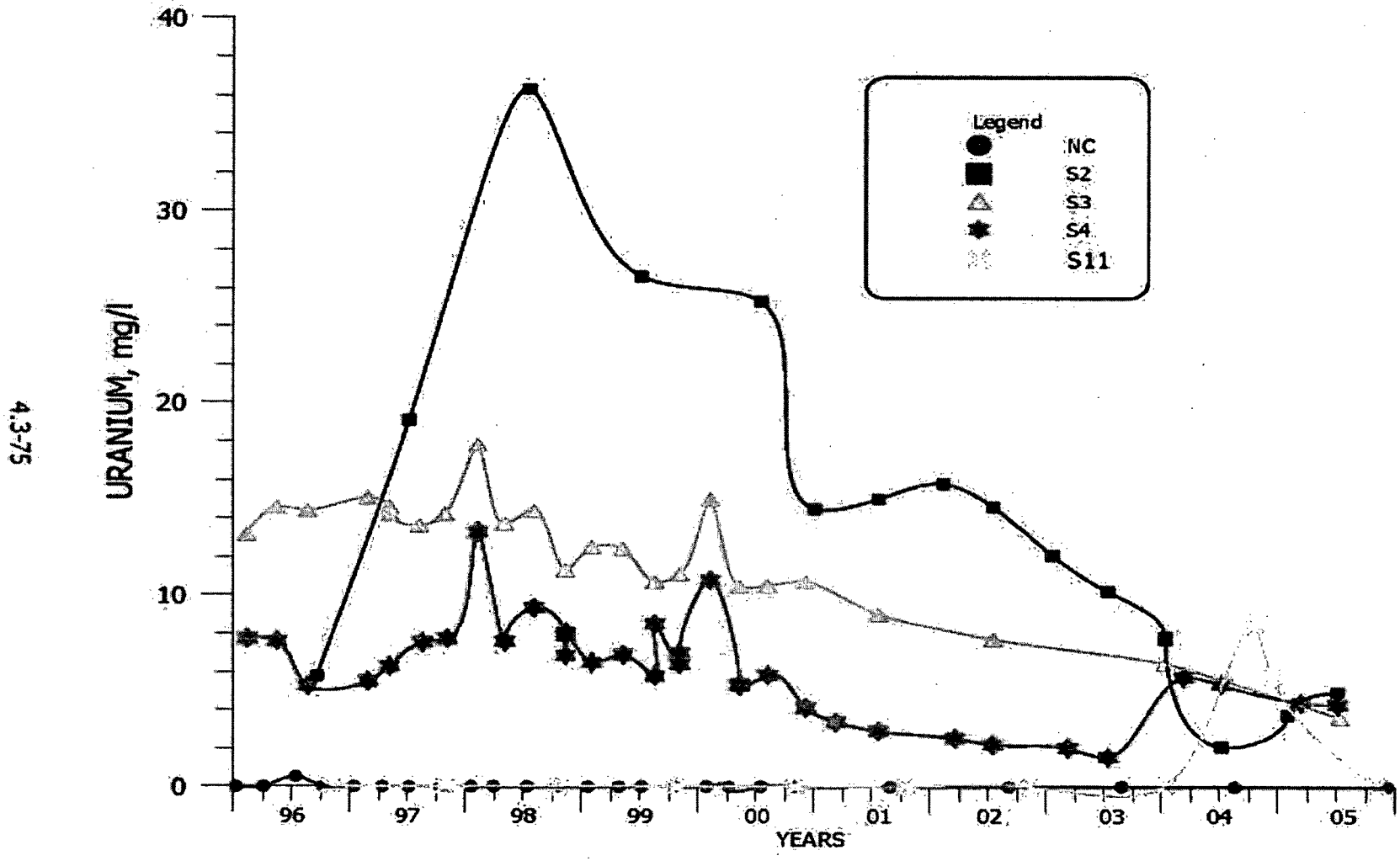
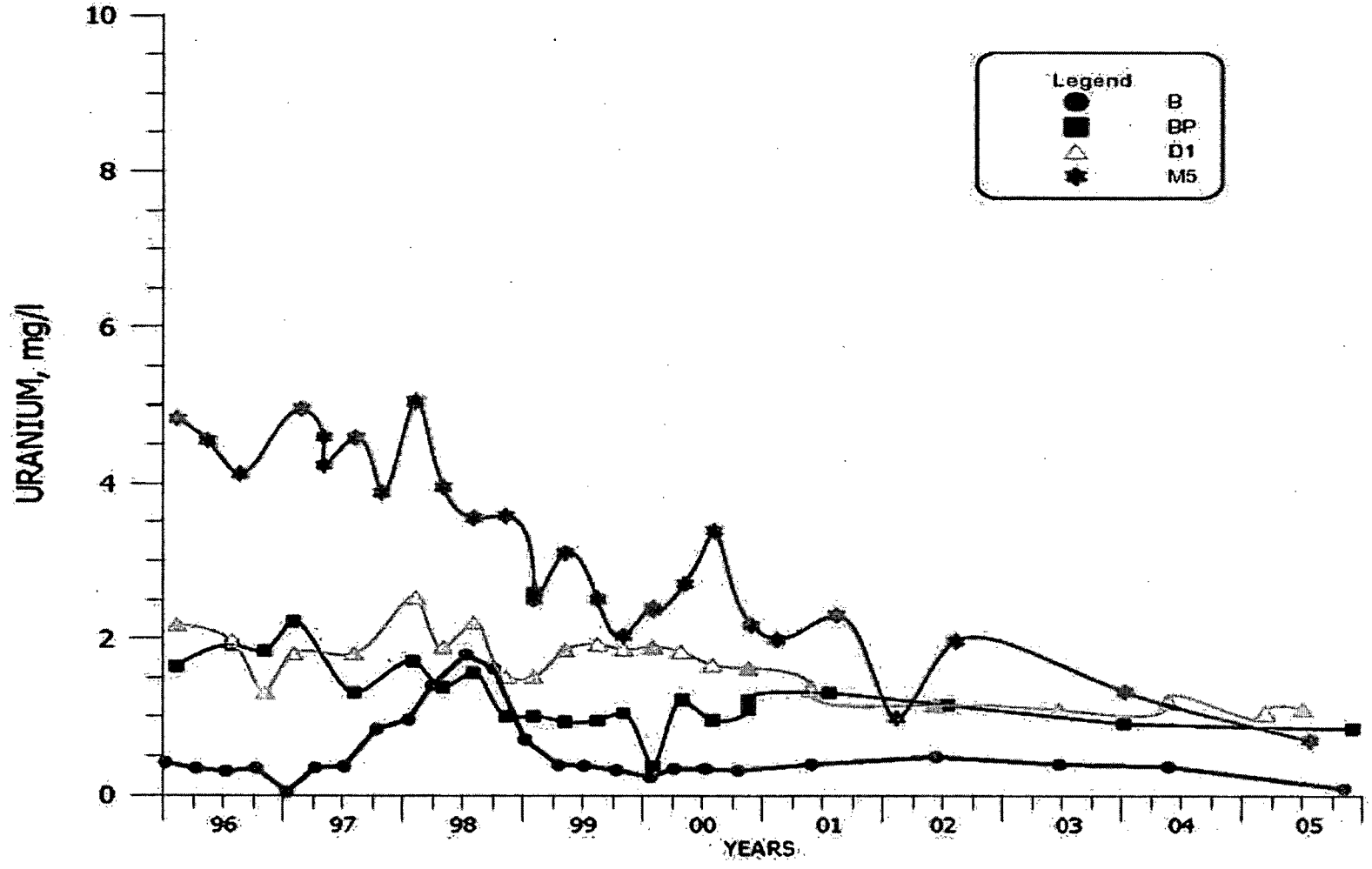



