OHM Remediation Services Corp.
A Subsidiary of OHM Corporation

1202 Kettner Blvd.
San Diego, California 92101

East Mesa Geothermal Test Facility
El Centro, California

Contract No. DACW45-94-D-0005, Delivery Order No. 0038
OHM Project No. 18904, Revision 0, December 13, 1996

Final Closure Report

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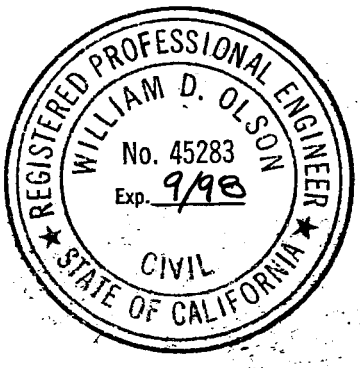

Approved by:

John Pepin
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List of Acronyms and Abbreviations

Bechtel	Bechtel Environmental, Inc.
BLM	Bureau of Land Management
CAM	California Assessment Metals
CAO	Cleanup and Abatement Order
CCR	California Code of Regulations
CFR	Code of Federal Regulations
CQC	Construction Quality Control
CRWQCB	Colorado River Basin Regional Water Quality Control Board
DOT	Department of Transportation
µg/kg	micrograms per liter
mg/kg	milligrams per kilogram
mg/l	milligrams per liter
NEPA	National Environmental Policy Act
NORM	naturally occurring radioactive material
OHM	OHM Remediation Services Corp.
pci/kg	picocurries per kilogram
PPE	Personal Protective Equipment
RCRA	Resource Conservation and Recovery Act
site	East Mesa Geothermal Test Facility
STLC	Soluble Threshold Limit Concentration
TCLP	Toxicity Characteristic Leaching Procedure
TDS	total dissolved solids
TPH	total petroleum hydrocarbons
TTLC	Total Threshold Limit Concentration
USACE	United States Army Corps of Engineers
USDOE	United States Department of Energy
WET	Waste Extraction Test (California)
WDRs	Waste Discharge Requirements
yd^3	cubic yards

Section 1
Introduction

This Closure Report documents the excavation operation and off-site disposal of approximately 21,260 tons of brine residue and contaminated soil located at the East Mesa Geothermal Test Facility (site) near El Centro, California. This work was performed for the United States Department of Energy (USDOE) Oakland Operations Office by OHM Remediation Services Corp. (OHM) under Delivery Order Number 0038 (DO 0038) under the United States Army Corps of Engineers (USACE), Contract Number DACW45-94-D-0005 and the Rapid Response Scope of Service, dated June 14, 1996.

The Colorado River Basin Regional Water Quality Control Board (CRWQCB) issued Cleanup and Abatement Order (CAO) Number 96-023 in 1996 for the remediation of the brine pond at the East Mesa Geothermal Test Facility. The contaminant of concern in the brine pond waste was elevated concentrations of soluble arsenic. The CAO required that the USDOE submit a Construction Work Plan for remediation of the site to the CRWQCB by July 1, 1996. The Construction Work Plan prepared by OHM was submitted and reviewed by the USACE and USDOE on June 28, 1996. Mr. Robert Perdue of the CRWQCB approved the Work Plan via a telephone conference dated July 2, 1996.

Remediation activities began on August 19, 1996, and were completed on November 15, 1996 at a cost of approximately $2.4 million. The USACE supervised and documented all site activities and remained in close contact with the USDOE's Project Manager. OHM executed the remediation field activities, collected post excavation confirmatory soil samples, and documented the remedial work. OHM has prepared this Closure Report to document the remediation and recommend a "no further action" status for the site under the CAO requirements. Based on this report, the USDOE requests that the CRWQCB rescind the CAO and the Waste Discharge Requirements (WDRs) for this site.

1.1 Site Location and Background

The East Mesa Geothermal Test Facility (site) is located in the Salton Trough (also known as the Coachella and Imperial Valleys) approximately 25 miles east of El Centro, California, 30 miles southeast of the Salton Sea, and 90 miles northwest of the Gulf of California (Figure 1-1, Site Location Map).

