TAILINGS MANAGEMENT PLAN
AMENDED DECEMBER, 2005

FOR

SHOOTARING CANYON URANIUM PROCESSING FACILITY

Utah Department of Environmental Quality
Division of Radiation Control
Byproduct Material License No. UT0900480
Division of Water Quality
Discharge Permit Number UGW170003

Prepared by

Plateau Resources, Ltd.
877 North 8th West
Riverton, WY 82501

&

Hydro-Engineering, LLC
4685 East Magnolia
Casper, WY 82604

George L. Hoffman
Hydrologist

Thomas G. Michel, Ph.D., P.E.
Hydrologist

TAILINGS MANAGEMENT PLAN
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1. INTRODUCTION

This submittal of this amended Tailings Management Plan (TMP) for the Shootaring Canyon Uranium millsite is in furtherance of conversion of the present license UT-0900480 from **Standby** to **Operational** Status. A TMP was previously submitted to the U. S. Nuclear Regulatory Commission (NRC) and State of Utah Department of Environmental Quality, Division of Radiation Control (DRC) in 1999. This TMP incorporates many of the general concepts included in the previous submittal with significant improvements in the approach to tailings management. This submittal of the TMP amends the plans previously submitted to the U. S. Nuclear Regulatory Commission (NRC) and State of Utah Department of Environmental Quality, Division of Radiation Control (DRC) for the Shootaring Canyon Uranium millsite.

One of the primary proposed improvements in the TMP is the option for Reduced-Moisture Tailings Placement (RMTP). With the RMTP approach, a belt press or similar fluid extraction equipment is used to extract a significant volume of tailings solution from the tailings slurry yielding a moist tailings in solid form and a liquid stream of tailings solution. This in turn allows handling tailings solids with the potential for placement above grade in the tailings cell(s). The extraction of water from the tailings slurry prior to delivery of the tailings to the cell also reduces the drainage from the in-place tailings and allows segregation of tailings solution in a process solution storage and/or evaporation pond. Some further advantages of this approach include increased capacity for each tailings cell which potentially reduces the areal extent of the reclaimed tailings facility, and a reduced potential for structural failure of tailings containment component such as a berm or dam.

A seven-part liner with a drainage collection system and leak detection system is used for containment in the tailings cell(s). The proposed liner is discussed in more detail in Section 5.1 of this Tailings Management Plan.

2. REGULATORY ANALYSIS AND OBJECTIVES OF THE TAILINGS MANAGEMENT AND RECLAMATION PLANS.

2.1 Federal Regulations

Prior to transfer of regulatory authority to the State of Utah as an agreement state in 2004, the uranium mill tailings at the Shootaring site were regulated primarily by the U.S. Nuclear Regulatory Commission (NRC) pursuant to 10 CFR 40, Appendix A, and the Environmental Protection Agency (EPA) under 10 CFR 61, Subparts A and W. Although this recent change has transferred primacy of regulatory authority to the State of Utah, the existing framework of regulations previously administered by the NRC is relevant as the foundation upon which the State of Utah will regulate the site. With this in mind the applicable federal regulations are referenced and described in Sections 2.1.1 through 2.1.3.

Additional, enhanced or modified regulations developed by the State of Utah are discussed in Section 2.2.

NRC and EPA have a Memorandum of Understanding (MOU) that covers joint expectations under what was originally Subpart T of 40 CFR 61 (uranium mill tailings closure) and a generic MOU on elimination of dual regulation. The NRC regulations also incorporate other standards by reference that were promulgated by the EPA pursuant to the Uranium Mill Tailings Radiation Control Act (UMTRCA - 1978), and Section 112 of the Clean Air Act, as amended. Compliance with these regulations under the authority of the State of Utah is essential to obtaining NRC approval for operating the existing tailings impoundment at the Shootaring Canyon facility.

In the following discussion, applicable federal regulations are summarized in **bold** lettering and the means by which this liner plan, the Tailings Management Plan and the Reclamation Plan meet these regulations are discussed immediately below the bold caption.

2.1.1 NRC Regulations - Guiding Principles

- **Permanent isolation of tailings (10 CFR 40 Appendix A, Criterion 1)**

  The tailings will be placed in a lined impoundment, designed and operated to meet all regulations referenced below and reclaimed with a stable cover designed according to applicable regulations, guidelines and NRC staff technical positions.

- **No ongoing maintenance (Appendix A, Criterion 1)**

  The reclamation design ensures that no ongoing maintenance will be required following reclamation. The tailings will be dewatered to mitigate seepage and tailings settlement. Cover slopes are designed and will be graded to be stable under Probable Maximum Precipitation (PMP) flows and steeper slopes will be covered with riprap to afford erosion protection. Installing a clay cap with a low permeability will control infiltration. These are described in the Reclamation Plan dated December 2005 and accompanying this TMP.

- **Closed with 1000-year design life, and in any case at least 200 years (Appendix A, Criterion 6)**

The reclamation design complies with applicable NRC staff technical positions. See above.

2.1.2 Design Requirements

2.1.2.1 Siting (Appendix A, Criterion 4)

- **Upstream drainage minimized**

The tailings impoundment is in a natural drainage enclosed on the downstream end by an engineered, NRC and Utah State Engineer approved dam within a very small watershed runoff area. The total watershed area is approximately 220 acres to the Shootaring Dam. The upper 53 acres of this drainage area will be diverted to a different drainage and, therefore, the effective drainage area is 167 acres. During operations, the runoff will collect in the impoundment and be recycled within the mill process and /or evaporated. After reclamation, runoff waters will be collected in channels that are located on the periphery of the tailings and diverted to the south where it is returned to the original drainage system.

- **Wind protection**

The tailings disposal basin is effectively surrounded by natural cliffs and hills. A net deposition of windborne soils is expected to occur over the impoundment area, rather than loss of covering over the tailings due to wind erosion.

- **Erosion potential limited through flat cover slopes and designed covers**

The reclamation cover will be graded to provide slopes sufficiently flat enough to mitigate erosional forces but allow for the runoff of precipitation. Where erosion may be a concern, additional or larger riprap will be placed to protect from these erosional forces. The tailings top reclamation surface will also be configured to limit upland contributing drainage area to overland flow.

- **Conservative factors of safety attained through flat embankment slopes**

The cells embankments and sides will be designed with sufficiently flat slopes to provide conservative factors of safety.

- **Not susceptible to earthquake damage**

Design of the cells embankments are based on stresses induced by the postulated maximum credible earthquake for the Shootaring facility region based on the June 26, 1994 “Seismic Hazard Analysis of Title II Reclamation Plans” by Lawrence Livermore National Laboratory. The State of Utah Division of Water Rights State Engineer requested that a set earthquake and acceleration be assigned to the dam and the Newmark deformation analysis be performed. The slope stability analyses are included in Section 3 of this Tailings Management Plan.

- **Deposition promoted**

Where possible, cover slopes will be flat enough to promote deposition, and in any case to limit erosion to acceptable levels during the 1000-year stability period.

2.1.2.2 Ground Water Protection Standards (Appendix A, 40 CFR 192, etc.)

- **Liner (40 CFR 264.221) that will prevent migration of wastes out of the impoundment**

The cells are designed with a competent liner system (double HDPE Liner with leak detection and sub-clay liner) to prevent migration of wastes from the cells.

- **If liner left in place following operations, wastes cannot migrate into liner during active life of facility (Appendix A, Criterion 5A(1))**

The proposed design will prevent the migration of wastes into the liner during and following operations.

- **Impoundment must not be overtopped (Appendix A, Criterion 5A(4))**

Freeboard is included in the design to store PMP inflow, operational water levels and to allow adequate height for wave action.

- **Leakage detection system mandatory for synthetic liners (Criterion 5E(1))**

A leakage detection system will be provided, independent of any ground-water monitoring program.

- **Tailings must be dewatered by a drainage system at the bottom of the impoundment (Criterion 5E(3))**

A dewatering system will be provided through inclusion of a leachate collection system.

- **Must install two or more liners and a leak collection system between such liners (40 CFR 264.221)**

Requirement satisfied by:

  - A double synthetic liner with leak detection system will be installed over a one-foot compacted clay base as described in this Tailings Management Plan.

  - A leachate collection will be installed in a filter bed over the double liner plus clay base.

2.1.2.3 Closure (40 CFR 264.228 and as Directed by NRC Staff Technical Position [STP] for Erosion Protection covers)

- **Eliminate free liquids**

With the reduced-moisture tailings placement, all free liquids will be diverted to a HDPE lined storage pond within the tailings area. In the event that slurry is discharged to the general tailings area, free liquids in the decant pool will be minimized in the tailings cells during operations by dewatering with the leachate collection system and, as necessary, a pump on the decant pool surface. Operation of the leachate collection system will be continued until the collection rates reach steady levels of less than 1.5 gpm or 10% of the typical full production operational collection rate, whichever is smaller.

- **Stabilize wastes**

Tailings will be allowed to stabilize prior to placement of the reclamation cover. The method of tailings deposition will promote rapid tailings consolidation.