**Figure 11 Uranium Concentration for POC Well S4** (Reproduced from Hydro-Engineering 2006)




4.3-77

**Figure 12 Uranium Concentration for POC Well D1** (Reproduced from Hydro-Engineering 2006)

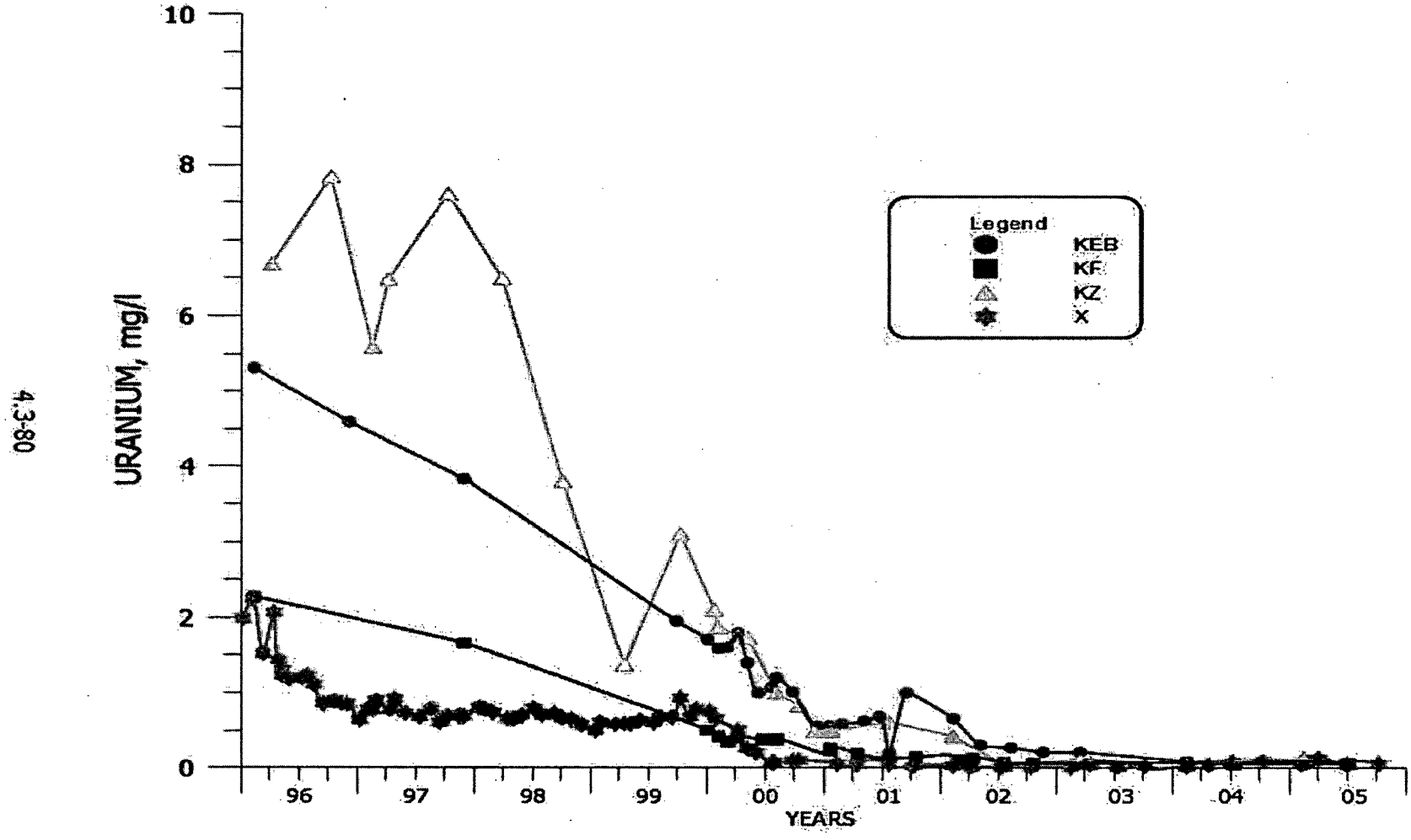



**Figure 13 Uranium Concentration for POC Well X** (Reproduced from Hydro-Engineering 2006)

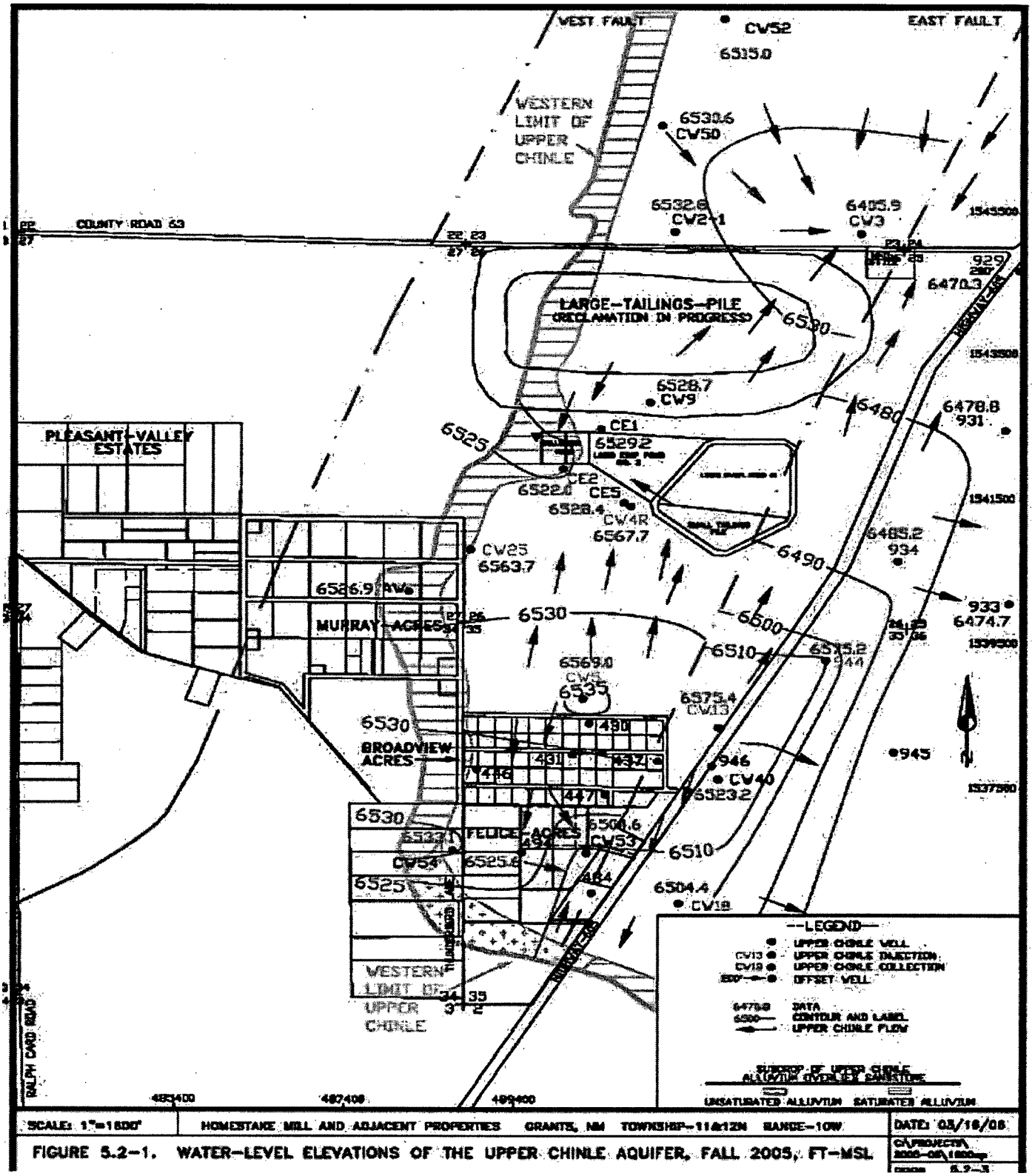



**Figure 14 Water Level Elevations of the Upper Chinle Aquifer** (Reproduced from Hydro-

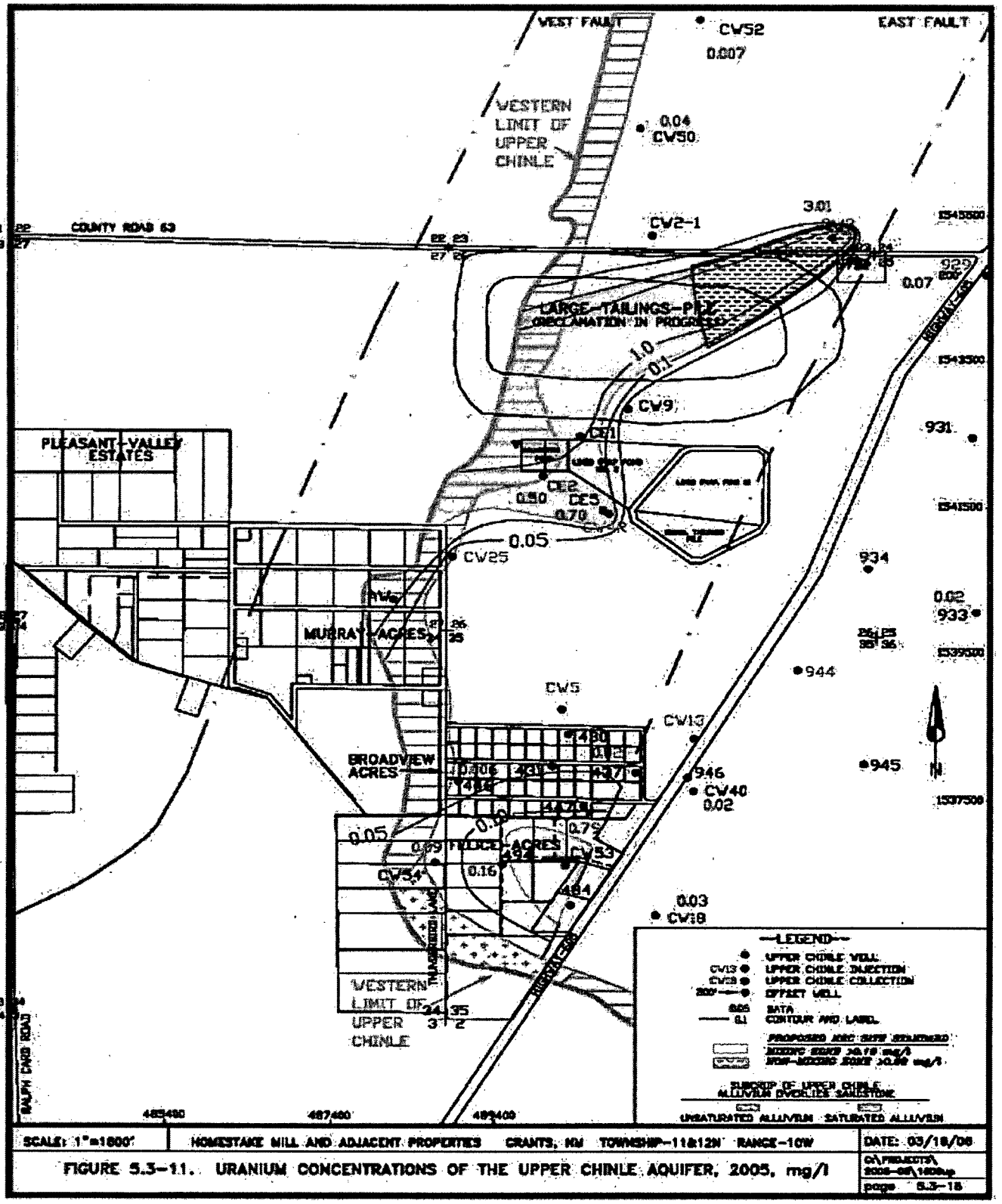



**Figure 15 Uranium Concentrations of the Upper Chinle Aquifer**
(Reproduced from Hydro-Engineering 2006)

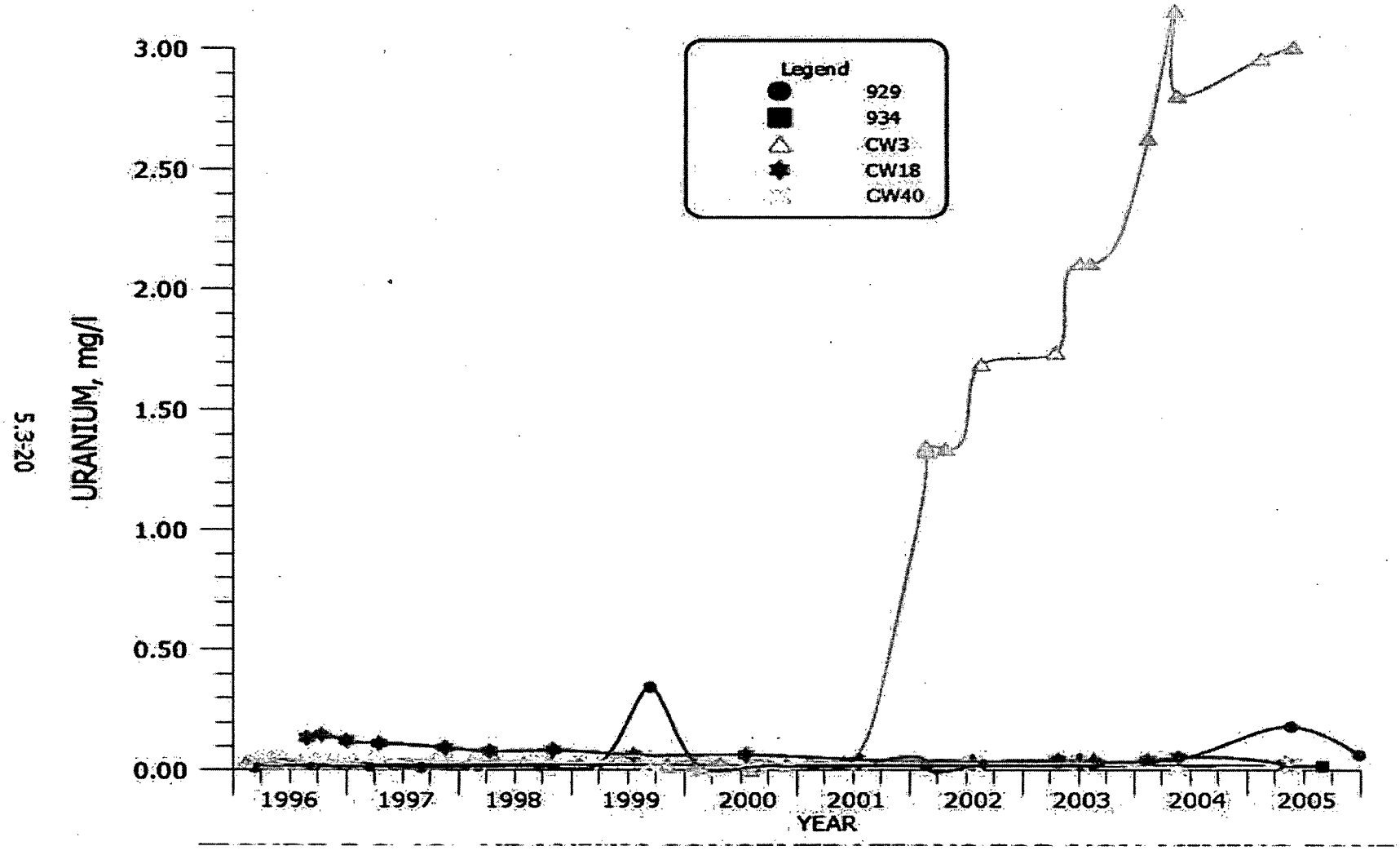



**Figure 16 Uranium Concentration in Well CW3** (Reproduced from Hydro-Engineering 2006)

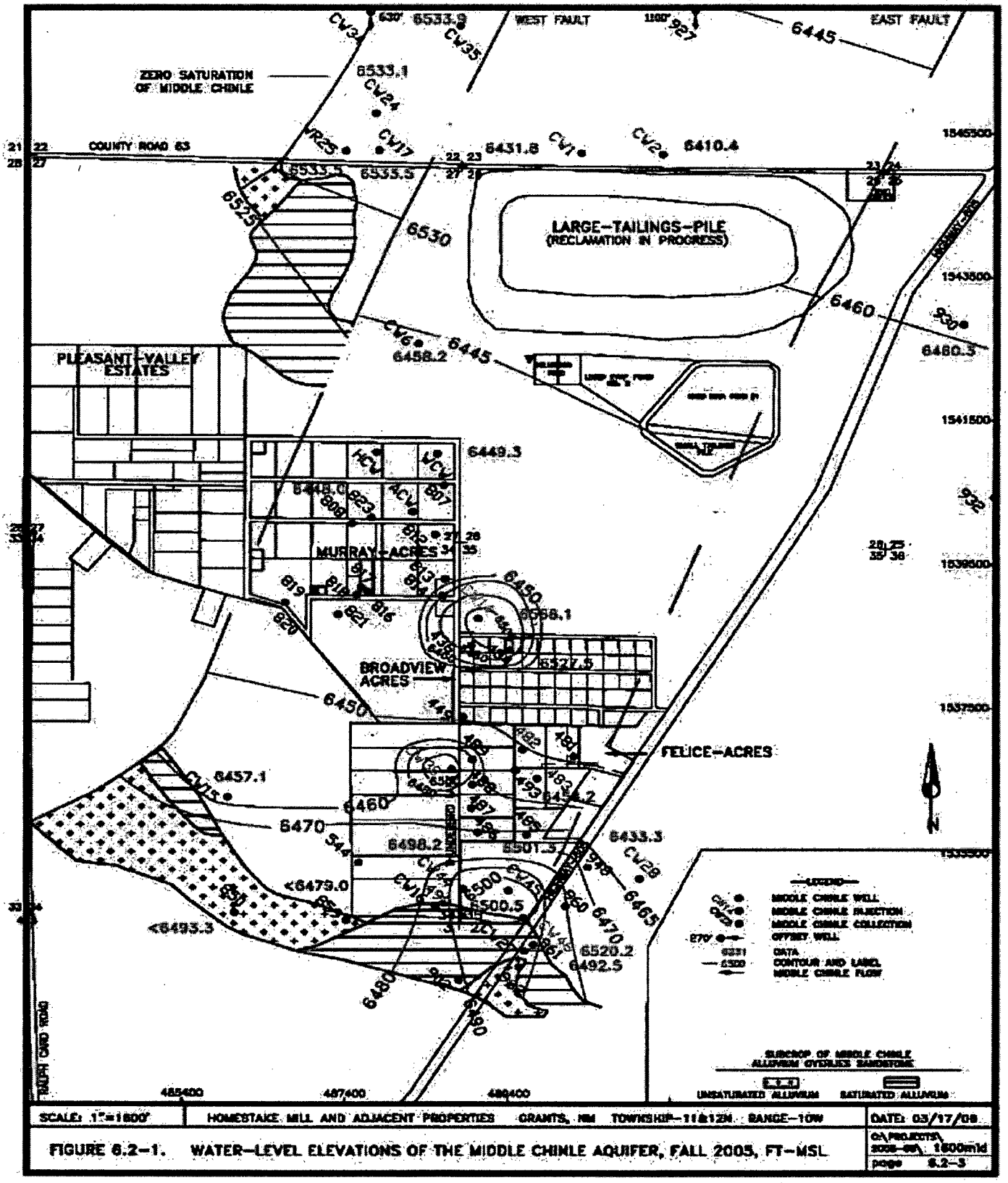



**Figure 17 Water Level Elevation of the Middle Chinle Aquifer**
(Reproduced from Hydro-Engineering 2006)

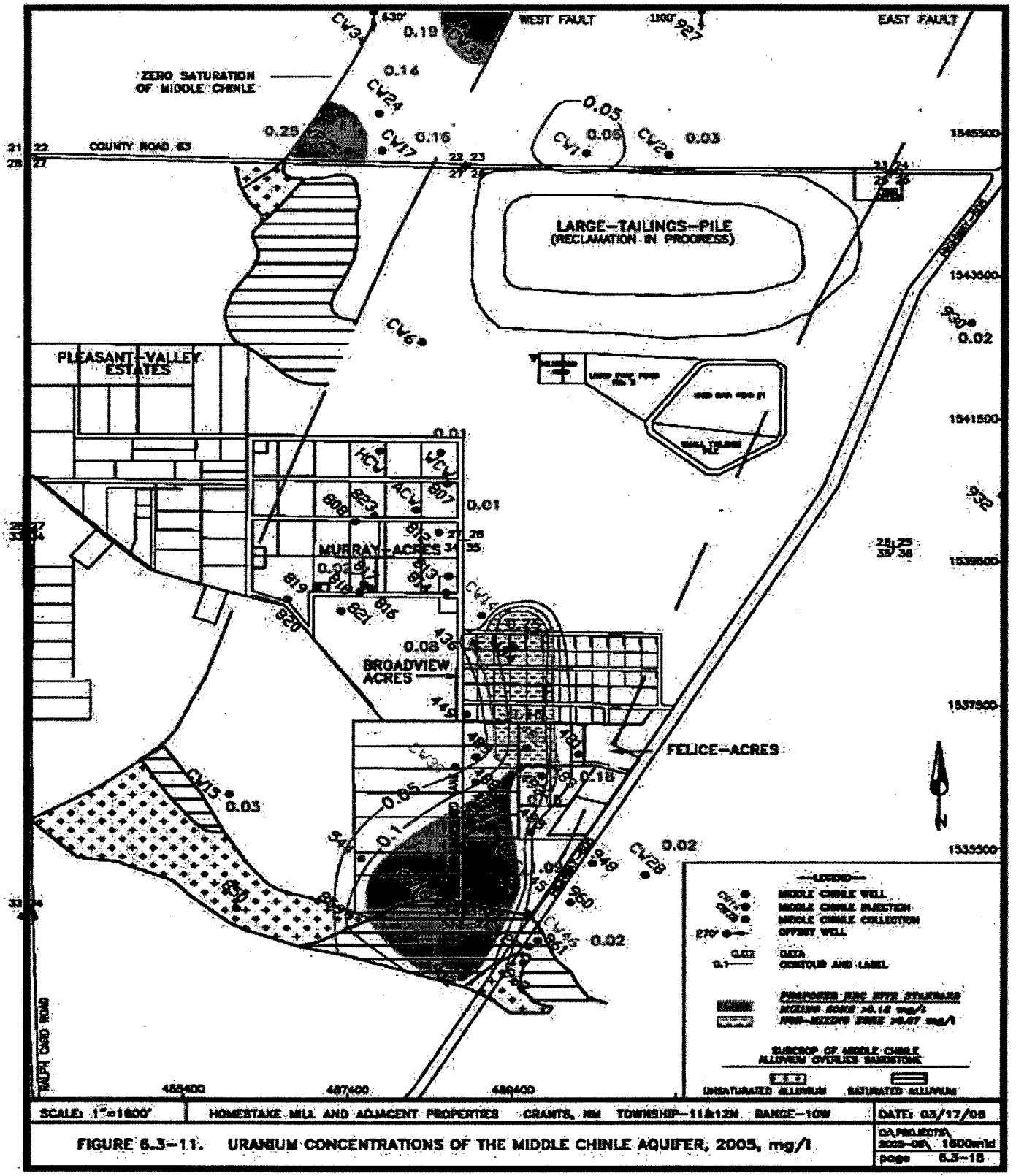



**Figure 18 Uranium Concentrations of the Middle Chinle Aquifer**
(Reproduced from Hydro-Engineering 2006)

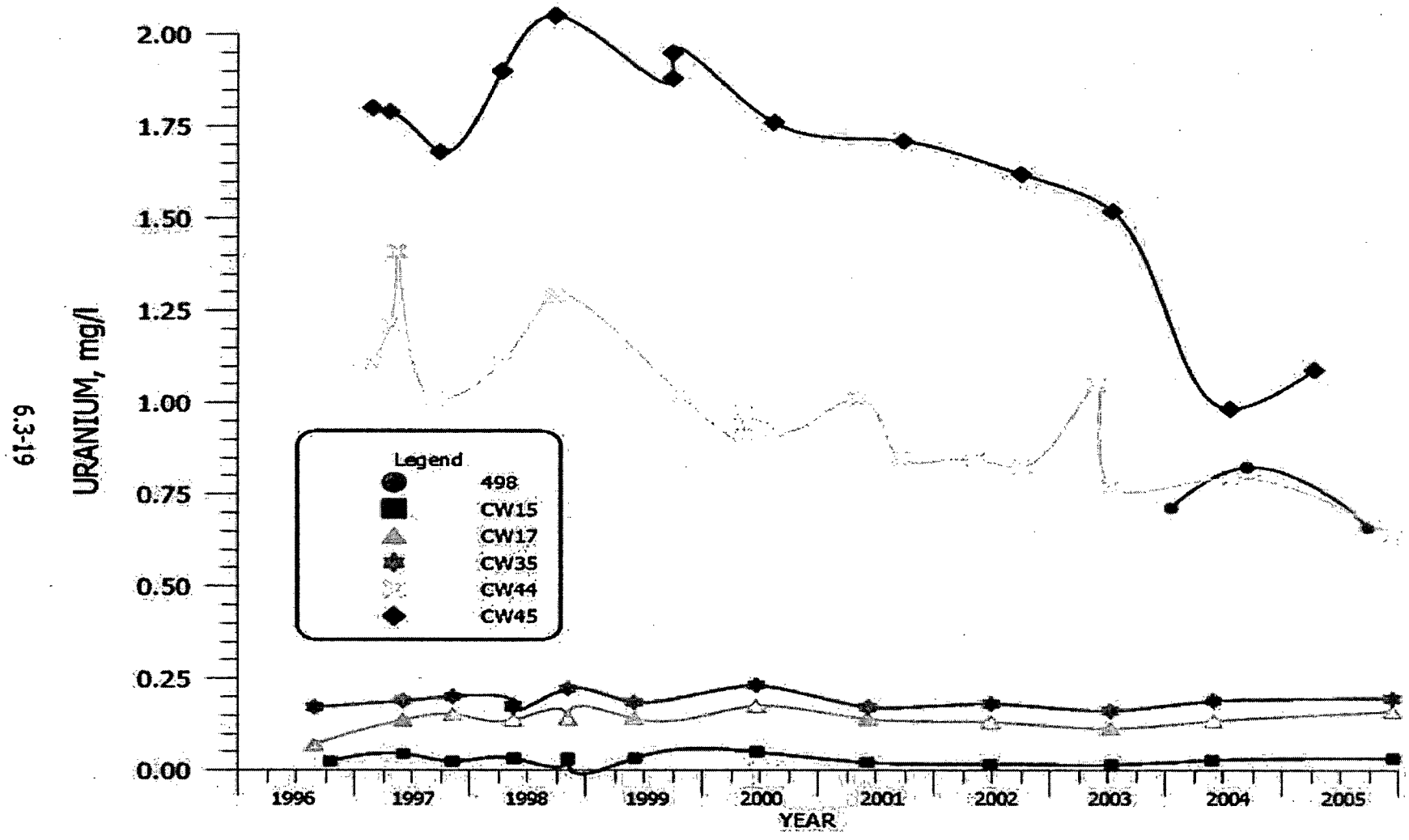



**Figure 19 Uranium Concentrations for well CW44 and CW45** (Reproduced from Hydro-Engineering 2006)

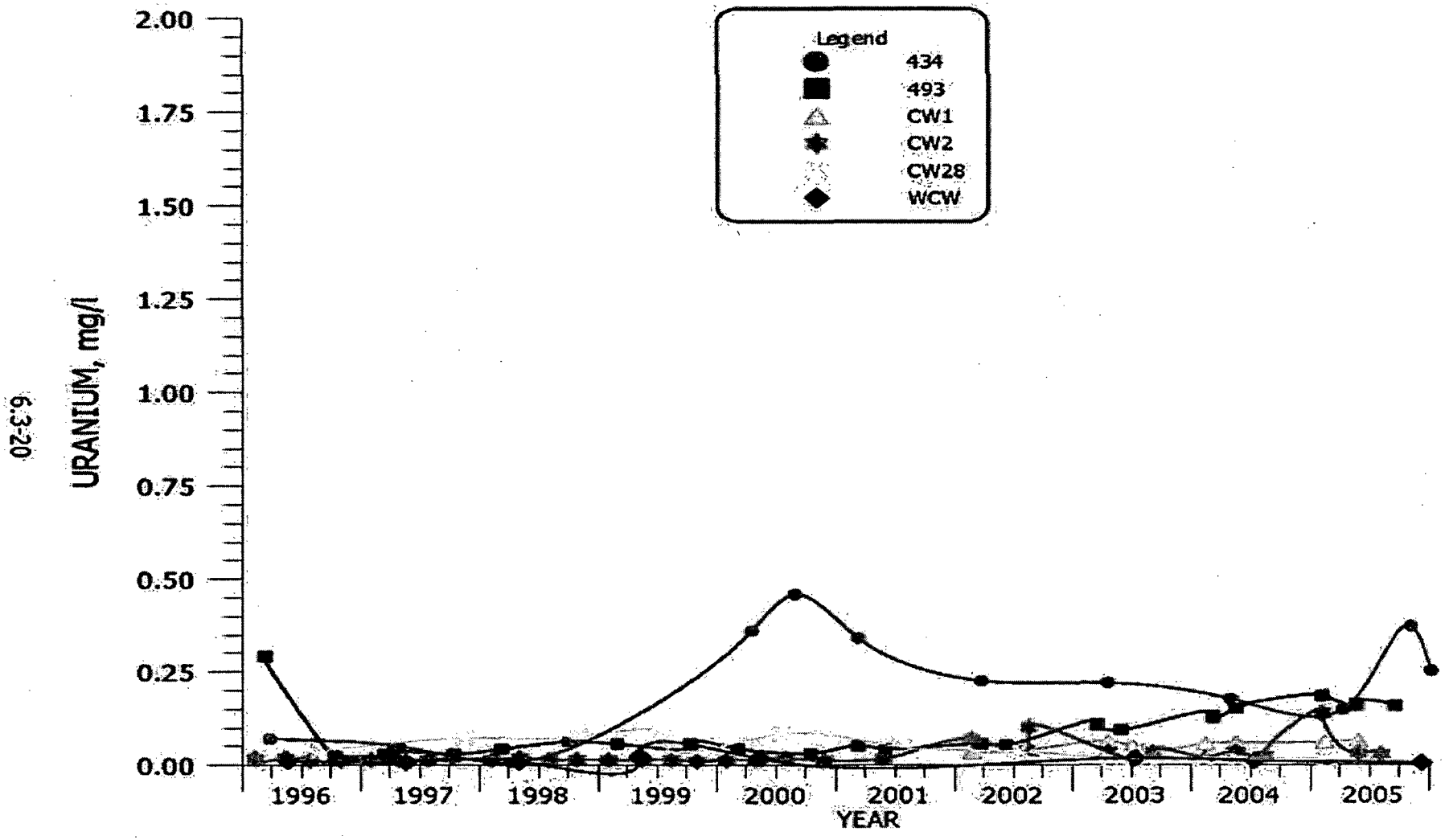



**Figure 20 Uranium Concentrations for Wells 434 and 493** (Reproduced from Hydro-Engineering 2006)

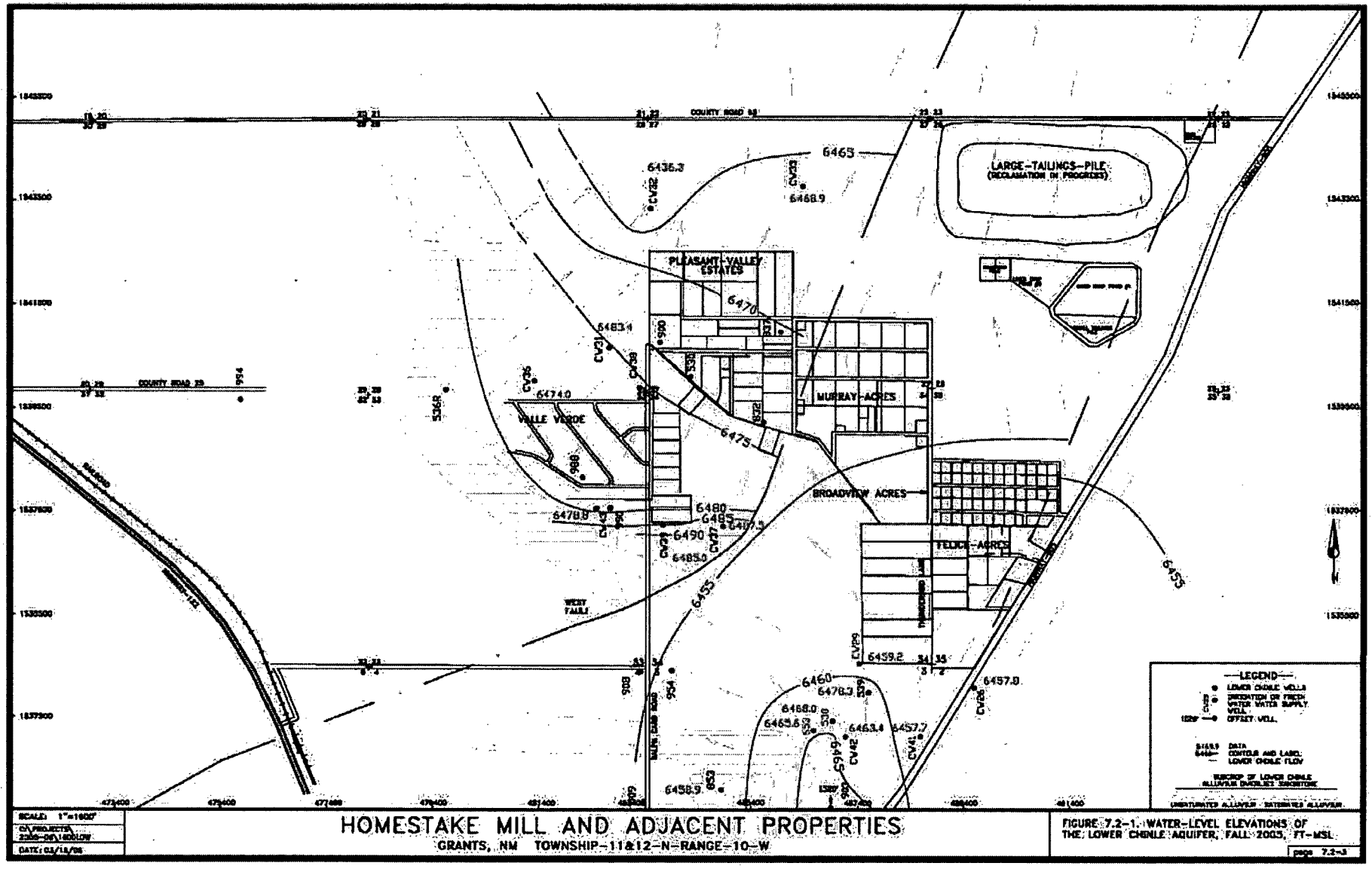



**Figure 21 Water Level Elevations of the Lower Chinle Aquifer** (Reproduced from Hydro-Engineering 2006)

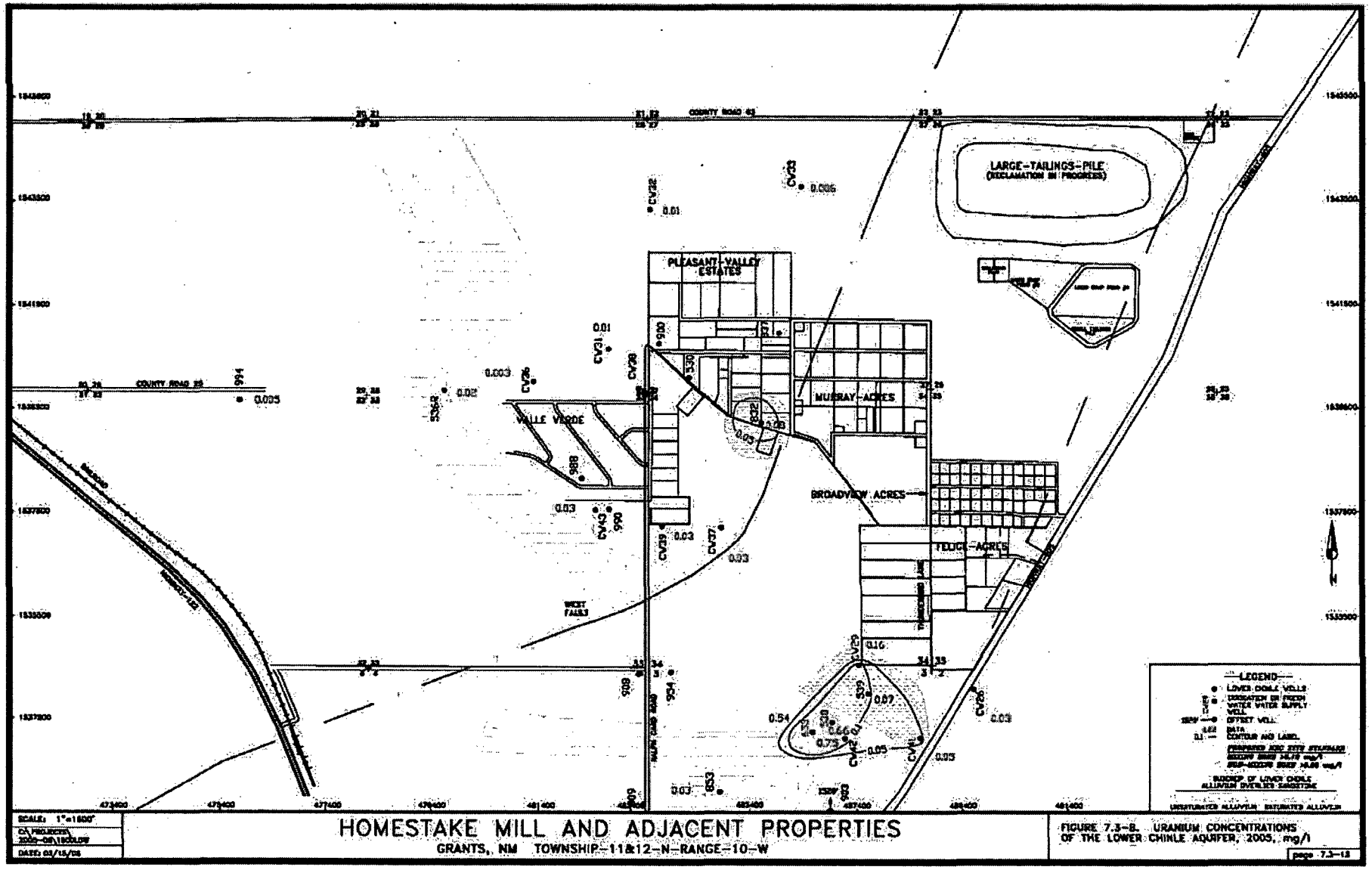



**Figure 22 Uranium Concentrations of the Lower Chinle Aquifer** (Reproduced from Hydro-Engineering 2006)

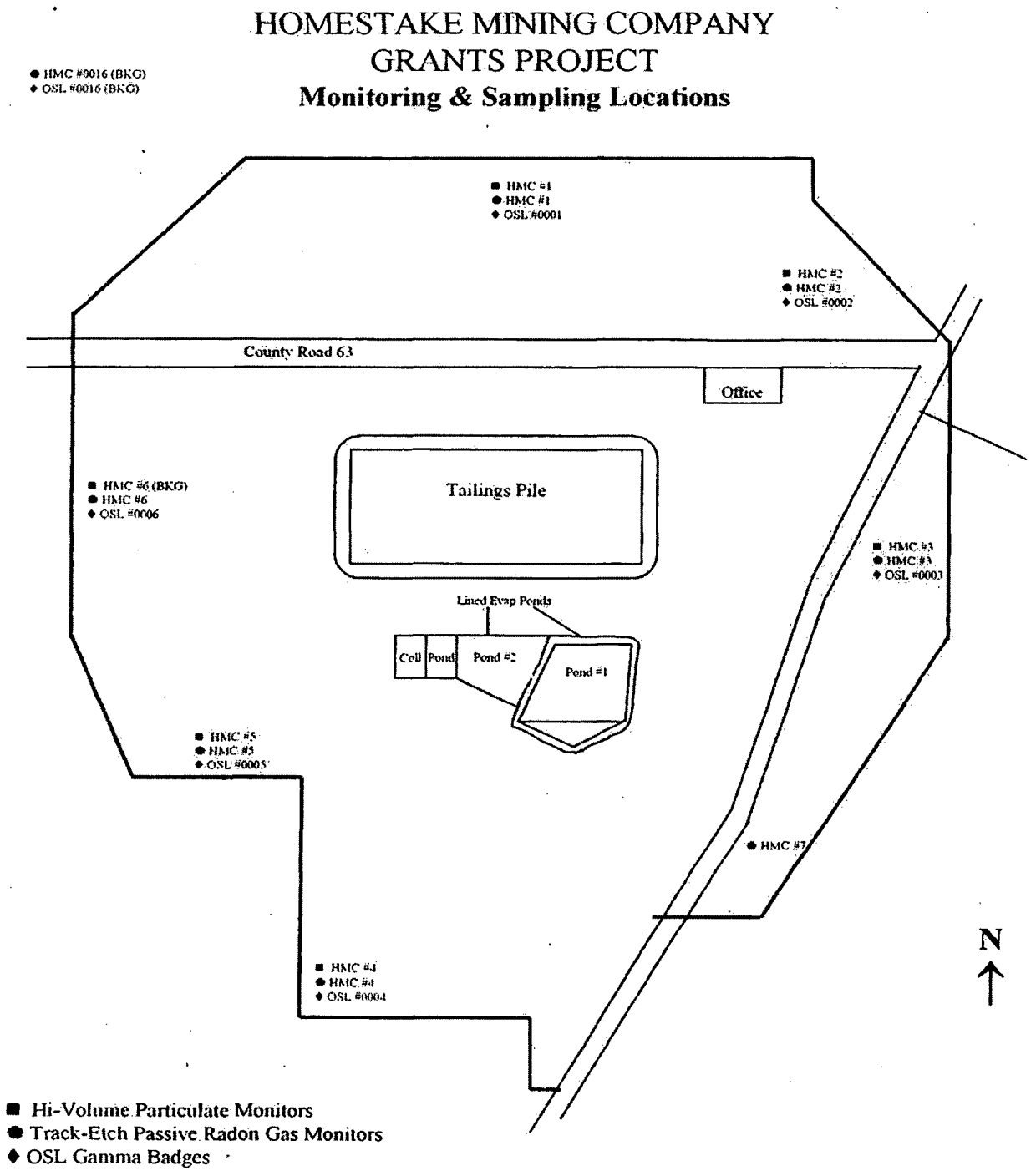



**Figure 23 Air Monitoring Station Locations**
(Reproduced from HMC Semi-Annual Environmental Monitoring Report July-December 2004)

**Attachment 3**

# Site Inspection Checklist

# HMC 2nd Five-Year Review Site Inspection Checklist

(Working document for site inspection. Information may be completed by hand and attached to the five-year review report as supporting documentation of site status. "N/A" refers to "not applicable.")

| I. SITE INFORMATION | |
|---|---|
| **Site name:** Homestake Mining Company of California | **Date of inspection:** April 24, 2006 |
| **Location and Region:** Cibola County, NM Region 6 | **EPA ID:** NMD007860935 |