The United States Bureau of Reclamation initiated studies of the geothermal resources at the site in 1968 as a potential method of augmenting the Lower Colorado River water supply. Operation of experimental desalting plants at the site began in 1972. The USDOE became the exclusive operator of the site in October 1978. A 6-acre lined brine holding pond was installed in 1972 to temporarily store and evaporate brine blowdown water as well as untreated brines extracted in the geothermal exploration process (Figure 1-2, Site Vicinity Map). An 8-foot high soil berm, protected by a liner, surrounded the pond. Typically, the bottom surface of the pond consisted of a 4-inch thick brine layer underlain by a 6- to 9- inch protective sand layer, over a 10-mil polyvinyl chloride liner (Bechtel Environmental,

Inc.[Bechtel], 1992). Selected photographs of the pre-remediation site conditions of the brine pond are included in Appendix A, Site Photographs.

During site operations from 1972 to 1975, waste brine was discharged into the brine holding pond. The disposal capacity of the pond was inadequate to handle increased site activities; consequently a waste brine injection system was installed in 1976. The brine pond was used intermittently after installation of the injection system, both to supplement the injection system, and to provide for brine disposal when the injection system was inoperable. Geothermal research activities were eventually discontinued by 1987 as commercial-scale geothermal power development matured in the region (Bechtel, 1992).

1.2 Previous Investigations

Previous investigations of the site conducted between 1991 and 1993 were documented in the following reports:

- *Field Investigation Report*, Bechtel Environmental, Inc. (Bechtel, 1991) includes characterization of the brine pond residue and the health and safety monitoring which focused on potential radiological concerns (Bechtel, 1991).
- *Limited Feasibility Study*, Bechtel, 1992, includes development and analysis of four remedial action alternatives for remediation of the brine pond based on the Field Investigation Report (Bechtel, 1992).
- *Site Restoration Phase II Report*, Dames and Moore, 1993, provides the results of Phase I and II site securing, survey, and sampling/analysis activities. This report focused primarily on facilities and equipment not located at the brine pond (Dames and Moore, 1993).

The results of these investigations were used to develop the approved Construction Work Plan.

1.3 Site Characterization

A field investigation was conducted in September 1991 (Bechtel, 1991). The purpose of the field investigation was to characterize the chemical nature of the residues contained in the brine holding pond. One hundred samples were collected at depths ranging from 4 to 8 inches below ground surface within the confines of the pond, and combined into 25 composite samples. The 590-by 500-foot pond was divided into 25 cell grids. Within each grid cell, four samples were collected and composited. This technique was repeated throughout the pond, resulting in the total of 27 composite samples, that included 2 duplicates. In addition, two grab samples were collected from areas that visually appeared different from the bulk of the pond residues (Bechtel, 1991).

The samples were analyzed for a variety of parameters including total metal concentration for the 17 metals listed under California Code of Regulations (CCR) Title 22. The soluble concentrations for these metals were also assessed using the California Waste Extraction Test (WET). The total metal and soluble metal concentrations were compared with the Total Threshold Limit Concentration (TTLC) and the Soluble Threshold Limit Concentration

(STLC) regulatory guidelines. Samples were also tested for Resource Conservation and Recovery Act (RCRA) defined hazardous waste characteristics of ignitability, corrosivity, toxicity (Toxicity Characteristic Leaching Procedure [TCLP]), and reactivity. In addition, tests for radiological constituents, oil and grease, total petroleum hydrocarbons (TPH), total dissolved solids (TDS) and the California 96-hour static acute bioassay tests were performed (Bechtel, 1992).

The results of brine pond residue characterization testing indicated the following:

- The brine residue is not a RCRA-defined hazardous waste based on characteristics of ignitability, corrosivity, toxicity, and reactivity.
- The brine residue is not a California-defined hazardous waste based on TTLC and California 96-hour static acute bioassay tests. STLC analytical results indicated soluble concentrations of the 17 CCR Title 22 metals were below regulatory limits, except for arsenic.
- Soluble arsenic was detected at or above the California hazardous waste regulatory limit of 5.0 milligrams per liter (mg/L) in samples collected from grid cells A5, C4, and C5 (Bechtel, 1991).
- TPH (EPA Method 418.1) and oil and grease (EPA Method 413.2) concentrations (less than 67 and 80 milligrams per kilogram [mg/kg], respectively) are below typical California soil cleanup levels of 100 to 1,000 mg/kg.
- TDS concentration of brine residue is approximately 16,000 mg/L (Bechtel, 1992).
- Naturally Occurring Radioactive Material (NORM) was detected at concentrations typical of geothermal brine waste.