- **Cover the impoundment to:**

  - **Minimize long-term liquid migration**
  - **Function with minimum maintenance**
  - **Promote drainage and minimize erosion**
  - **Accommodate settling and subsidence**

The final cover will be designed: with a low permeability clay cap to minimize infiltration; to not require post-closure maintenance due to its conservative erosion-resistant design; to promote drainage while minimizing erosion through flat slopes and/or rock protection; to control run-on and drainage of waters and to accommodate any tailings settlement. See Section 4.1.1 for more detail on infiltration through cover. Further, the site is located in a geographical area where annual evaporation (70 inch/yr.) exceeds the sum of annual precipitation, (7 inch/yr.).

2.1.2.4 Radon Standards

- **Post-operations (40 CFR 61, Subpart T; currently EPA - NRC MOU):**

  - **radon emissions not to exceed 20 pCi/m^2-s**
  - **must be in compliance 7 years after ceasing to be operational**

The reclamation cover is designed with a radon barrier to limit emissions to the radon standard and time requirement cited above while reducing infiltration of surface waters. See Section 4.1.1 for more details on reduction of infiltration through cover.

2.1.3 EPA Regulations (40 CFR 61, National Emission Standards for Hazardous Air Pollutants [NESHAPs])

Any modifications to the existing cells shall be in accordance with 40 CFR 61. Operations, maintenance and monitoring of the facility shall comply with 40 CFR 61.

2.2 State of Utah Regulations

The State of Utah entered into an agreement with the NRC in 2004 that resulted in the State of Utah assuming primacy in the regulation of uranium milling and tailings facilities. With this agreement, the applicable regulations as cited in Section 2.1 and any modifications or additions are under the administration of the State of Utah.

2.2.1 Ground Water Protection

The administrative rule stipulates that any newly constructed facility which discharges or would probably result in a discharge of pollutants that may move directly or indirectly into the groundwater must apply for a groundwater discharge permit. The rule identifies a broad range of facilities to which it applies, and specifically includes facilities with waste storage piles, landfills and dumps, mining, milling and metallurgical operations. The rule also requires that any facility constructed or operated before the rule was enacted (August 1989), must submit a notice of the nature and location of any discharges to the state within 180 days of the adoption of the rule, and submit an application for a discharge permit upon notification by the state. The design of the seven-part liner system, as outlined within this TMP, will prevent discharge of pollutants either directly or indirectly into the groundwater for this milling operation.

3. TAILINGS DAM DESIGN FEATURES

3.1 Dam Stability Analysis

The design, construction and inspection of the existing tailings embankment retention system includes construction methods, hydraulic analyses, seepage analyses, stability analyses, seismic analyses and settlement analyses. Most of those items have been addressed in the following reports: *Preliminary Geotechnical Engineering Report Shootaring Canyon Uranium Project Garfield County*, Utah Woodward-Clyde, April 1978; *Tailings Management Plan and Geotechnical Engineering Studies Shootaring Canyon Uranium Project Garfield County*, Utah Woodward-Clyde, September 1978; *Stage I – Tailings Impoundment and Dam Final Design Report Shootaring Canyon Uranium Project Garfield County, Utah* Woodward-Clyde, May 1979 and *Earthwork Quality Control Overview and As-Built Drawings Construction of Stage I Tailings Impoundment and Dam Shootaring Canyon Uranium Project Garfield County, Utah* Woodward-Clyde, July 1982. Recent reviews of the seismic stability and settlement analysis have been completed and are included in this section. The consulting engineering firm of Inberg-Miller Engineers completed the analysis with results that show the tailings dam has a safety factor of 1.14 at a horizontal seismic coefficient of 0.19g. Using the Newmark Deformation analysis with a magnitude 6.5-earthquake and peak ground acceleration of 0.33g gave a displacement of 1.9 inches. See attachments in Appendix A: Inberg-Miller Engineers letter reports dated January 9, 1997, December 11, 1997 and January 28, 1999. On March 8, 1999 the State of Utah Department of Natural Resources Division of Water Rights determined that the Shootaring Canyon Mill Tailings Dam meets the stability criteria adopted by their office. See attached State of Utah Department Of Natural Resources Division of Water Rights letter dated March 8, 1999 in Section A.6 in Appendix A.

3.2 Cross Valley Berm Analysis

The cross valley berm was evaluated for stability by Inberg-Miller Engineers on June 14, 1999. Inberg-Miller Engineers found that is necessary to reshape the cross valley berm in order to stabilize the berm at a seismic coefficient of 0.19g. The specifications and reshaping recommendations are provided in the Slope Stability Analysis Cross Valley Berm Letter Report section (see Appendix A). During construction of Cell 1 of the planned tailings facility, the upstream and downstream slopes of the cross valley berm will be further flattened to a steepest slope of 3H:1V. This is a more conservative and stable condition than the recommended steepest slope of 2H:1V provided by the stability analysis.

4. CONTROL OF LIQUID AND SOLID EFFLUENTS

The following section discusses the above-grade retention systems used to prevent the release of liquid or solid wastes containing radioactive materials to the groundwater and offsite areas. NRC Regulatory Guide 3.11, "Design, Construction and Inspection of Embankment Retention Systems for Uranium Mills" and the Utah Water Quality Discharge Permit served as a guide for those sections. Further details on0 the existing tailings impoundment system are presented in the referenced support documents.

4.1 WATER RESOURCE PROTECTION

4.1.1 Seven Part Liner System

The tailings management plan for the Shootaring Canyon uranium project has been developed to prevent contamination of groundwater underlying the tailings disposal area. A lining system consisting of a 12" minimum clay base under a double HDPE liner with leak detection over the natural sandstone of the impoundment area will prevent seepage from the tailings impoundment into the foundation rock (see Figure 4-1). To reduce the amount of tailings liquids available for seepage from the impoundment, the tailings slurry will be processed through a belt press or other fluid extraction equipment to remove the majority of the liquid and divert it to a process storage pond for recycle to the process circuit. Also, tailings liquid collected in the leachate collection system of the impoundment will be recycled to the process circuit. During initial tailings placement for a particular cell, the tailings will be distributed over the base of the cell in a lift of several feet starting from a constructed access point at the base of the cell. This initial lift will anchor the liner system and reduce the potential for lateral slippage and damage to the liners. After the initial lift is placed, the moist tailings will then be transported to the tailings area in solid form and placed in a selected area in a six-foot to twenty-foot lift. A commercial tacifying agent will be applied to the newly placed tailings as required to minimize wind blown tailings. Following the cessation of tailings placement in a cell, the average moisture content in the tailings will be only slightly greater than the expected long-term moisture content for the tailings. Hence, the tailings will be almost completely dewatered when the use of the cell is discontinued. At the time of reclamation, the tailings area will be dewatered of drainable water, further limiting the amount of water which may seep from the tailings impoundment.

At the project site, net evaporation from exposed water surfaces will average approximately 70 inches (177.8 cm) per year, which is equivalent to approximately 3.6 gallons (13.63 l) per minute per acre of exposed surface. At an ore processing rate of 1,000 tons (907 mt) per day, and assuming a tailings slurry containing 49 percent solids by weight, approximately 175 gallons (662.4 l) per minute of tailings liquid will be delivered to the processing area where the belt press(es) or other fluid extraction equipment will be located. In the event that the operation of the belt press(es) is temporarily suspended or terminated, the tailings slurry will be delivered directly to the tailings cell. During normal operations, it is anticipated that the belt press processing will reduce the moisture content of the tailings solids to a target level of 30 to 40 percent by weight. Saturated, dense, settled tailings would be expected to have retained long-term moisture content of 30 to 35 percent. Based on this assumption, approximately 84 gallons (318 liter) per minute will be recycled to the mill and approximately 90 gallons (341 l) per minute of the tailings liquid will be retained in the settled tailings.

Since the tailings management plan provides a means for disposing of all excess tailings liquids during the project operation, no significant amount of free tailings liquid will remain in the impoundment at project termination to seep into the groundwater. Also, after the project is terminated, normal evaporation from the tailings cap will help to dispose of the incident precipitation. The slope of the final reclaimed surface will help to reduce infiltration by shedding precipitation off the reclaimed facility. To prevent the “bathtub” effect from occurring a detailed infiltration model was completed which stated infiltration will be reduced to as low as achievable. The Tailings Reclamation Plan accompanying this Tailings Management Plan includes a discussion of infiltration modeling and the potential accumulation of infiltration within the lined cell. A very limited potential therefore exists for groundwater contamination from this project, and the requirements for surveillance of the groundwaters of the area will be minimal. The monitoring wells located near the impoundment perimeter for monitoring potential seepage from the basin during project operation will be maintained and be available for subsequent groundwater monitoring.