| **Agency leading the five-year review:** EPA | **Weather/temperature:** Sunny, 62 degrees |
| **Remedy Includes:** (Check all that apply)<br>Landfill cover/containment — Monitored natural attenuation<br>Access controls — Ground water containment<br>Institutional controls — Vertical barrier walls<br>Ground water pump and treatment — Surface water collection and treatment<br>Other: Uranium Mill tailings pile radon barrier and erosion protection | |
| **Attachments:** Inspection team roster attached — Site map attached | |

| II. INTERVIEWS (Check all that apply) |
|---|
| 1. **O&M site manager**<br>Name: Alan Cox<br>Title: Site Project Manager<br>Date: 04/26/2006<br>Phone no. 505-287-4456<br>Interviewed: at the site — at office — by phone |
| 2. **O&M staff**<br>Name:<br>Title:<br>Date:<br>Phone no.<br>Interviewed: at the site — at office — by phone |

3. **Local regulatory authorities and response agencies** (i.e., State and Tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices, etc.) Fill in all that apply.

**IV. Agency: NMED Groundwater Quality Bureau, Superfund Oversight Section**

**Contact:**
Name: Jerry Schoeppner
Phone: 505-827-0652
Problems, suggestions: Additional report attached

**V. Agency: U.S. NRC, Fuels Cycle Licensing Branch, Division of Fuel Cycle Safety and Safeguards**

**Contact:**
Name: Paul Michalak
Phone: 301-415-7612
Problems, suggestions: Additional report attached

**VI. Agency:**

**Contact:**
Name:
Phone:
Problems, suggestions: Additional report attached

**VII. Agency:**

**Contact:**
Name:
Date:
Phone: 505-827-0652
Problems, suggestions: Additional report attached

4. **Other interviews** (optional) N/A Additional report attached

Interview Record Forms are provided in Attachment 3 to the Five-year review Report.

## III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

1. **O&M Documents**

| | | | |
|---|---|---|---|
| O&M manual | Readily available | Up to date | N/A |
| As-built drawings | Readily available | Up to date | N/A |
| Maintenance logs | Readily available | Up to date | N/A |

Remarks: Documents related to operation, maintenance and history are kept at the Site. There is no single O&M Manuel because of complex remedial actions ~~is~~ operating simultaneously. A single O&M Manual is not required by the NRC, the lead Federal Agency.