1.4 Project Objectives and Cleanup Criteria

The primary objective of the cleanup project was to remediate the brine holding pond at the site in accordance with the CAO. Based on the CAO and the direction provided by the USACE, the cleanup objective was to remove the brine pond wastes (i.e., brine residue, protective sand layer, and the liner) for disposal at an approved offsite facility and return the site for unrestricted use.

Quantitative cleanup criteria were not established for the subgrade soil below the pond liner. Therefore, the cleanup criteria was defined as the removal of the brine wastes (i.e. brine residue, sand, and the liner), thereby removing the source which might be a potential threat to the ground water beneath the site.

1.5 Scope of Work

The following activities were completed to achieve the project objective:

- Develop a work plan, health and safety plan, and related attachments pursuant to project scope of work and obtain USDOE and CRWQCB approval.
- Provide site security for the remediation/construction area.

- Improve access road to the pond area.
- Demolish, remove and dispose of the concrete inlet/outlet structure (north side of pond).
- Excavate brine residue and sand layer (approximately 21,260 tons or 14,500 cubic yards [yd^3]) and remove liner from brine pond.
- Transport and dispose of brine residue, sand layer, and liner from the brine pond at an approved off-site disposal facility (Laidlaw Environmental, Inc.).
- Collect five confirmatory soil samples from excavation cavity and analyze for leachable arsenic.
- Backfill brine pond to grade and restore disturbed surfaces to "natural" condition.
- Prepare Closure Report.
- Obtain CRWQCB approval of site closure with no further action under the CAO, and assist the USDOE to have the WDRs rescinded.
- Provide modifications and deviations to the approved Work Plan as described in Section 3.9 of this report, Deviations from Construction Work Plan.

1.6 Project Personnel

The following individuals served as contacts for this project:

• USDOE Project Manager:	Hemant Patel	(510) 637-1568
• USDOE HQ (POC):	Rod Cummings	(301) 903-7606
• USACE Project Manager:	Andrew Winslow	(402) 293-2532
• USACE Construction Rep.:	Steve Dawson	(402) 293-2523
• United States Bureau of Land Management (BLM) Field Engineer:	Larry Caffey	~~(619)~~ 760 337-4425
• OHM Program Manager:	John Hitchings	(419) 424-4919
• OHM Project Manager:	John Pepin	(619) 239-1690 ext. 123
• OHM Manager of Health and Safety:	Roger Margotto	(619) 239-1690 ext. 111
• OHM Site Superintendent:	Nick Quintanilla	(619) 239-1690

Section 2
Preconstruction Activities

2.1 Permitting

No permits were required for the project based on discussions with the following regulatory agencies:

- Colorado River Basin Regional Water Quality Board
- Imperial County Planning Department
- Imperial County Public Works Department
- Imperial County Air Pollution Control District
- Imperial County Solid Waste Local Enforcement Agency

2.2 Preconstruction Conference

Prior to commencing field activities, a preconstruction meeting was held August 21, 1996, on site with USDOE, USACE, BLM, and OHM representatives. The meeting was held to discuss the field activities and execution of the project. The location of equipment lay down, storage area, and haul roads were identified and approved. Appropriate notifications required to commence work were verified with the USACE Representative, and site protocol as applicable to the work was discussed. Minutes of the meeting are included as Appendix B, Preconstruction Conference Minutes.