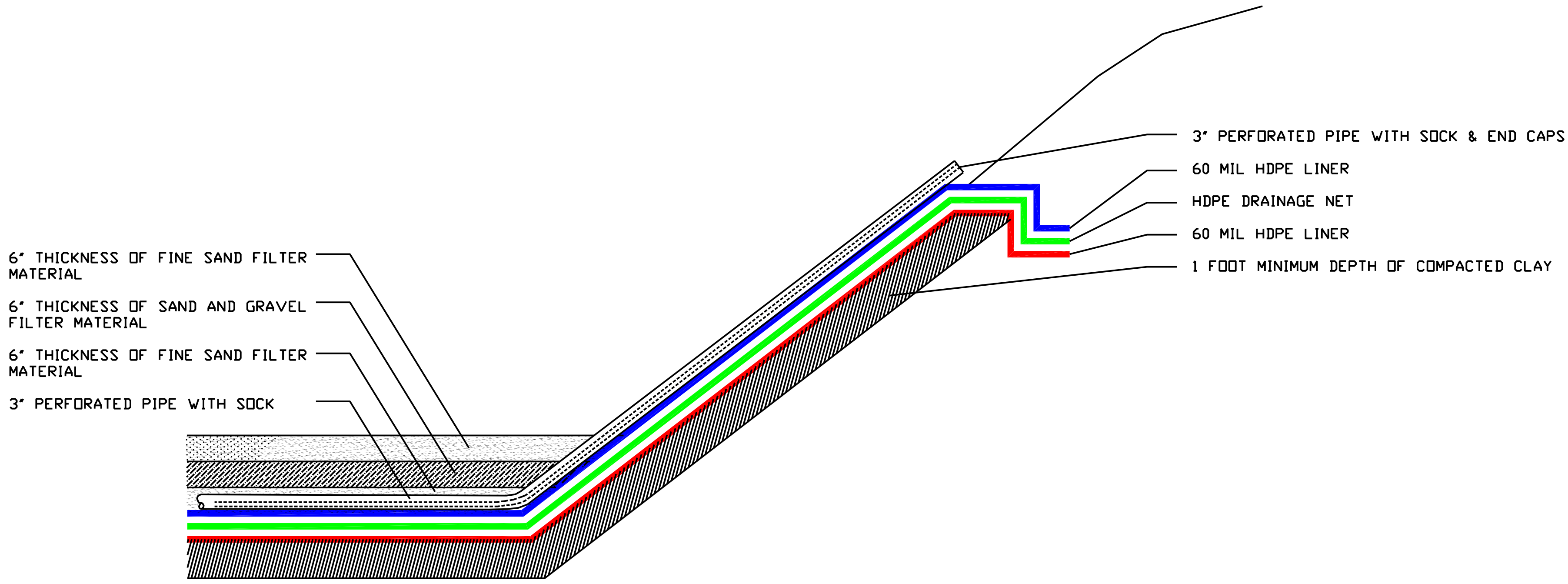
CFR 40 Appendix A requires the use of a liner under the tailings that "is designed, constructed, and installed to prevent any migration of wastes out of the impoundment to the adjacent subsurface soil, ground water, or surface water at any time during the active life” (including the closure period) of the impoundment. The installation of the double liner system as described for of the tailings impoundment would preclude any seepage from those areas

The double liner with leak detection system design is the Best Available Technology (BAT) and comparable to similar facilities in the industry. The design allows for verifying on a continuous basis that the ground-water protection levels are not being exceeded. The use of Geosynthetic HDPE material offers superior performance by maintaining the highest standards of durability and the low permeability provides assurance that the leachate will not penetrate the liner.

The area above the existing cross-valley berm has been lined with a clay blanket of not less than two feet up to ten feet thick. The clay blanket has been overlain with sandy material covered with gravel material, which is designed to collect slimes. Within the sand layer and adjacent to the clay liner are drainage pipes which drain to a collection sump. The collection sump, located downstream of the cross-valley berm, is equipped with a pump. The liquid in the sump is pumped to surface evaporation ponds or recycled back to the mill. Prior to installation of the seven-part liner system in Cell 1, all tailings and associated material in this existing cell will be placed in a cell located adjacent to Cell 1 on the east side. This additional cell is designated as the Evaporation and Process Pond Cell (EPPC) because it will contain an HDPE lined fluid storage pond. This adjacent cell will be constructed with the seven-part liner system prior to the start of construction work on Cell 1. Once the tailings and other contaminated material are removed from the existing tailings cell, a lined cell designated as Cell 1 will be constructed upstream of the cross valley berm. Construction of this cell with a seven-part liner system will require reshaping and reconfiguration of the cross valley berm to a much more stable configuration with 3H:1V upstream and downstream outslopes. The Cell 1 liner system will preserve as much of the existing clay liner as possible with attendant testing of clay thickness and quality. During construction of Cell 1, the liner system will be extended to connect Cell 1 and the EPPC and allow Cell 1 to serve as an additional containment measure for the EPPC. See Section 10 for more detail.

During milling activities, seepage from the ore storage pad will be minimal due to the current pad construction on a clay pad to reduce infiltration and future pads will be constructed to reduce infiltration. The limited rain water runoff from the ore stockpiles and ore storage pad is diverted into the tailings facility. Recent studies have determined that a clay material has been used to construct the ore pad. Tested depth of the ore pad clay material is 12 to 14 inches with a hydraulic conductivity of 3.7 E-6 cm/sec. See Section 9 for more detailed discussion on the current ore pad.

The impoundment will be divided into two major tailings cells and the EPPC which will all have a double liner system with leak detection placed over a 12" compacted clay base. A collection system will be installed over the double liner consisting of ADS, HDPE drainage piping placed within a filter bed. All the collection piping will attach together into one continuous drain field per sump, which will collect tailing leachate into sumps. The liquid will be pumped to the lined Storage/Evaporation Pond for evaporation or recycling to the mill. The sumps will be used until the reclamation phase of covering the impoundment has been completed. See Section 5 for detailed design drawings of the tailings facility and liner system.



TYPICAL SECTION FOR SEVEN PART LINER SYSTEM
NOT TO SCALE

ALL INTERIOR SLOPES WILL NOT EXCEED A MAXIMUM OF 3H:1V.

18" TOTAL DEPTH OF FINE SAND AND SAND AND GRAVEL FILTER PLACED IN BOTTOM OF CELLS ONLY.

LINER ANCHOR SYSTEM PER MANUFACTURE'S RECOMMENDATIONS.

FINE SAND FILTER SHALL CONSIST OF TYPICAL ENTRADA SAND

SAND AND GRAVEL FILTER SHALL MEET THE FOLLOWING GRADATION:

3"	100%	PASSING
NO. 4	20 - 70%	PASSING
NO 200	0 - 25%	PASSING

TYPICAL ON SITE MATERIALS WILL SATISFY THESE REQUIREMENTS

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Figure 4-1. Schematic of Seven Part Liner System		
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Page 4-4	HYDRO-ENGINEERING L.L.C.	

5. TAILINGS DISPOSAL SYSTEM

5.1 Design

Tailings from the ore processing operation is discharged to an impoundment, created by a dam, adjacent to the uranium mill. Cell 1 has an estimated ultimate capacity of 1,602,000 tons with a maximum stacking height of 50 feet above the top of cell elevation of 4455 feet above MSL and an assumed emplaced tailings density of 80 pcf (dry basis). Cell 2 has an estimated ultimate capacity of 5,265,000 tons with a maximum stacking height of 70 feet above the top of cell elevation of 4430 feet above MSL and an assumed emplaced tailings density of 80 pcf (dry basis). A portion of the Cell 2 capacity (approximately 200,000 cu. yd.) will be reserved for tailings fluid or runoff storage. At the point when Cell 2 is approaching capacity, a drainage diversion or interior runoff storage system will be proposed to allow utilization of the full Cell 2 storage capacity unless the decision has been made to expand the cell to the Stage II configuration. At a plant throughput of 1000 tons of dry ore per day with 350 days per year operation, Cell 1 has a capacity of slightly more than 4 years of production. With full utilization of Cell 2, the capacity is sufficient for approximately 14 years of mill production. At capacity, the two tailings cells in the impoundment will cover an area of approximately 60 surface acres. The impoundment is fenced to exclude livestock and warn the general public that the facility has restricted access. Although it is not included in this submittal, the Stage II configuration includes raising the tailings dam 30 feet for an additional capacity of 2,867,000 tons.

The tailings management system for the facility was designed to meet the criteria in Regulatory Guide 3.11, 3.11.1, Appendix A of 10 CFR Part 40 and State of Utah Dam Safety Guide to Standard Operating Procedures, 1991. Stabilization will be accomplished by draining the tailings as they are placed in the impoundment. For this purpose, a leachate collection system has been installed in the bottom of the impoundment and the planned reduced moisture placement procedures will limit the segregation of fine and coarse tailings within the cells. The combination of reduced moisture placement, limited segregation of tailings fines, and the presence of the leachate collection system will maintain the tailings in a largely dewatered condition throughout operation. It will therefore be possible to reclaim the tailings disposal area in a relative short time period after it is filled to its ultimate level.

A site selection survey (*Preliminary Site Selection Study Proposed Shootaring Canyon Uranium* Project, Utah, Woodward-Clyde Consultants, June, 1977) was completed to identify locations near the Shootaring Canyon uranium mines best suited for the safe and efficient disposal of tailings and convenient to areas suitable for an ore processing facility. A preliminary design and construction specification (Woodward-Clyde Consultants, May, 1978) was completed for a dam and tailings impoundment facility at a candidate site identified in the earlier study. A third study *Evaluation of Tailings Disposal Alternatives Shootaring Canyon Uranium Project, Utah,* Woodward-Clyde Consultants, December, 1978 reviewed alternative tailings disposal systems considered for the project. A supporting document, presenting the results of an assessment of the performance of the tailings disposal system included with the proposed ore processing facility, was submitted to the NRC in June, 1978. The report included comparative data on costs and performance for the alternative methods of tailings disposal considered for the project. Construction plans and specifications for the tailings disposal dam and impoundment area clay liner, and a final design report, were submitted to the NRC in May, 1979.