| | | | | |
|---|---|---|---|---|
| 2. | **Health and Safety Plan Documents** | | | |
| | Site-Specific Health and Safety Plan | Readily available | Up to date | N/A |
| | Contingency plan/emergency response plan | Readily available | Up to date | N/A |
| | Remarks: | | | |
| 3. | **O&M and OSHA Training Records** | Readily available | Up to date | N/A |
| | Remarks: | | | |
| 4. | **Permits and Service Agreements** | | | |
| | Air discharge permit | Readily available | Up to date | N/A |
| | Effluent discharge | Readily available | Up to date | N/A |
| | Waste disposal, POTW | Readily available | Up to date | N/A |
| | Other permits | Readily available | Up to date | N/A |
| | Remarks: | | | |
| 5. | **Gas Generation Records** | Readily available | Up to date | N/A |
| | Remarks: | | | |
| 6. | **Settlement Monument Records** | Readily available | Up to date | N/A |
| | Remarks: | | | |
| 7. | **Groundwater Monitoring Records** | Readily available | Up to date | N/A |
| | Remarks: | | | |
| 8. | **Leachate Extraction Records** | Readily available | Up to date | N/A |
| | Remarks: | | | |
| 9. | **Discharge Compliance Records** | | | |
| | Air | Readily available | Up to date | N/A |
| | Water (effluent) | Readily available | Up to date | N/A |
| | Remarks: | | | |
| 10. | **Daily Access/Security Logs** | Readily available | Up to date | N/A |
| | Remarks: | | | |

| **IV. O&M COSTS** | | Applicable | N/A |
|---|---|---|---|
| 1. | **O&M Organization** | | |
| | State in-house | Contractor for State | |
| | PRP in-house | Contractor for PRP | |
| | Federal Facility in-house | Contractor for Federal Facility | |
| | Other: O&M is performed in accordance with the NRC License SUA-1471 requirements. O&M costs are not reported as with a typical superfund site. The NRC license requires HMC to periodically submit estimated costs for remaining reclamation milestone as a part of the financial surety requirements. Mr. Cox of HMC stated that the annual O&M costs are running at about $3.5 million per year, and may increase as they augment the remedy for improvement. | | |
| 2. | **O&M Cost Records** | | |
| | Readily available | Up to date | |
| | Funding mechanism/agreement in place | | |
| | Original O&M cost estimate: | Breakdown attached | |

| | | | | |
|---|---|---|---|---|