Section 3
Field Activities

Field activities were conducted over a period of approximately 3 months from August 19, 1996 to November 15, 1996. The description of field activities provided in this section will be organized as follows:

- Project Chronology
- Mobilization
- Temporary Facilities and Site Setup
- Excavation
- Waste Transportation and Disposal
- Confirmatory Sampling
- Backfill/Site Restoration
- Health and Safety Monitoring
- Deviations from Construction Work Plan
- Final Inspection and Demobilization

3.1 Project Schedule and Chronology

The schedule of activities is included as Figure 3-1, Project Schedule. The following list of milestone dates for field activities summarizes the project chronology from August 19, 1996 to November 15, 1996:

August 19	Mobilize to field and temporary facilities setup
August 26	Start excavation and stockpiling hazardous brine waste
September 10	Start stockpiling brine waste soil
October 1	Start transportation and disposal
October10	Start restoration of brine pond
November 6	Complete transportation and disposal
November 13	Site restoration complete
November 15	Demobilization complete

3.2 Mobilization

Mobilization activities began on August 19, 1996, and included the following personnel and equipment:

PERSONNEL

- 1 Site Superintendent
- 1 Project Accountant
- 1 Team Leader
- 3 Equipment Operators
- 4 Recovery Technicians

EQUIPMENT

- 1 - 623 Scraper
- 1 - D8 Dozer
- 1 - 936 Loader
- 1 - 950 Loader
- 1 - 330 Excavator
- 1 - 4,000 gallon Water Truck
- 1 - 613 Water Wagon
- 1 - Vibratory Compactor
- 1 - Miscellaneous Support Equipment

3.3 Temporary Facilities and Site Setup

Temporary facilities were mobilized and utilities were set up to support the field activities. A field office trailer was set up and equipped with telephone and electricity. Construction water was obtained from an existing pipeline that supplies irrigation water to the Ormesa facility. The development of temporary facilities also included setup of portable restrooms/wash facilities; a 100,000-gallon water storage pool; 10,000-gallon water tank stand; soil stockpile area; personal and equipment decontamination areas; equipment storage area; ingress and egress pathway for vehicles; and posting appropriate project signs indicating removal work was being conducted.

Figure 3-2, Site Plan and Operation Plan, shows the site temporary facilities. The haul roads were constructed with standard road base (gravel) material to improve road stability. A temporary equipment decontamination area, as shown on Figure 3-2, was set up between the construction/support area and the Exclusion Zone. The Exclusion Zone encompassed both the excavation area and brine waste stockpile area. The boundary of the Exclusion Zone was the top of the brine pond perimeter berm. The decontamination area was constructed with a perimeter berm, sloped pad underlain by 2-inch gravel and lined with 10-mil polyethylene plastic sheeting. A small sump area and a pump were located in the center of the pad.

Equipment and vehicles that came in contact with brine waste were decontaminated prior to being released from the Exclusion Zone. Dry brushing or wiping was used to minimize the volume of water requiring treatment and or disposal. Pressure washing was used when needed. Decontamination proceeded until soil and staining were removed from the vehicle or equipment. Water from the decontamination station was allowed to evaporate within the decontamination area.

Personnel who entered the Exclusion Zone on foot or left their vehicles or equipment while in the Exclusion Zone were required to undergo decontamination procedures at the personal decontamination area. Personnel performed a sequential decontamination process prior to exiting the Exclusion Zone. This process was described in detail in the Site Health and Safety Plan presented as Appendix C of the approved Construction Work Plan.

3.4 Excavation

Prior to excavation, the concrete inlet/outlet structure located at the north end of the brine pond was removed and decontaminated for disposal. In addition, the "high arsenic level areas" (grids C4, A5, and C5) were delineated as shown on Figure 3-2. Excavation of the "high arsenic level areas" began on August 26, 1996. Excavated material was stockpiled in the northeastern portion of the basin.

Following stockpiling of the "high arsenic level" soil, the remaining general removal excavation was initiated on September 10, 1996. A combination of scraper, dozer, and loader equipment was used to remove approximately 10 to 15 inches of brine waste and the liner. The excavated soil and liner were stockpiled in the northern portion of the brine pond.

The excavation operation began at the south side of the pond and moved northward, toward the brine waste stockpile and loading area. As excavation activities approached the north side of the pond, the scraper was eliminated, and the dozer consolidated the brine waste for loading. Photographs of the excavation operations are included in Appendix A, Site Photographs.

An excavator was positioned on the top of the berm of the pond to load the brine waste stockpile directly into transport trucks located in the Contamination Reduction Zone. The haul road allowed transport trucks to enter the site, remain outside of the Exclusion Zone, position next to the loading excavator, and exit the site with minimal obstruction.

Throughout excavation activities, the water wagon was located within the brine pond (i.e. Exclusion Zone) to moisture condition the brine waste prior to and during excavation for dust control. A water truck was used to control dust on the haul roads during loading operations.