Prior to construction of the tailings impoundment, the area was shaped to remove surface irregularities, unsuitable materials were removed, and the surface compacted; care was taken to ensure that the natural southwesterly slope of the area was maintained. Following the foundation dressing and compaction, selected clay was spread evenly over the impoundment area and compacted to 95 percent Standard Proctor Density with a sheepsfoot compactor. Water was used to wet the clay during the operation to facilitate proper compaction. Total depth of the compacted clay liner is at least two feet in all areas. A layer of sandy material was spread over the clay liner promptly after it was placed, to preserve its integrity.

A dam key trench, about 40 feet wide and extending up the abutments above the level of the top of the dam was excavated across the natural drainage outlet from the impoundment basin. A dam about 400 feet wide at the base and 68 feet high was constructed for the first stage. The interior of the dam was constructed with a clay core placed into the key trench. Exterior slopes of the dam are not steeper than two horizontal to one vertical (2:1). The initial structure is expected to serve without raising the dam for the first 16 to 18 years of operations. Materials for constructing the dam were obtained from the vicinity. Adequate quantities of all materials required for additions to the dam and any other clay usage in the impoundment have been identified in the locality.

The new seven-part liner system will be placed over prepared impoundment basin. Preparation will consist of removal of base rock and/or dirt fill placed as per Construction Quality Control and Quality Assurance Plan (CQCQAP). The surface will be graded to create a smooth uniform surface prior to placement of the base clay liner. A minimum of twelve inches of clay material will serve as the base and the secondary 60 mil HDPE liner will be placed on top of the clay (see Figure 4-1). In Cell 1, portions of the existing clay will be preserved if possible. The next component in the liner system is a HDPE geonet material for leak detection and this is overlain by the primary 60 mil HDPE liner. A leachate collection system consist of perforated ADS, HDPE piping with drainage sock will be placed in a six inch thick layer of Entrada sand. A six-inch thick layer of rocky sand and gravel soil will be placed on top of the Entrada sand. This will be overlain by a second six inch thick layer of Entrada sand for a total of 18 inches of drainage layer on the base of the ponds. An analysis of the hydraulic and chemical properties of the two proposed drainage layer materials was conducted with the conclusion that the proposed materials are suitable to perform the functions of: guarding the HDPE liner against penetration or damage by stones or other objects; conveying drainage from the tailings to the piping network; and preventing intrusion of tailings into the drainage system. A synopsis of the analysis of the filter gradations and estimated hydraulic conveyance is included in Appendix B. The drainage sand and sand and gravel materials will not be placed on the side slopes of the lined cells. This new liner system is detailed in the attached figures. Figure 5-1 presents the Cell 1, EPPC and Cell 2 configurations with contours to the top of the upper HDPE liner.

Figure 5-2 presents the layout of the drainage collection system for the tailings cells. This figure also shows the location of the below grade berms that serve to separate and isolate drainage from the cell to individual sumps. In some cases, these berms are minor extensions of natural drainage divides in the cell base. The separation berms will be constructed as a small (approximately 1 foot high) ridge in the subgrade, and will be overlain with the full thickness of liner and drainage system. Two cross sections were developed to represent the two tailings cells and the EPPC, and these are included in Figure 5-3. Figures 5-4 through 5-7 present details of the collection and leak detection sump construction. The Construction Quality Control and Quality Assurance Plan is presented in Section 5.2.

5.2 Construction Quality Control and Quality Assurance Plan

The Construction Quality Control and Quality Assurance Plan that will be utilized in the construction of the tailings impoundment system is included in Section C.1 of Appendix C.

5.3 SOP for Main Tailings Dam Inspection Program

SOP for Main Tailings Dam Inspection Program is kept on the Shootaring Mill site. SOP HP-21 presents the tailings dam inspection program. The references used to develop this program were NRC Regulatory Guide 3.11.1, *Operational Inspection and Surveillance of Embankment Retention System for Uranium Mill Tailings, 1980* and *State of Utah Dam Safety Guide to Standard Operating Procedures, 1991.*

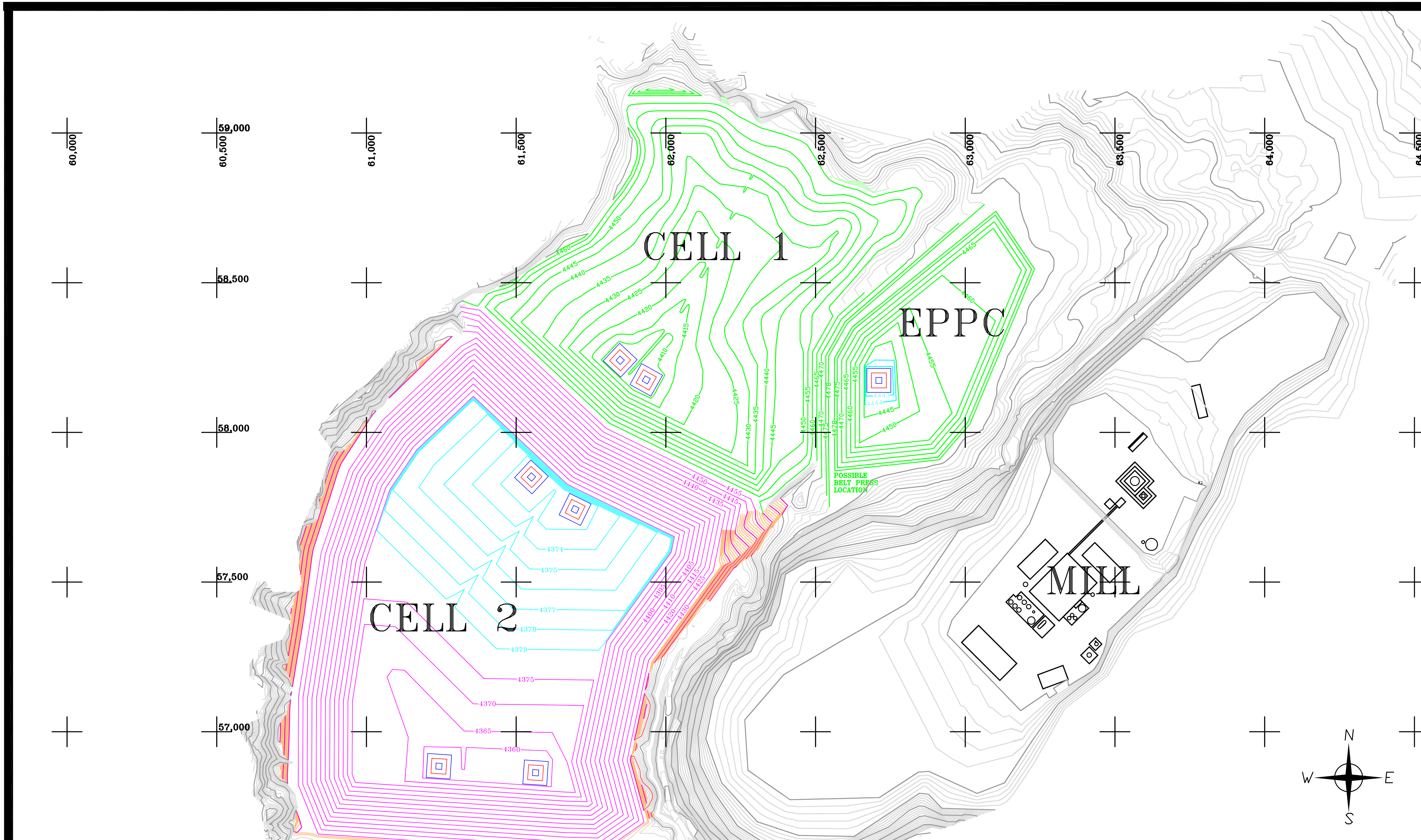

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Figure 5-1. Tailings Cell 1, EPPC and Tailings Cell 2

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Page 5-4	HYDRO-ENGINEERING L.L.C.	