| | Total annual cost by year for review period if available | | | |
| | From_____ To_____ | | | Breakdown attached |
| | Date | Date | Total cost | |
| | From_____ To_____ | | | Breakdown attached |
| | Date | Date | Total cost | |
| | From_____ To_____ | | | Breakdown attached |
| | Date | Date | Total cost | |
| | From_____ To_____ | | | Breakdown attached |
| | Date | Date | Total cost | |
| | From_____ To_____ | | | Breakdown attached |
| | Date | Date | Total cost | |
| 3. | **Unanticipated or Unusually High O&M Costs During Review Period** | | | |
| | Describe costs and reasons: | | | |

| | | | |
|---|---|---|---|
| | **V. ACCESS AND INSTITUTIONAL CONTROLS** | Applicable | N/A |
| **A.** | **Fencing** | | |
| 1. | **Fencing damaged** Location shown on site map Gates secured N/A<br>Remarks: The Mill Site, which includes, office, tailings impoundments, evaporation ponds and treatment plant, is surrounded by a barbed wire fence. The office building is surrounded by a chain link fence. | | |
| **B.** | **Other Access Restrictions** | | |
| 1. | **Signs and other security measures** Location shown on site map N/A<br>Remarks: | | |

| | | | | |
|---|---|---|---|---|
| **C.** | **Institutional Controls (ICs)** | | | |
| 1. | **Implementation and enforcement** | | | |
| | Site conditions imply ICs not properly implemented | Yes | No | N/A |
| | Site conditions imply ICs not being fully enforced | Yes | No | N/A |
| | Type of monitoring *(e.g.,* self-reporting, drive by): | | | |
| | Frequency: | | | |
| | Responsible party/agency: | | | |
| | Contact: | | | |
| | Name: | | | |
| | Title: | | | |
| | Date: | | | |
| | Phone Number | | | |
| | Reporting is up-to-date | Yes | No | N/A |
| | Reports are verified by the lead agency | Yes | No | N/A |
| | Specific requirements in deed or decision documents have been met | Yes | No | N/A |
| | Violations have been reported | Yes | No | N/A |
| | Other problems or suggestions: | | | |
| 2. | **Adequacy** ICs are adequate ICs are inadequate N/A<br>Remarks: | | | |
| **D.** | **General** | | | |
| 1. | **Vandalism/trespassing** Location shown on site map No vandalism evident<br>Remarks: Recently, the chain at the front gate was cut and a drum of diesel and a welder were taken from the site. A security system and security cameras were added. | | | |