Excavation activities were completed on November 1, 1996 with approximately 14,500 yd^3 (21,260 tons) of waste removed. The quantity of waste was approximately 2,500 yd^3 more than the original estimate. This additional material resulted from variations in thickness of the brine waste. In addition, waste material from the side slopes (on top of the liner) was removed.

3.5 Waste Transportation and Disposal

Transportation and disposal activities were initiated on October 1, 1996 after completion of waste profiling and acceptance requirements by the disposal facility. Based on the waste profile documents (see Appendix C, Waste Profile Documents), the non-RCRA hazardous waste streams consisted of the California-hazardous material with elevated concentrations of soluble arsenic (which comprised approximately 10% of the waste), and the California-nonhazardous material. Due to the geothermal origin of the waste and associated NORM component in the waste streams, disposal was required at Laidlaw Environmental's Class I Disposal Facility near Westmoreland, California. The Westmoreland landfill is the only disposal facility in southern California permitted to accept NORM geothermal waste streams. The waste was transported in covered semi-end dump trucks by Joe Torres Trucking, a licensed hazardous waste transporter, pursuant to transporter selection requirements provided in the Construction Work Plan. Applicable DOT and California transportation regulations were observed.

Prior to leaving the site, each load was weighted using portable scales located at the loading area to ensure the truck complied with weight requirements. Nine to 15 trucks were used in the hauling operation. Each truck transported approximately three to four loads per day. Hauling and disposal activities were completed on November 8, 1996.

Table 3-1, Daily Summary of Waste Transportation, provides a daily summary of waste transportation quantities. Table 3-1 indicates that 908 loads (i.e. 21,284.08 tons) of brine waste were hauled to the disposal facility. Appendix D, List of Waste Disposal Manifests, lists each load and includes the manifest number and tons per load. Approximately 2,079.23 tons were classified as California hazardous "high soluble arsenic" material. The remaining 19,204.85 tons were classified as non-hazardous material. Copies of the manifests were not attached to this report by mutual agreement with Mr. Krull of the CRWQCB during a November 20, 1996 telephone conversation.

3.6 Confirmatory Sampling

Confirmatory soil samples were collected, preserved, transported, and analyzed pursuant to methods and procedures provided in the Field Sampling Plan (see Construction Work Plan, Appendix E). Five confirmatory samples were collected following brine waste removal at the locations shown in Figure 3-3, Confirmatory Sampling Map. These locations included the four proposed randomly selected locations (grids B7, D3, G7, and H3). An additional confirmation soil sample was collected in the soil stockpiling area located at grid H5. One field duplicate was also collected from grid B7. One split sample from grid D3 was collected and shipped to the USACE's Missouri River Laboratory for analysis.

The confirmatory samples were analyzed by Ceimic Laboratories, a California-certified laboratory, for leachable arsenic by EPA Method 1312/6010A; the results are summarized in Table 3-2, Analytical Results of Confirmatory Soil Samples. Analytical data for the confirmation sampling is presented in Appendix E, Laboratory Reports and Chain-of-Custody Documentation. The results indicated nondetectable concentrations (less than 50 µg/L) of leachable arsenic in four of the five samples. The result reported from grid H5

indicated a concentration of leachable arsenic at 28.6 µg/L. However, it should be noted that the detection limits for all other confirmation samples were 50 µg/L, reducing the significance of the 28.6 µg/L result. These analytical results indicate significant concentrations of leachable arsenic were not present in the subgrade soil below the brine pond liner. Based on the low concentrations of NORM in the brine waste and confirmatory sample results indicating that waste constituents were not present below the liner, removal of the brine waste including associated NORM is complete.

3.7 Backfill/Site Restoration

Upon receipt of confirmatory analytical results indicating that contaminant levels were within acceptable limits, the RWQCB representative for the project was contacted for verbal authority to proceed with backfilling activities. Non-contaminated soil (i.e. soil below the liner) from the pond's perimeter berms was leveled into the excavated area to match existing grade of the surrounding topography. Additional fill material was not needed to complete final grading of the site.