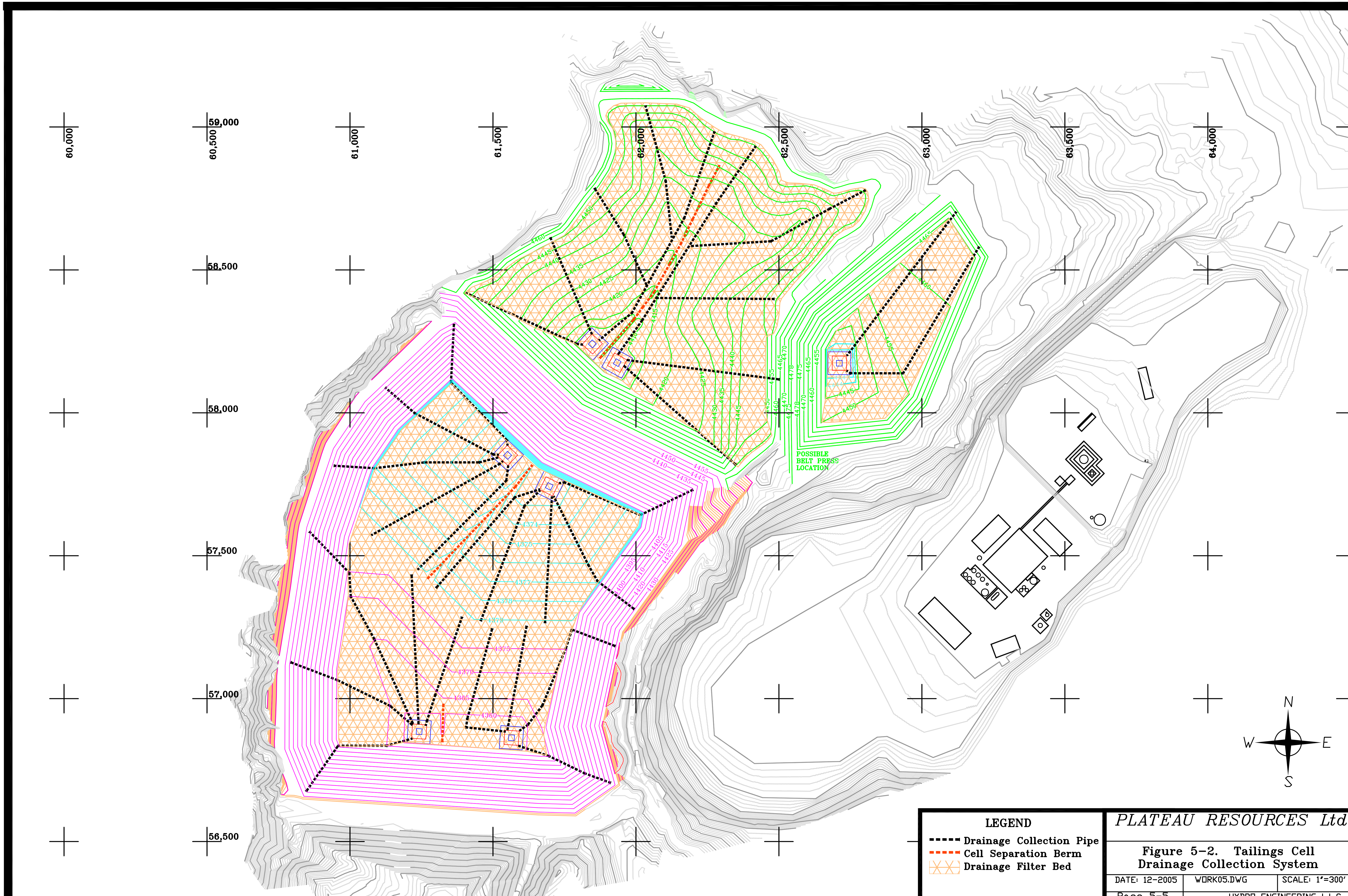

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Figure 5-2. Tailings Cell Drainage Collection System

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Page 5-5	HYDRO-ENGINEERING L.L.C.	

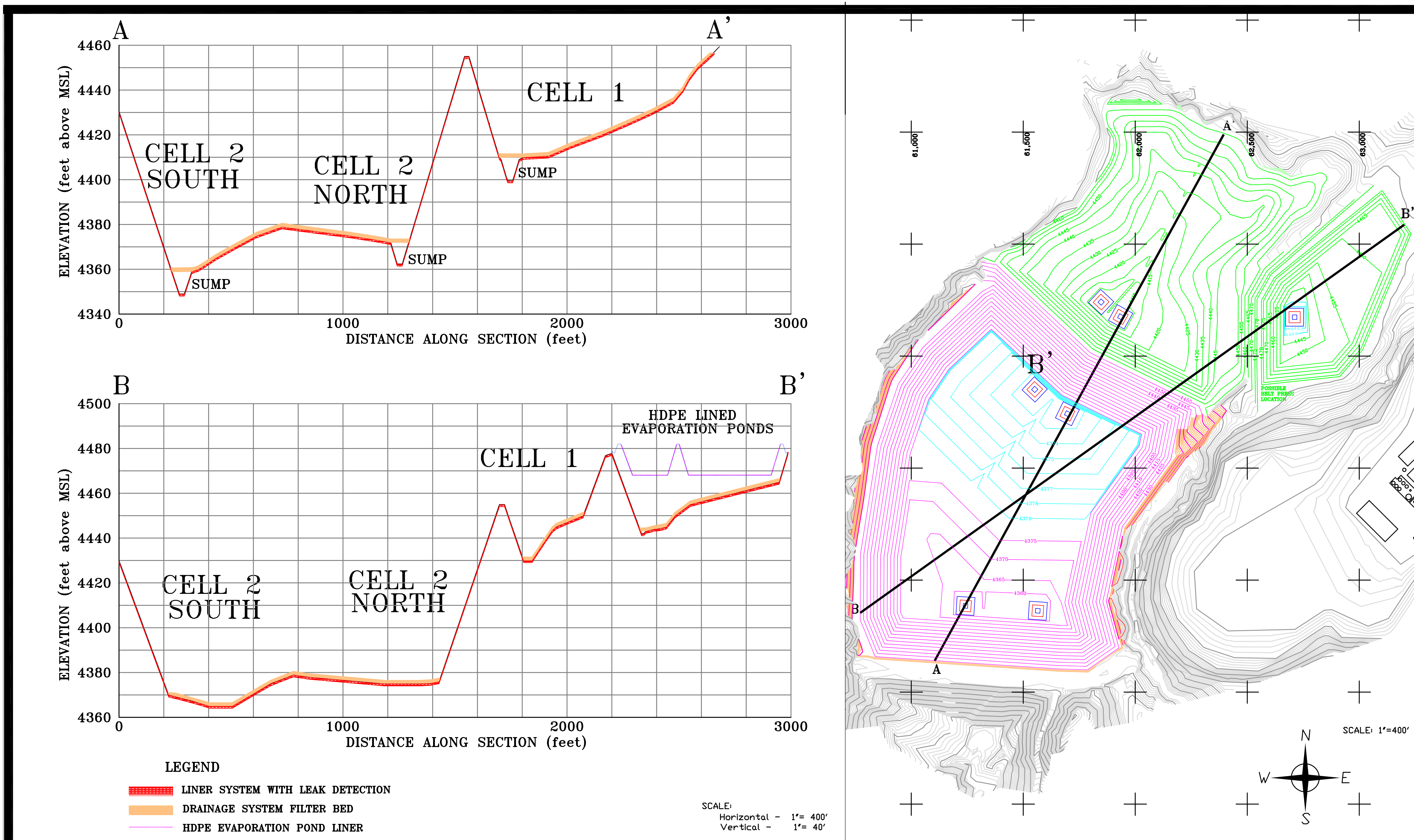

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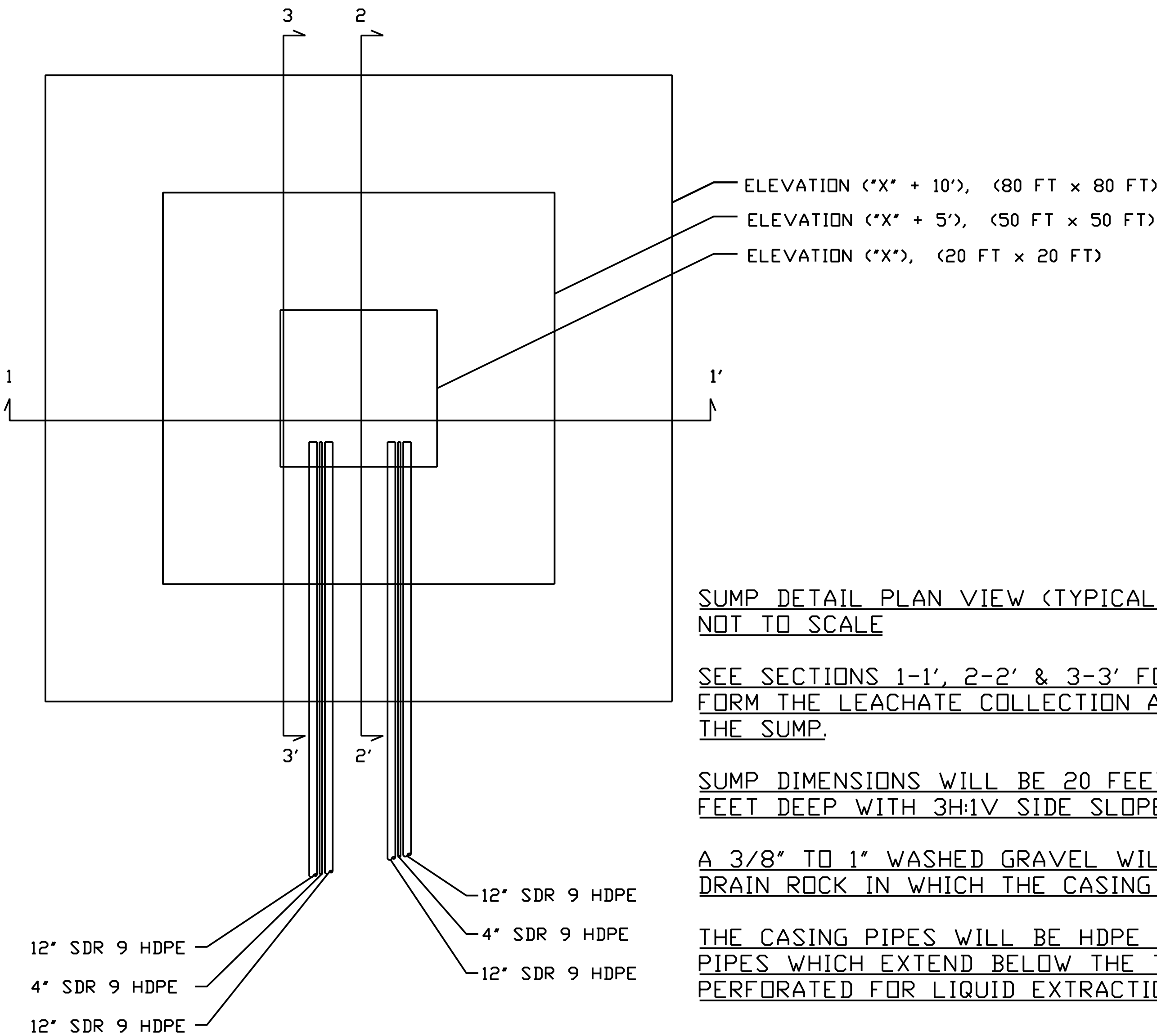
Figure 5-3. Tailings Area Cross Sections

DATE: 12-2005	WORK05.DWG	SCALE: 1"=300'
Page 5-6	HYDRO-ENGINEERING L.L.C.	