| | | | | |
|---|---|---|---|---|
| 2. | **Land use changes on site**<br>Remarks: | | | N/A |
| 3. | **Land use changes off site**<br>Remarks: | | | N/A |
| | **VI. GENERAL SITE CONDITIONS** | | | |
| **A.** | **Roads** | Applicable | N/A | |
| 1. | **Roads damaged**<br>Remarks: | Location shown on site map | Roads adequate | N/A |
| **B.** | **Other Site Conditions**<br>Remarks: The Site appeared to be well organized, maintained and operated. | | | |
| | **VII. LANDFILL COVERS** | Applicable | N/A | |
| **A.** | **Temporary Radon Cover** | Applicable | N/A | |
| 1. | **Settlement** (Low spots)<br>Areal extent:<br>Remarks: Settlement is monitored as a part of tailings stabilization | Location shown on site map<br>Depth: | Settlement not evident | |
| 2. | **Cracks**<br>Lengths:<br>Depths:<br>Remarks: | Location shown on site map<br>Widths: | Cracking not evident | |
| 3. | **Erosion**<br>Areal extent:<br>Remarks: | Location shown on site map<br>Depth: | Erosion not evident | |
| 4. | **Holes**<br>Areal extent:<br>Remarks: Numerous tailings flushing and dewatering wells completed on top of the tailings impoundment | Location shown on site map<br>Depth: | Holes not evident | |
| 5. | **Vegetative Cover N/A**<br>Trees/Shrubs (indicate size and locations on a diagram)<br>Remarks: | Grass | Cover properly established | No signs of stress |
| 6. | **Alternative Cover** (armored rock, concrete, etc.)<br>Remarks: Rock Cover will be placed on the radon cover for erosion control | | | |
| 7. | **Bulges**<br>Areal extent:<br>Remarks: | Location shown on site map<br>Height: | Bulges not evident | |
| 8. | **Wet Areas/Water Damage**<br>Wet areas<br>Ponding<br>Seeps<br>Soft subgrade<br>Remarks: | <br>Location shown on site map<br>Location shown on site map<br>Location shown on site map<br>Location shown on site map | Wet areas/water damage not evident<br>Areal extent:<br>Areal extent:<br>Areal extent:<br>Areal extent: | |

| | | | |
|---|---|---|---|
| 9. | **Slope Instability** Slides<br>Areal extent:<br>Remarks: Slopes contain final radon cover with rock cover for erosion protection. | Location shown on site map | No evidence of slope instability |
| **B.** | **Benches** Applicable N/A<br>(Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel.) | | |
| 1. | **Flows Bypass Bench**<br>Remarks: | Location shown on site map | N/A or okay |
| 2. | **Bench Breached**<br>Remarks: | Location shown on site map | N/A or okay |
| 3. | **Bench Overtopped**<br>Remarks: | Location shown on site map | N/A or okay |
| **C.** | **Letdown Channels** Applicable N/A<br>(Channel lined with erosion control mats, riprap, grout bags, or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies.) | | |
| 1. | **Settlement**<br>Areal extent:<br>Remarks: | Location shown on site map<br>Depth: | No evidence of settlement |
| 2. | **Material Degradation**<br>Material type:<br>Remarks: | Location shown on site map<br>Areal extent: | No evidence of degradation |
| 3. | **Erosion**<br>Areal extent:<br>Remarks: | Location shown on site map<br>Depth: | No evidence of erosion |
| 4. | **Undercutting**<br>Areal extent:<br>Remarks: | Location shown on site map<br>Depth: | No evidence of undercutting |
| 5. | **Obstructions** Type:<br>Location shown on site map<br>Size:<br>Remarks: | Areal extent: | No obstructions |
| 6. | **Excessive Vegetative Growth** Type:<br>No evidence of excessive growth<br>Vegetation in channels does not obstruct flow<br>Location shown on site map<br>Remarks: | Areal extent: | |

| | | | | |
|---|---|---|---|---|
| **D.** | **Cover Penetrations** | Applicable | | N/A |
| 1. | **Gas Vents** | Active | Passive | |
| | Properly secure d/locked Functioning | | Routinely sampled | Good condition |
| | Evidence of leakage at penetration | | Needs Maintenance | |
| | N/A | | | |
| | Remarks: | | | |
| 2. | **Gas Monitoring Probes** | | | |
| | Properly secure d/locked Functioning | | Routinely sampled | Good condition |
| | Evidence of leakage at penetration | | Needs Maintenance | N/A |
| | Remarks: | | | |
| 3. | **Monitoring Wells** (within surface area of landfill) | | | |
| | Properly secure d/locked Functioning | | Routinely sampled | Good condition |
| | Evidence of leakage at penetration | | Needs Maintenance | |
| | Remarks: | | | |
| 4. | **Leachate Extraction Wells** | | | |
| | Properly secure d/locked Functioning | | Routinely sampled | Good condition |
| | Evidence of leakage at penetration | | Needs Maintenance | |
| | Remarks: | | | |
| 5. | **Settlement Monuments** | Located | Routinely surveyed | |
| | Remarks: | | | |
| **E.** | **Gas Collection and Treatment** | Applicable | | N/A |
| 1. | **Gas Treatment Facilities** | | | |
| | Flaring | Thermal destruction | Collection for reuse | |
| | Good condition | Needs Maintenance | | |
| | Remarks: | | | |
| 2. | **Gas Collection Wells, Manifolds and Piping** | | | |
| | Good condition | Needs Maintenance | | |
| | Remarks: | | | |
| 3. | **Gas Monitoring Facilities** *(e.g.,* gas monitoring of adjacent homes or buildings) | | | |
| | Good condition | Needs Maintenance | N/A | |
| | Remarks: | | | |
| **F.** | **Cover Drainage Layer** | Applicable | | N/A |

| | | | |
|---|---|---|---|
| 1. | **Outlet Pipes Inspected**<br>Remarks: | Functioning | |
| 2. | **Outlet Rock Inspected**<br>Remarks: | Functioning | |
| **G.** | **Detention/Sedimentation Ponds** | Applicable | N/A |
| 1. | **Siltation** Areal extent:<br>Siltation not evident<br>Remarks: | Depth: | |
| 2. | **Erosion** Areal extent:<br>Erosion not evident<br>Remarks: | Depth: | |
| 3. | **Outlet Works**<br>Remarks: | Functioning | |
| 4. | **Dam**<br>Remarks: | Functioning | |
| **H.** | **Retaining Walls** | Applicable | N/A |
| 1. | **Deformations**<br>Horizontal displacement:<br>Vertical displacement:<br>Rotational displacement:<br>Remarks: | Location shown on site map | Deformation not evident |
| 2. | **Degradation**<br>Remarks: | Location shown on site map | Degradation not evident |
| **I.** | **Perimeter Ditches/Off-Site Discharge** | Applicable | N/A |
| 1. | **Siltation**<br>Areal extent:<br>Remarks: | Location shown on site map Siltation not evident<br>Depth: | |
| 2. | **Vegetative Growth**<br>Vegetation does not impede flow<br>Areal extent:<br>Remarks: | Location shown on site map<br>Type: | |
| 3. | **Erosion**<br>Areal extent:<br>Remarks: | Location shown on site map<br>Depth: | Erosion not evident |

| | | |
|---|---|---|
| 4. | **Discharge Structure** Functioning<br>Remarks: | |

| | | | |
|---|---|---|---|
| | **VIII. VERTICAL BARRIER WALLS** | Applicable | N/A |
| 1. | **Settlement** Location shown on site map Settlement not evident<br>Areal extent: Depth:<br>Remarks: | | |
| 2. | **Performance Monitoring** Type of monitoring:<br>Performance not monitored<br>Frequency: Evidence of breaching<br>Head differential:<br>Remarks: | | |

| | | | |
|---|---|---|---|
| | **IX. GROUNDWATER/SURFACE WATER REMEDIES** | Applicable | N/A |
| **A.** | **Groundwater Extraction Wells, Pumps, and Pipelines** | Applicable | N/A |
| 1. | **Pumps, Wellhead Plumbing, and Electrical**<br>Good condition All required wells properly operating Needs Maintenance<br>Remarks: The site contains over 625 wells, so not all wells were examined during the inspection. Newly modified injection well on top of the tailings impound was inspected, which was operating appropriately. Other injection, extraction and monitoring wells were observed during drive through during the inspection, and appeared to be well maintained. | | |
| 2. | **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances**<br>Good condition Needs Maintenance<br>Remarks: Complex system of ground water restoration system which includes extensive piping and associated equipment to convey extraction and treated ground water. All parts of the system that were examined during the inspection appeared to be in good condition. Portions of piping have been buried to prevent freezing during the winter. | | |
| 3. | **Spare Parts and Equipment**<br>Readily available Good condition<br>Requires upgrade Needs to be provided<br>Remarks: | | |

| | | | |
|---|---|---|---|
| **B.** | **Surface Water Collection Structures, Pumps, and Pipelines** | Applicable | N/A |
| 1. | **Collection Structures, Pumps, and Electrical**<br>Good condition Needs Maintenance<br>Remarks: | | |
| 2. | **Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances**<br>Good condition Needs Maintenance<br>Remarks: | | |
| 3. | **Spare Parts and Equipment**<br>Readily available Good condition<br>Requires upgrade Needs to be provided<br>Remarks: | | |

| C. | **Treatment System** | Applicable | N/A |
|---|---|---|---|
| 1. | **Treatment Train** (Check components that apply)<br>Metals removal — Oil/water separation<br>Bioremediation — Air stripping<br>Carbon adsorbers<br>Filters<br>Additive *(e.g.,* chelation agent, flocculent)<br>Others (list): Reverse Osmosis Treatment Plant, Passive & Force Evaporation<br>Good condition — Needs Maintenance<br>Sampling ports properly marked and functional<br>Sampling/maintenance log displayed and up to date<br>Equipment properly identified<br>Quantity of groundwater treated: 256 gpm (RO Treatment) and 159 gpm (Evaporative)<br>Quantity of surface water treated:<br>Remarks: The ground water restoration system includes two evaporation ponds that includes passive and forced evaporative treatment. The forced evaporation (spray mists) was operating during the Site inspection. The system also includes RO Treatment Plant. The second RO treatment unit added during the review period was observed. The RO Treatment Plant was down during the inspection for maintenance activities. | | |
| 2. | **Electrical Enclosures and Panels** (properly rated and functional)<br>Good condition — Needs Maintenance<br>Remarks: | | |
| 3. | **Tanks, Vaults, Storage Vessels**<br>Good condition — Proper secondary containment — Needs Maintenance<br>Remarks: | | |
| 4. | **Discharge Structure and Appurtenances**<br>Good condition — Needs Maintenance<br>Remarks: System brine waste discharge is reported to the evaporation pond system; RO product water is reinjected to enhance ground water restoration efforts. | | |
| 5. | **Treatment Building(s)**<br>Good condition (esp. roof and doorways) — Needs repair<br>Chemicals and equipment properly stored<br>Remarks: | | |

| | | | |
|---|---|---|---|
| 6. | **Monitoring Wells** (pump and treatment remedy)<br>Properly secured/locked — Routinely sampled<br>Good condition — Needs Maintenance<br>All required wells located — Functioning<br>Remarks: The site contains hundreds of monitoring wells, so not all were inspected. The wells that were observed appeared in good condition. | | |
| **D.** | **Monitoring Data** | Applicable | N/A |
| 1. | **Monitoring Data**<br>Is routinely submitted on time — Is of acceptable quality<br>Remarks: Monitoring data are submitted on time to NRC and NMED as required by the license | | |

| | | | |
|---|---|---|---|
| | conditions, the ground water CAP and the NMED DP-200 and DP-725. | | |
| 2. | **Monitoring data suggests:**<br>Ground water plume is effectively contained<br>Remarks: | Contaminant concentrations are declining | |
| **E.** | **Monitored Natural Attenuation** | Applicable | N/A |
| 1. | **Monitoring Wells** (natural attenuation remedy)<br>Properly secure d/locked Functioning<br>All required wells located<br>Remarks: | Routinely sampled<br>Needs Maintenance | Good condition |

## X. OTHER REMEDIES

Applicable N/A

The other operable unit of the remedy involves stabilization of tailings impoundments, surface reclamation and mill decommissioning. The site includes two tailings impoundments. The large tailings impoundment has the final radon barrier and rock erosion protection cover on the side slopes. The top of the tailings impoundment only contains an interim cover and no other significant tailings and surface soil reclamation activities were performed during this review period because tailings flushing / dewatering consisting of extraction and injection wells, and use of evaporation ponds for treatment of collected water during the ongoing ground water restoration activities is necessary. The final phase of reclamation of the tailing impoundments and evaporation ponds will be implemented following completion of ground water restoration program. Also, the NRC settlement requirements must be met before the final cover and radon barrier can be placed on the large tailings pile. There are currently large pipes along the slopes to collect runoff from the top of the pile, but these will be removed once the final cover and barrier are placed on top of the pile. No cracking, slumping, bulging, or signs of erosion were noticed in the cover of the slopes. The cover on the slopes of the large tailings pile appeared to be in good condition. Only an interim cover and radon barrier exists on the small pile. Evaporation pond #1 is located on top of the small tailings pile. Evaporation pond #2 is located adjacent to and west of the Evaporation Pond #1. Both ponds are used for evaporative treatment (forced and passive) of extracted contaminated ground water, collected water from the large tailings pile via collection wells and perimeter seepage sumps, and brine reject water from the RO plant. The forced evaporative treatment was operating in both ponds during the inspection.