No compaction requirements were specified for the grading work at the site, based on the guidelines provided by the BLM representative during the site walk on June 11, 1996. However, pursuant to BLM requirements, site restoration of the brine pond and adjacent disturbed areas to a native desert condition included creating a hummock surface and grading the general area to match existing surrounding topography. The hummocky or mounding surface, as shown in Figure 3-4, Restoration Surface Detail, was created using an excavator and loader. All restoration activities were coordinated with the USACE and the BLM representatives. The USACE indicated that a final topographic survey of the site was not required.

3.8 Health and Safety

Health and safety issues, including monitoring procedures, were discussed daily with field personnel and documented in the Daily Tailgate Safety Meeting Reports (available upon request). On site personnel were monitored as required for heat stress. Monitoring activities included procedures described in the approved Site Health and Safety Plan (Appendix C of the Construction Work Plan) and additional activities requested by the USDOE and USACE.

Heat stress monitoring readings were recorded in the Daily Heat Stress Monitoring Log. No cases of heat stress were observed during the project. Dust and silica were monitored for two days to verify that there was no worker exposure. Based on analytical results of dust samples collected by personnel air sampling equipment, workers were not exposed to detectable concentrations of dust containing hazardous forms of silica. Monitoring data, which includes field notes, instrument readings, and laboratory analytical results, was placed in the project files and is available upon request. There were no incidents, accidents or injuries on this project.

3.9 Deviations from Construction Work Plan

Minor deviations and modifications of procedures described in the approved Construction Work Plan occurred during remedial activities. These changes were initiated by the USACE and USDOE, and were documented in an August 16, 1996 letter included as Appendix F, August 16, 1996 Letter to USACE Documenting Changes to Work Plan. These deviations have been addressed in this report and are summarized as follows:

- Topographic surveys of the site prior to and after construction were not performed.
- One additional confirmatory soil sample was collected from the subgrade soil beneath the stockpile area.
- Personal air monitoring for dust was conducted.
- Use of import material, and the associated BLM "free-use" permit for the material, was not required for site restoration.

3.10 Final Inspection and Demobilization

A final inspection of the restored site was conducted on November 12, 1996, and included representatives from BLM, USDOE, USACE, and OHM. Mr. Larry Caffey of BLM inspected the former brine pond and nearby disturbed areas, and indicated that the site restoration to "native desert" topography was satisfactory. Photographs of the restored surface are included in Appendix A.

Demobilization activities were completed on November 15, 1996 and included dismantling and/or removal of equipment and temporary facilities used to complete the project.

Section 4
Construction Quality Control

Construction quality control procedures were performed pursuant to the approved Construction Quality Control Plan (CQCP) (see Appendix D of the Construction Work Plan), and included the following:

- verification and onsite documentation of appropriate health and safety training for field personnel
- in-house weekly estimates
- daily equipment inspections
- verification of driver qualifications from subcontractor
- quality improvement procedures for cost-effective resource utilization
- maintaining required documents and records

The following quality control documents and records were prepared and submitted as described in the CQCP during construction activities:

- Rapid Response Quality Control Daily Report
- OHM Daily Project Tracking System Report
- Rapid Response Daily Work Order
- Weekly Status Report
- Monthly Cost Performance Report

Copies of these documents will be maintained in the project files for five years and are available upon request.

Section 5
Conclusions and Recommendations

Based on the analytical results of confirmatory soil samples described in this report, excavation and offsite disposal of the brine pond waste including associated NORM is complete and complies with the CAO requirements.

It is recommended that the CRWQCB concur with the findings of this report by approving closure of the brine pond area with no further action. Based on these findings, it is requested that the WDRs for this site (CRWQCB Order No. 89-027), and subsequent CAO No. 96-023 against the USDOE, Oakland Operating Office, be rescinded. Once the WDRs and CAO have been rescinded, it is USDOE's intent to return the site to the landowner, the BLM.

Section 6
References

Bechtel Environmental, Inc. 1991. *Field Investigation Report - Field Activities at US Department of Energy's Former Geothermal Test Facility Near El Centro.* Prepared for Department of Energy San Francisco Field Office. November.

Bechtel Environmental, Inc. 1992. *Limited Feasibility Study - Remedial Activities at US Department of Energy's Former Geothermal Test Facility Near El Centro, California.* Prepared for Department of Energy San Francisco Field Office. August.

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