SUMP DETAIL PLAN VIEW (TYPICAL)
NOT TO SCALE

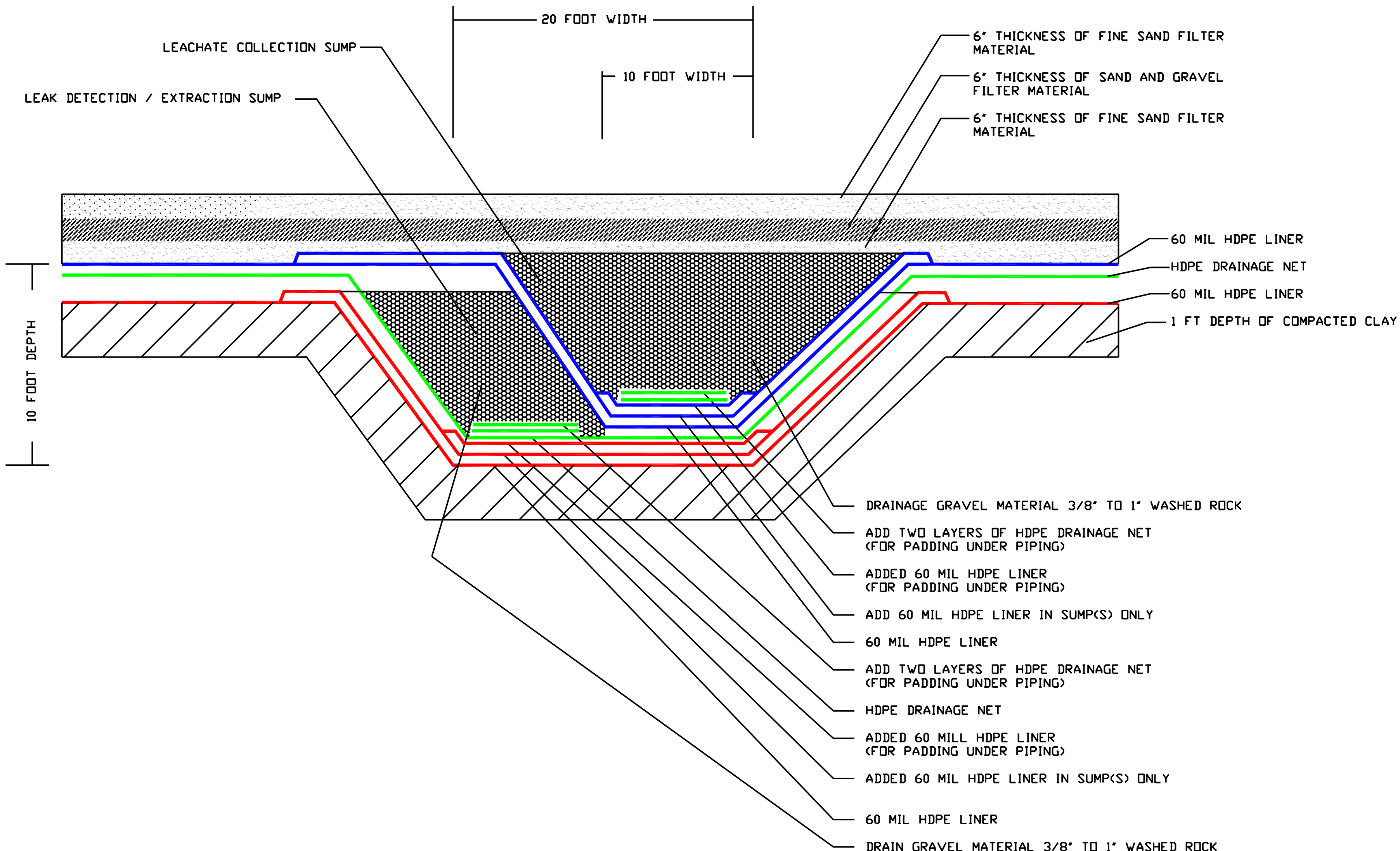
SEE SECTIONS 1-1', 2-2' & 3-3' FOR LINER AND PIPE PLACEMENT TO FORM THE LEACHATE COLLECTION AND LEAK DETECTION CELLS WITHIN THE SUMP.

SUMP DIMENSIONS WILL BE 20 FEET BY 20 FEET SQUARE BOTTOM, 10 FEET DEEP WITH 3H:1V SIDE SLOPES.

A 3/8" TO 1" WASHED GRAVEL WILL BE USED IN THE SUMPS AS THE DRAIN ROCK IN WHICH THE CASING PIPES ARE PLACED.

THE CASING PIPES WILL BE HDPE SDR 9. THE PORTION OF THE CASING PIPES WHICH EXTEND BELOW THE TOP OF THE SUMP WILL BE PERFORATED FOR LIQUID EXTRACTION.

PLATEAU RESOURCES Ltd.		
Figure 5-4. Tailings Cell Sump Detail and Cross Section Locations		
DATE: 12-2005	Liner_schematic.dwg	NOT TO SCALE
Page 5-7	HYDRO-ENGINEERING L.L.C.	



<u>SECTION 1-1' LEACHATE COLLECTION LEAK DETECTION / EXTRACTION SUMP(S)</u>
(FRONT VIEW) NOT TO SCALE

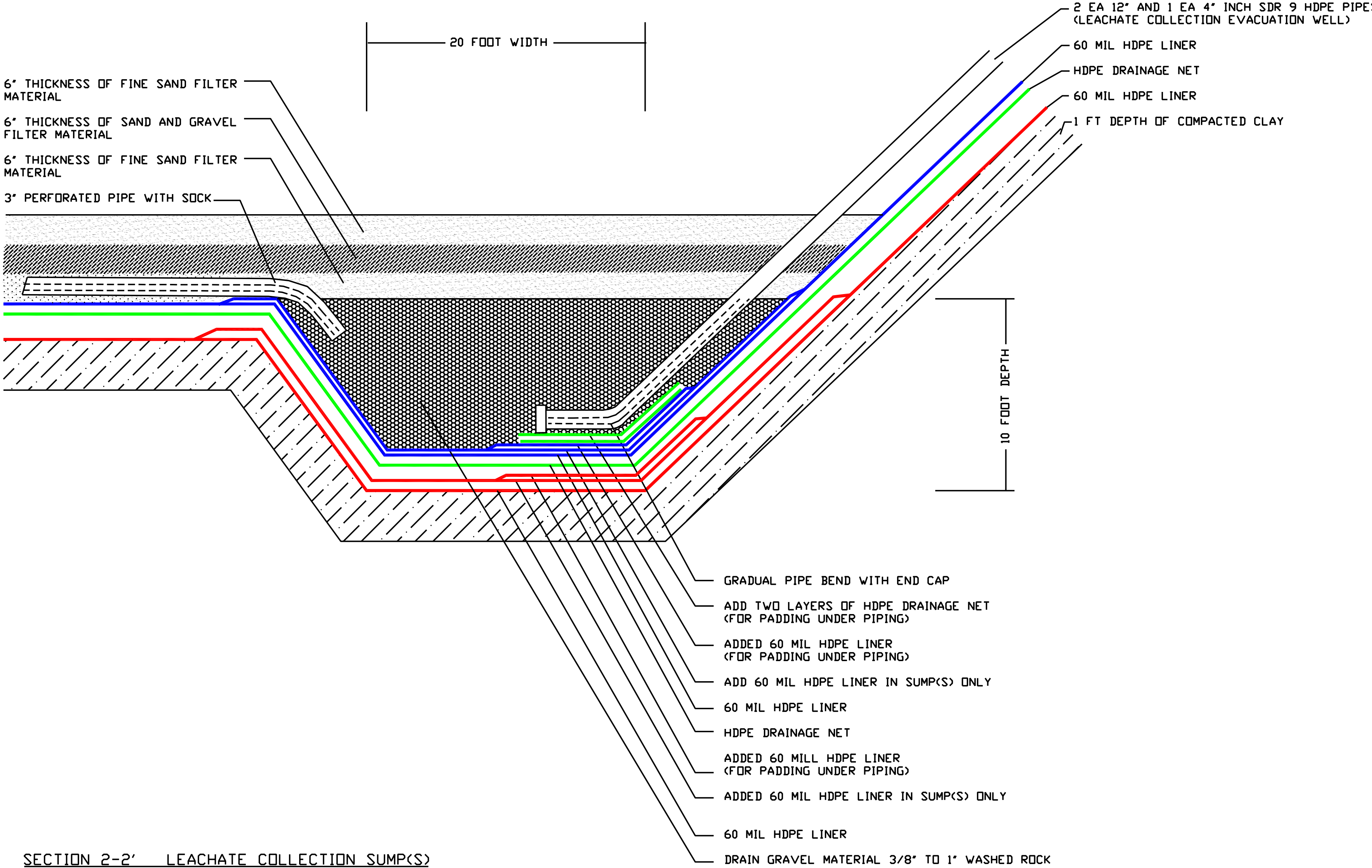
INSTALL SUMP PUMP(S) INTO GRAVEL SUMP(S) THROUGH 12" SDR 9 HDPE PERFORATED CASING PIPE. (NOT SHOWN) NOTE: PERFORATIONS ONLY WITHIN THE SUMP(S)