## XI. OVERALL OBSERVATIONS

**Implementation of the Remedy**

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.)

The purpose of the remedy is to limit radon emissions from the tailings impoundments; remediate contamination in soil that resulted from windblown tailings; remediate ground water to levels stipulated in the NRC License SUA-1471 and the NMED DP-200; dewater the large tailings impoundment to remove this area as a continuing source of ground water contamination; and prevent the use of contaminated ground water by nearby residents in the Subdivisions for domestic use. The remedy appears to be functioning as intended by the NRC, NMED and HMC. The ground water gradients have been reversed away from the subdivisions, and contaminant concentrations are decreasing. HMC has been actively seeking ways to enhance and speed up the rate of restoration of the contaminated ground water. Other monitoring data is collected to verify that no airborne emissions are coming from the site. The monitoring program shows that the site is operating within the conditions of its NRC License and NMED permits, and the remedy appears to be effective at protecting human health and the environment.

**B. Adequacy of O&M**

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

The remedy has been well implemented, operated and maintained. HMC has taken actions not specifically required by the regulatory agencies to seek improvements in their design and operations. They have implemented on their own initiative several actions, such as the reverse osmosis plant and the ground water extraction and irrigation treatment to remediate ground water contamination plume that has migrated off site and is outside the capture zone of the primary remediation system. It appears that the remedy, once completed, could be fully protective as long as long-term site monitoring and care are conducted to maintain the integrity of the radon barriers and covers placed on the tailings piles and to ensure that the ground water restoration has been effective. Currently, no threat appears to exist to human health or the environment at the site.

Early Indicators of Potential Remedy Failure

Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future.

None.

**D. Opportunities for Optimization**

Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.

HMC appears to have sought opportunities to optimize their operation.

## Site Inspection Roster for Site Inspection Conducted April 26, 2006
## Homestake Mining Company Superfund Site

| Name | Agency/Company | Phone Number | Email Address |
|---|---|---|---|
| Alan Cox | Homestake Mining Company of California | 505-287-4456 | acox@barrick.com |
| George Hoffman | Hydro-Engineering | 307-266-3704 | hydro@trib.com |
| Doug Bruner | U.S. Army Corps of Engineers, District 6 | 505-342-3477 | douglas.w.bruner@spa02.usace.army.mil |
| Natver Patel | AVM Environmental Services, Inc. | 505-287-4593 | natavm@7cities.net |
| Arvind Patel | AVM Environmental Services, Inc. | 505-287-4593 | natavm@7cities.net |

**Attachment 4**

# Interview Record Forms

| **Five-Year Review Interview Record**<br><br>Homestake Mining Company<br>Cibola County, New Mexico | **Interviewee:** Paul Michalak<br>**Organization:** U.S. NRC, Fuels Cycle Facilities Branch, Division of Fuel Cycle Safety and Safeguards<br>**Phone:** 301-415-7612<br>**Email:** pmx2@nrc.gov |
|---|---|

| **Site Name** | **EPA ID No.** | **Date of Interview** | **Interview Method** |
|---|---|---|---|
| Homestake Mining Company Superfund Site | NMD007860935 | 04-19-2006 | Telephone |

| **Interview Contacts** | **Organization** | **Phone** | **Email** | **Address** |
|---|---|---|---|---|
| Nat Patel | AVM Environmental Services, Inc. | (505) 287-4593 | natavm@7cities.net | 216B West High St. Grants, NM 87020 |
| Arvind Patel | AVM Environmental Services, Inc. | (505) 287-4593 | natavm@7citites.net | 216B West High St. Grants, NM 87020 |
| Art O'Hayre | Applied Hydrology Associates | (303) 782-0164 | aohayre@appliedhydrology.com | 950 S. Cherry St. Suite 810 Denver, CO 80246 |

Interview Questions

*1.* What is your overall impression of the work conducted at the site since the last 5-Year Review in 2001?

**Response:** Mr. Michalak indicated that his impression of work conducted at the site has been very good and HMC has met all the expectations of the NRC. "HMC is on top of the issues and is working hard to meet the licensee expectations," said Mr. Michalak.

*2.* Have there been routine communications or activities (site visits, inspections, reporting activities, etc.) conducted by your office regarding the site? If so, please describe purpose and results.

**Response:** Mr. Michalak indicated that the communication between his office and HMC has been very good. He has had a number of phone conversations with HMC representatives and performed a comprehensive site visit in March 2006. He further added that all of his inquires were answered to his satisfaction.

*3.* Have there been any complaints, violations, or other incidents related to the site that required a response by your office? If so, please summarize the events and results of the responses.

**Response:** Mr. Michalak stated that he reviewed NRC's document system (ADAMS) for HMC violations between 2001 and 2006. He indicated that his review did not indicate any violations or incidents related to the site that required a response by his office. His ADAMS research did reveal one complaint to NMED concerning odors from HMC's evaporation pond.

4. Are you aware of opportunities to optimize the operation, maintenance, or sampling efforts at the site?

**Response:** Mr. Michalak stated that he is satisfied at this point with the remedial approach at the site and he is not aware of any opportunities to optimize the operation, maintenance, or sampling efforts at the site.

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|---|
| *5.* From NRC's perspective, have any of the changes in site operation or maintenance requirements implemented since the CAP was approved had an affect on the protectiveness or effectiveness of the remedial approach? Please describe changes and impacts.<br><br>**Response:** Mr. Michalak indicated that he is not aware of any negative affect on the protectiveness or effectiveness of the remedial approach. |
| *6.* Have there been any changes in NRC's environmental standards since the time the remedial approach was delineated, which may call into question the protectiveness or effectiveness of the remedial approach?<br><br>**Response:** Mr. Michalak responded by saying, "there has been no change in environmental standards that affect the protectiveness or effectiveness of the remedial approach." |
| 7. Is the ground water remediation progressing in accordance with NRC's expectations for the site? Does NRC have any concerns about the status of the ground water remediation being conducted for the site?<br><br>**Response:** Mr. Michalak indicated that yes, the ground water remediation is progressing in accordance with NRC's expectations. However, he stated that he believes there is likely some uncertainty in HMC's proposed remedial action timeframe and that remedial predictions and modeling can be very inaccurate. |
| *8.* Do you feel well informed about the site's activities and progress?<br><br>**Response:** Mr. Michalak stated the he does feel well informed about the site's activities and progress. He also added that he is very pleased with the communication between his office and HMC. |
| *9.* Do you have any comments, suggestions, concerns, or recommendations regarding the site?<br><br>**Response:** Mr. Michalak indicated that he doesn't have any comments, suggestions, concerns, or recommendations regarding the site, but stated that he is very impressed with HMC being on top of the site issues.<br><br>During the interview, Mr. Michalak stated that NRC is in the final stages of completing its review of HMC's proposed license amendment concerning revisions to existing ground water quality standards, some of which involve changes to previously defined background concentrations. He indicated the proposed revisions are based on extensive analytical and statistical studies performed by HMC and that it is likely that the NRC will approve the proposed revisions. This may require additional POC wells since the three current POC wells are only in the alluvial aquifer and the revised background concentrations are different for different aquifers. This may also require further license amendments and an updated ground water CAP.<br><br>The recent NMED sampling results of the private down gradient residential wells of HMC were discussed. Mr. Michalak indicated that, based on a temporal and spatial analysis of ground water quality performed by NMED, uranium concentrations exceeding the ground water standards in private wells at residences that are not connected to the Village of Milan water system are not definitively impacted by HMC. He also discussed a lack of available enforceable institutional controls to control ground water usage down gradient of HMC; however, the NMED, EPA, and NRC are working to resolve this issue. |

On April 21 2006 Mr. Michalak called and stated that he found one complaint by an individual regarding an odor coming from the HMC site. He faxed a letter from the NMED dated August 30, 2001 to the individual regarding NMED's investigation and follow up with HMC about this issue, and a letter from HMC's consultant (MWH) to HMC addressing the odor issue. The NMED letter indicates that HMC took appropriate actions and the air monitoring data show that no airborne health risk exists. Although the odor is unpleasant, it does not pose a risk to human health, and is not regulated by the State of New Mexico.

During the April 21 phone conversation with Mr. Michalak, he followed up on a question regarding tailings impoundment reclamation approval and indicated that the erosion protection cover on the tailings impoundment slopes was approved by the NRC in October 24, 1997.

| **Five-Year Review Interview Record**<br><br>Homestake Mining Company<br>Cibola County, New Mexico | **Interviewee:** Jerry Schoeppner/Jake Ingram<br>**Organization:** NMED, Ground water Quality Bureau<br>Superfund Oversight Section<br>**Phone:** 505-827-0652/505-827-0039<br>**Email:** jerry.schoeppner@state.nm.us<br>jake.ingram@state.nm.us |
|---|---|

| **Site Name**<br>Homestake Mining Company<br>Superfund Site | **EPA ID No.**<br><br>NMD007860935 | **Date of Interview** | **Interview Method**<br><br>Telephone |
|---|---|---|---|

| **Interview Contacts** | **Organization** | **Phone** | **Email** | **Address** |
|---|---|---|---|---|
| Nat Patel | AVM Environmental Services, Inc. | (505) 287-4593 | natavm@7cities.net | 216B West High St.<br>Grants, NM 87020 |
| Arvind Patel | AVM Environmental Services, Inc. | (505) 287-4593 | natavm@7cities.net | 216B West High St.<br>Grants, NM 87020 |
| Art O'Hayre | Applied Hydrology Associates | (303) 782-0164 | aohayre@appliedhydrology.com | 950 S. Cherry St. Suite 810<br>Denver, CO 80246 |

Interview Questions

*1.* What is your overall impression of the work conducted at the site since the last 5-Year Review in 2001?

**Response:** The NMED stated that HMC is making a good effort to implement the remedial action and is meeting the expectations of the NMED. The NMED also added that based on historical information about the site, there are no operational issues or red flags.

*2.* Have there been routine communications or activities (site visits, inspections, reporting activities, etc.) conducted by your office regarding the site? If so, please describe purpose and results.

**Response:** The NMED stated that yes; there have been routine communications and inspections regarding the site as part of Superfund and Mining Environmental Compliance Sections oversight responsibilities.

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| *3.* Have there been any complaints, violations, or other incidents related to the site that required a response by your office? If so, please summarize the events and results of the responses.<br><br>**Response:** The NMED stated that yes; there have been two complaints. The first complaint was about the existence of domestic wells used as primary drinking water supplies. The NMED performed ground water sampling of 34 private wells at subdivisions near the site in September 2005. In addition, the NMED plans to follow up with the sampling of additional private residence wells recently discovered that are not connected to the Village of Milan public water supply system. The NMED is also working with ATSDR to evaluate any hazard for any use of impacted ground water for irrigation, gardening and watering livestock and pets.<br><br>The second complaint was about odor coming from the HMC site. The NMED followed up this complaint with HMC, and HMC took appropriate actions by altering their operational processes. Air monitoring data show that no airborne health risk exists. Although the odor is unpleasant, it does not pose a risk to human health, and is not regulated by the State of New Mexico. |
| 4. Are you aware of opportunities to optimize the operation, maintenance, or sampling efforts at the site?<br><br>**Response:** The NMED indicated that there are none directly. They stated the remedy is operating efficiently and HMC is optimizing the remedy on their own by concentrating remediation efforts in "hot spots". |
| *5.* From NMED's perspective, have any of the changes in site operation or maintenance requirements implemented since the DP-200 was approved had an affect on the protectiveness or effectiveness of the remedial approach? Please describe changes and impacts.<br><br>**Response:** The NMED indicated that no change made had a negative affect on the protectiveness or effectiveness of the remedial approach; instead the optimization of the remedy performed enhanced the protectiveness of the remedial approach. |
| *6.* Have there been any changes in state environmental standards since the time the remedial approach was delineated which may call into question the protectiveness or effectiveness of the remedial approach?<br><br>**Response:** The NMED stated that no changes in environmental standards have been made which may call into question the protectiveness or effectiveness of the remedial approach, however the NMED uranium ground water quality standards have changed from 5.0 mg/l to 0.03mg/l which would increase the protectiveness of the remedial approach. The NMED also added that this might impact the treatment of the irrigation system implemented by HMC to address impacted ground water offsite since the uranium concentration in the irrigation water is above the revised standard and the revised DP-200 would incorporate this revised standard. |
| 7. Is the ground water remediation progressing in accordance with NMED's expectations for the site? Does NMED have any concerns about the status of the ground water remediation being conducted for the site?<br><br>**Response:** The NMED stated that the ground water remediation is progressing as expected. |
| *8.* Do you feel well informed about the site's activities and progress?<br><br>**Response:** The NMED indicated that yes, they feel well informed by HMC about the site activities. |

9. Do you have any comments, suggestions, concerns, or recommendations regarding the site?

**Response:** The NMED indicated that a ground water CAP revision might be necessary to eliminate any potential receptors or targets to the impacted ground water. The NMED also indicated that the ground water cleanup timeframe might be questionable.

The NMED stated that many of the residents that are connected to the Village of Milan public water supply system who use their private wells for irrigation and gardening have asked if it is ok to use their private wells for irrigation, gardening, and watering livestock and pets. The NMED stated they have provided data to the ATSDR to evaluate any hazards from this use and will inform the residents of their evaluation.

Regarding a need for institutional controls to limit the use of impacted ground water, the NMED indicated that the current available institutional controls are not legally enforceable in New Mexico. A possibility of moratoriums by the New Mexico State Engineers' Office is being discussed, however it would only be a temporary solution that would be in effect while reclamation work proceeds. The NMED said several attempts have been made to pass legislation incorporating institutional controls but large hurdles still exists which may never be resolved. They will continue to resolve this issue. They also intend to work with the EPA, NRC, and HMC to connect several residents to the Village of Milan public water supply system who are not currently connected.

| **Five-Year Review Interview Record**<br><br>Homestake Mining Company<br>Cibola County, New Mexico | **Interviewee:** Alan Cox<br>George Hoffman<br>**Organization:** Homestake Mining Company<br>Site Project Manager<br>**Phone:** 505-287-4456<br>**Email:** acox@barrick.com |
|---|---|

| **Site Name** | **EPA ID No.** | **Date of Interview** | **Interview Method** |
|---|---|---|---|
| Homestake Mining Company Superfund Site | NMD007860935 | 4-26-2006 | Personal Interview |

| **Interview Contacts** | **Organization** | **Phone** | **Email** | **Address** |
|---|---|---|---|---|
| Nat Patel | AVM Environmental Services, Inc. | (505) 287-4593 | natavm@7cities.net | 216B West High St.<br>Grants, NM 87020 |
| Arvind Patel | AVM Environmental Services, Inc. | (505) 287-4593 | natavm@7cities.net | 216B West High St.<br>Grants, NM 87020 |
| Doug Bruner | USACE, Albuquerque District | (505) 342-3477 | Douglas.w.bruner@Spa02.usace.army.mil | 4101 Jefferson Plaza, NE<br>Albuquerque, NM 87107 |

## VIII. Interview Questions

*1.* What is your overall impression of the work conducted at the site since the last Five-year review?

**Response:** HMC stated they are continuing effective operation and maintenance of the remedy. HMC is making the necessary modifications to the operations to effectively implement the ground water remedial actions.

*2.* Is the remedy functioning as expected? How well is the remedy ~~is~~ functioning?

**Response:** HMC stated that overall yes; the remedy is functioning as expected and is making good progress. HMC also indicated that the remedy is lowering ground water concentrations of contaminants in most areas.

*3.* What does the monitoring data show? Are there any trends that show the contaminant levels decreasing?

**Response:** HMC indicated that the monitoring data shows the remedy is effective and is showing the first affects of the flushing of the tailings in the alluvial underneath the tailings impoundment. HMC added that there is a decreasing ground water concentration trend in most areas and some increasing ground water concentrations in select areas as expected due to flushing and associated displacement/movement of pore water from the large tailings pile as a result of remedial efforts.

*4.* Are you aware of any events, incidents, or activities that have occurred at the site, such as dumping, vandalism, trespassing, or emergency response from local authorities? If so, please give details.

**Response:** Mr. Cox recalled that there was a break-in incident recently. The chain at the front gate was cut and a drum of diesel and a welder were taken from the site. There is a security fence around the whole property and a chain link fence around the office buildings along with a security system and newly added security cameras.

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| *5.* Have any problems occurred that have resulted in significant changes in the operations and maintenance requirements, maintenance schedules, or sampling routines at this site? If so, do they affect the protectiveness or effectiveness of the remedy? Please describe changes and impacts.<br><br>**Response:** Mr. Cox indicated that there haven't been any problems that occurred which have resulted in any negative impact towards the protectiveness or effectiveness of the remedy. |
| *6.* Have there been opportunities to optimize the operation, maintenance, or sampling efforts? Please describe changes and resultant or desired cost savings or improved efficiency.<br><br>**Response:** Mr. Cox indicated that they have added more dewatering and injection wells on top of the tailings impoundment to aid in the flushing process. Mr. Cox also added that force spray systems modifications have been made to Evaporation Pond #1 to enhance the forced evaporation process as well as addition of a number of fresh water infiltration trenching systems to enhance ground water cleanup/restoration in select areas. |
| *7.* Is there a continuous on-site O&M presence? If so, please describe staff and activities. If not, describe staff and frequency of site inspections.<br><br>**Response:** Mr. Cox indicated the operating staff is on-site five days a week from 7:30 am until 4:00 pm. After hours, plant operators are on-call. Under certain conditions after hours, the treatment plant auto-dialer system will notify the on-call operators of any problems that might occur. The HMC staff also has a rotational assignment for weekend mill watch. |
| *8.* Are there any planned activities that would accelerate and/or enhance the remediation of the ground water contamination at the site?<br><br>**Response:** Mr. Cox stated that HMC is planning the addition of another evaporation pond to increase the treatment capacity. Mr. Cox also added that HMC has internal project reviews that look at new feasible technologies that would accelerate and/or enhance the remedy. |
| *9.* Do you have any comments, suggestions, concerns, or recommendations regarding the site?<br><br>**Response:** As far as the institutional control issues that arose in the last Five Year Review, Mr. Cox indicated that they are working with the NRC, EPA, and NMED to evaluate potential future controls. They are looking at various options to manage or eliminate use of impacted ground water.<br><br>Mr. Cox indicated that the EPA and NMED have approved the proposed background concentration which will become the ground water standard when NRC approves and incorporates it into the license. HMC believes their responsibility is to cleanup the ground water to the approved background concentration levels. Mr. Cox also indicated that once the NRC issues the revised background concentrations, they intend to revise the CAP and submit it to the NRC for approval. HMC stated that they might have to evaluate the addition of more POC wells associated with one or more aquifers other than the alluvial. HMC also stated that they plan to re-initiate feasibility evaluations for using insitu bioremediation as well as other possible technologies to expedite the remediation.<br><br>Mr. Cox indicated that during 2005, they ~~have~~ performed flow and transport modeling (MODFLOW-96 – Harbaugh and McDonald, 1996) and MT3DMS – Zeng and Wang, 1999) to re-evaluate timeframes for achieving remediation / cleanup goals at the site. The modeling assumes that another evaporation pond is added to increase treatment capacity and the proposed background concentrations are approved by the NRC. Any required changes in the remedial action schedule will be reflected in amendment to the NRC license pursuant to future discussions with NRC in association with NMED and EPA involvement. |

| **Five-Year Review Interview Record**<br><br>Homestake Mining Company<br>Cibola County, New Mexico | | | | **Interviewee:** Larry Carver<br><br>**Organization:** Murray Acres Irrigation Association<br><br>**Phone: 505-287-4291**<br>**Email:** | |
|---|---|---|---|---|---|
| **Site Name**<br>Homestake Mining Company<br>Superfund Site | | **EPA ID No.**<br><br>NMD007860935 | | **Date of Interview**<br>08-10-06 | **Interview Method**<br><br>Personal Interview |
| **Interview Contacts** | **Organization** | **Phone** | **Email** | **Address** | |
| Nat Patel | AVM Environmental Services, Inc. | (505) 287-4593 | natavm@7cities.net | 216B West High St.<br>Grants, NM 87020 | |
| Sai Appaji | USEPA, Region 6 | 214-665-3126 | Appaji.sairam@epamail.epa.gov | USEPA, Region 6<br>1445 Ross Ave., Suite 1200<br>Dallas, TX 75202-2733 | |

## IX. Interview Questions

*1.* What is your overall impression of the project (general sentiment)

**Response:** Mr. Carver stated that the ground water remediation at the HMC Site has taken too long. Mr. Carver said that the remediation started in 1976 and it is almost 40 years since that time and still the ground water has not been cleaned up. They were promised in 1983 that the ground water would be restored in 10 years. He stated that until recently, HMC was not communicating well with the community on the project. Since the new Project Manager, Al Cox has arrived, HMC has been reasonable in explaining the project.

*2.* What effects have site operations had on the surrounding community?

**Response:** Mr. Carver stated that besides the contaminated ground water issue the other most notable problem is the odor from the site. He also indicated that local residents have been observing residue film on equipment and structures that he believes are coming from contaminated water evaporative treatment at the Site.

*3.* Are you aware of any community concerns regarding the Site or its operation and administration? If so, please give details.

**Response:** Mr. Carver said he is concerned about the prolonged length of the timeframe for ground water cleanup and not having understanding who has ultimate authority in the project. Mr. Carver stated that it has been over six months since the last meeting and there is much more to discuss than overall project background. He indicated about ground water cleanup to background concentrations, which he believes may not be appropriate since the upgradient water is impacted from mining activities. He also indicated that the community is concerned about some yellow cake disposed in the mill disposal area and its impact on ground water.

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|---|---|
| *4.* | Are you aware of any events, incidents, or activities at the Site such as vandalism, trespassing, or emergency responses from local authorities? If so, please give detail. |
| **Response:** | He said none that he is aware of. |
| *5.* | Do you feel well informed about the Site's activities and progress? |
| **Response:** | He believes Murray Acres residents have been well informed for the past two years. He said that they wrote letters to elected officials and the President of the United States of America that have opened up dialogues. Representative from HMC corporate office, Bill Ferdinand, visited with the residents in August 2005 to hear their concerns. He said that after new project Manager, Al Cox, came to the project, communications have improved. He said that periodic public meetings should be held to discuss the status of the ground water remediation at the Site. |
| *6.* | Do you have any comments, suggestions, or recommendations regarding the Site's management or operation? |
| **Response:** | Mr. Carver said that if the regulatory agencies are concerned about providing safe drinking water, then they should ~~be~~ ensured that all residents are provided alternate water supply, not just connection but payment for monthly water bills until the ground water is cleaned up. He also said that residents on the Ralph Card Road should not have to pay for alternate water supply extension to their residences. He said that HMC should pay for water usage until the ground water is cleaned up, not just for 10 years. He also commented again on the timeframe of the ground water cleanup being too long. He suggested that a public meeting should be held at least once a year to discuss issues with agencies. |