SUMP PUMP(S) CONTROL SYSTEMS INSERTED INTO THE SUMP(S) THROUGH A 4" SDR 9 HDPE PERFORATED CASING PIPE. (NOT SHOWN) NOTE: PERFORATIONS ONLY WITHIN THE SUMP(S).

A RESERVE 12" SDR 9 HDPE PERFORATED CASING PIPE WILL BE INSTALLED INTO EACH SUMP(S) AS A BACKUP IF NEEDED FOR ADDITIONAL PUMPING.

SLOPES IN SUMP(S) WILL NOT EXCEED 3H:1V.

PLATEAU RESOURCES Ltd.		
Figure 5-5. Sump Detail Cross Section 1 - 1'		
DATE: 12-2005	Liner_schematic.dwg	NOT TO SCALE
Page 5-8	HYDRO-ENGINEERING L.L.C.	



SECTION 2-2' LEACHATE COLLECTION SUMP(S)
(SIDE VIEW) NOT TO SCALE

INSTALL SUMP PUMP(S) INTO GRAVEL SUMP(S) THROUGH 12" SDR 9 HDPE PERFORATED CASING PIPE. NOTE: PERFORATIONS ONLY WITHIN THE SUMP(S).

SUMP PUMP(S) TO OPERATE ON A HIGH/LOW (ON/OFF) CONTROL SYSTEM. CONTROL SYSTEM INSERTED INTO THE SUMP(S) THROUGH A 4" SDR 9 HDPE PERFORATED CASING PIPE. NOTE: PERFORATIONS ONLY WITHIN THE SUMP(S).

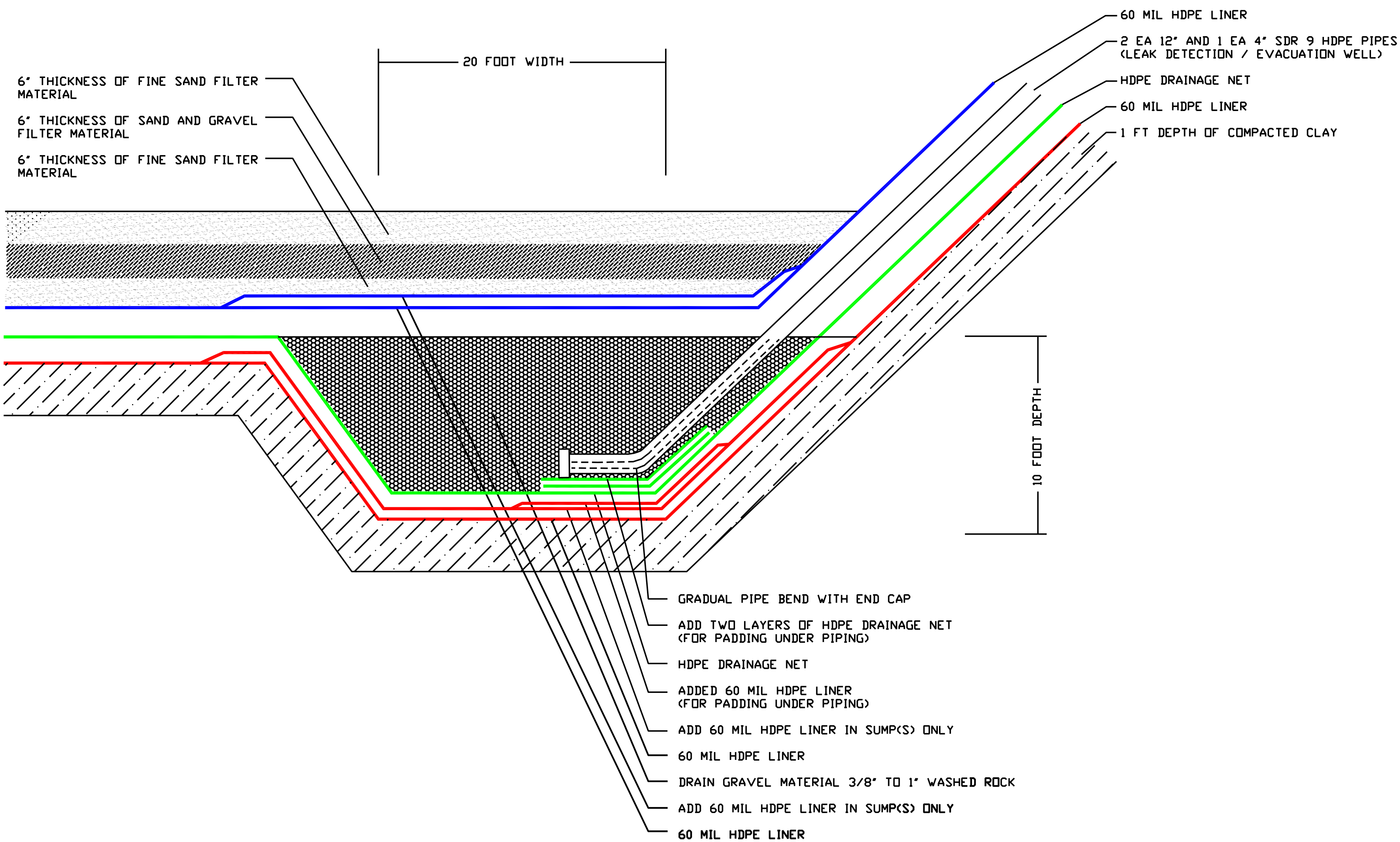
A RESERVE 12" SDR 9 HDPE PERFORATED CASING PIPE WILL BE INSTALLED AS A BACKUP IF NEEDED FOR ADDITIONAL PUMPING.

SLOPES IN SUMP WILL NOT EXCEED 3H:1V.

PLATEAU RESOURCES Ltd.

Figure 5-6. Sump Detail Cross Section 2 - 2'

DATE: 12-2005	Liner_schematic.dwg	NOT TO SCALE
Page 5-9	HYDRO-ENGINEERING L.L.C.	



SECTION 3-3' LEAK DETECTION / EVACUATION SUMP(S)
(SIDE VIEW) NOT TO SCALE

INSTALL SUMP PUMP(S) INTO GRAVEL SUMP(S) THROUGH 12" SDR 9 HDPE PERFORATED CASING PIPE. NOTE: PERFORATIONS ONLY WITHIN THE SUMP(S).

SUMP PUMP(S) TO OPERATE ON A HIGH/LOW (ON/OFF) CONTROL SYSTEM WITH HIGH WATER LIGHT SIGNAL(S). CONTROL SYSTEM INSERTED INTO THE SUMP THROUGH A 4" SDR 9 HDPE PERFORATED CASING PIPE. NOTE: PERFORATIONS ONLY WITHIN THE SUMP(S).

A RESERVE 12" SDR 9 HDPE PERFORATED CASING PIPE WILL BE INSTALLED AS A BACKUP IF NEEDED FOR ADDITIONAL PUMPING.

SLOPES IN SUMPS WILL NOT EXCEED 3H:1V.

PLATEAU RESOURCES Ltd.		
Figure 5-7. Sump Detail Cross Section 3 – 3'		
DATE: 12-2005	Liner_schematic.dwg	NOT TO SCALE
Page 5-10	HYDRO-ENGINEERING L.L.C.	

6. TAILINGS DISPOSAL MANAGMENT

Tailings will be transported, in the form of slurry at about 45-55 percent solids, by weight, to the fluid extraction area adjacent to the EPPC through a high-density polyethylene pipe. A provision will be made to allow direct discharge of the tailings slurry to the tailings cell(s) in the event of a fluid extraction failure. The discharge pipe will be supported within an HDPE-lined trench (60 mil or thicker) with a minimum depth of 12 inches, or alternatively, within an 18-inch half-round polyethylene pipe. The HDPE-lined trench or half-round pipe will contain any potential leakage from the discharge slurry pipe. This slurry pipe support will conduct any potential leakage to the impoundment by gravity flow.

The tailings impoundment area has been divided into two major disposal cells and a smaller disposal cell for the existing tailings and other contaminated material. The existing cross valley berm will be reshaped and reconfigured to serve as the cell divider between Cell 1 and Cell 2. The first cell to be constructed will be the Evaporation and Process Pond Cell and this will be followed by construction of Cell 1. The use of multiple cells will allow progressive expansion of tailings capacity along with interim stabilization measures and eventually progressive reclamation of cells. The anticipated start of construction for Cell 2 will be approximately 1 to 2 years prior to reaching full capacity in Cell 1.

A belt press or other fluid extraction equipment will be used to extract a significant portion of the fluid from the tailings slurry. This fluid will be discharged to a small HDPE-lined decant pond and subsequently delivered to the Storage/Evaporation ponds or recycled directly to the mill. All fluid storage ponds and the fluid extraction equipment will be located within the perimeter of the seven-part liner system. The target moisture content of the reduced moisture tailings is 35% by weight. The reduced-moisture tailings solids will be delivered to the tailings cells by one of two methods. The preferred method will be a solids-handling pumping system which delivers the reduced moisture tailings via pipeline to a continuously moving distribution machine which places the tailings in a lift of 6 feet or more. Alternatively, a vehicle equipped with a hopper and conveyor unloading system will be used to haul the tailings to the cell. A lift of several feet of tailings will be placed over a large area of the base of the cell prior to placement of significant volumes of tailings within the cell to avoid load-induced displacement and damage of the liner. Subsequent tailings placement will be in the largest practical lift thickness to consolidate newly-placed tailings in the smallest possible area. A commercial co-polymer dust suppression agent will be applied to the newly-placed tailings when the condition at the tailings is such that there may be any wind-blown transport of tailings. During the summer months, it is anticipated that the dust suppression agent will be applied at least once a day.

In the event that reduced-moisture tailings handling is suspended for an extended period of time and the conventional hydraulic slurry placement is used, tailings discharged to the cells will be located within the boundary of the lined cell with a sequential rotation of the discharge location to all the corners of each cell. Present expectations are to discharge the entire flow of tailings slurry from a single spigot at one corner of a cell. This flow may be continued for a period chosen to provide efficient cell operation before the discharge is shifted to the lowest corner of the cell. With the hydraulic placement, the sand and slime fractions of the tailings will segregate as they are discharged to the cells, with the sand depositing nearer the point of discharge and the slimes flowing to the lowest area within the cell (which will continuously be shifting in location because of the shifting discharge points). The sands, being concentrated near the points of discharge, will be readily accessible for use as bedding material for the leachate collection system piping. Since each layer of slimes will collect and stabilize in the lowest part of the cell and since the next tailings discharge will be from the lowest corner of that cell, each layer of slimes should be largely covered by sand. Ultimately, the central part of each cell will be filled with alternating layers of sand and slimes lying in a helical configuration. The cell perimeter will consist mainly of tailings sand. This configuration will facilitate drainage and consolidation of the slimes, and will lead to continuous burial of that part of the tailings containing most of the residual radioactivity in the processed ore.

The Tailings Management Plan permits a wide variation in tailings placement procedures. The duration of tailings placement in a cell may be varied and the number of points of stacking or discharge may be adjusted. These procedures may require seasonal adjustments due to the large local seasonal variations in evaporation rates. A major advantage of the planned reduced-moisture stacking, as described, will be that most of the tailings liquid will be immediately reclaimed for reuse in the process circuit, which decreases the amount of fresh water to be consumed by the plant. Since the tailings liquid will be acidic, its recovery will have an important effect on the total acid requirements of the plant. As previously noted, tailings placement will start in Cell 1, which is located at the impoundment basin. The available tailings disposal volume in the first cell is sufficient to store the tailings from the first three to four years of plant operation.

7. COMPLIANCE MONITORING

All environmental and radiological monitoring will be in accordance to the standard operating procedures (SOP's) as detailed in the *Plateau Resources Limited Administrative Procedures, Environmental Protection Procedures and Radiation Protection Procedures, Radiological and Environmental Monitoring Program found in Table 5.5-7 and 5.5-8* (March 1, 1996 Renewal Application) and State of Utah Water Quality Discharge Permit. The tables and Discharge Permit includes the groundwater monitoring schedule along with all other types of monitoring.

7.1 Groundwater Monitoring Quality Assurance Plan

Ground water is monitored at the locations specified in Table 5.5-7, and 5.5-8 and Discharge Permit. These locations are designed to monitor any seepage entering surface waters or groundwater from the tailings impoundment during operations. See the Groundwater Monitoring Quality Assurance Plan dated June 3, 2005.

The seventeen groundwater monitoring well locations were selected using the following criteria stipulated in Regulatory Guide 4.14 and in the EPA Health and Environmental Protection Standards for Uranium Mills, 40 CFR 192, Subpart D and State of Utah Discharge Permit:

1. Groundwater hydrologically down gradient and relatively close to the tailings impoundment and hydrologically up gradient, i.e., not influenced by potential seepage from tailings.
2. Criteria to be used as indicator chemical and radiological parameters for early detection of potential tailings seepage allow for simplified but efficient monitoring program.
3. No surface waters leave the mill facility or tailings facility, all drainage flows into the tailings impoundment. No monitoring of surface water is expected to be necessary at this site.

7.1.1 Location, Number and Type of Groundwater Monitoring Wells.

Two upgradient monitoring wells and five downgradient monitoring wells, all located with respect to the uranium mill tailings impoundment, are sampled for compliance with the following NRC License threshold values: Arsenic = 0.022 mg/L, Chloride = 40 mg/L, Selenium = 0.022 mg/L, and pH = 6.8 standard units. Uranium is compared to the 10 CFR 20, Appendix B effluent concentration of 3E-7 mCi/mL. The upgradient wells RM-1 and RM-12 are located immediately north of the tailings impoundment. Well RM-14 is located on the west side of the tailings impoundment while well RM-2R is located to the east. The remaining wells, RM-7, RM-18 and RM19 are located in the downgradient of Cell 1. A summary of the well depths and screen locations for each of the above wells is given in attached Ground-water Hydrology of the Shootaring Canyon Tailings Site – 2005 Table 3-1. This table is included in Section D.3 of Appendix D.

7.1.2 Monitored Parameters and Frequency.

Monitoring wells RM-1, RM-2R, RM-7, RM-12, RM-14, RM-18 and RM-19 will be sampled semiannually for the following parameters: U-nat; As; Cl; Se; pH

Wells RM-23 through RM-32 will replace wells RM-7, RM-18 and RM-19 prior to the construction of Cell 2.

Groundwater surface elevation will also be measured semiannually to calculate groundwater flow rate and direction in the uppermost aquifer.

7.1.3 Sampling and Analytical Techniques

Groundwater samples will be obtained after each well has been pumped until the specific conductance remains constant or after one well casing volume has been removed from each well. Each sample will be filtered, preserved and analyzed using EPA analytical procedures or the equivalent. The Groundwater Monitoring Assurance Plan, dated June 3, 2005 presents the details of the sampling program. The sampling results will be used to determine whether a significant increase in any constituents has occurred and to provide reasonable confidence that the migration of hazardous constituents from the tailings impoundment into and through the aquifer will be indicated.

7.1.4 Background Levels.

Background data for various constituents for the groundwater monitoring program are being collected prior to the operation of the facility. The background data will be used to define the natural range in concentration for each constituent.

Action levels for the groundwater monitoring program are based on sampling results and trend analyses. If individual sampling results approach 10 CFR 20, Appendix B, Table I values for groundwater samples which are obtained within the restricted area of the mill, or if trends of increasing concentrations with time are observed, the ERHS staff will investigate to determine the cause of the water quality changes. Corrective actions involve identification of the source of the contamination and possible mitigating measures, such as the installation of groundwater flow barriers or seepage pump-back systems. Currently, all analyses are performed by commercial laboratories. These commercial laboratories will be Utah certified. During operations, analysis may be completed by the mill laboratory if it is Utah certified and at commercial laboratories with various commercial laboratories utilized for quality assurance on an as needed basis.

7.1.5 Exceed Site Standards

Site standards have not been set for the Shootaring site. Additional background monitoring is being collected and needs to continue as long as possible to best define the full range of natural background concentrations. Site standards will then be developed based on the historical background data set.

7.2 Surface Water Monitoring Quality Assurance Plan

To insure that the primary upper liner is functioning properly, a continuous recorder for the detection of liquid will be installed in the sump(s) which will collect liquid from between the two 60 mil HDPE Liners. Any indication of leakage will result in pumping the liquid into an operating tailings or evaporation cell when necessary. The pumping assembly will be connected to an alarm and light to monitor the pumping systems operation. Weekly evaluations will be made to determine the quantity of liquid, if any, due to leakage.

7.3 BAT Performance Monitoring Plan Leak Detection

The quantity and rate of any leakage collected in the sump(s) will be measured on a minimum frequency of once per week. Any leakage that is collected will be delivered to the Storage/Evaporation Pond for disposal through evaporation or recycle through the mill. The maximum allowable leakage rate is 200 gallon per day per acre. The maximum allowable head on the leak detection system is three feet above the top of the individual leak detection sump.

7.4 Other Environmental Monitoring

Tables 5.5-7 and 5.5-8 which are presented in Sections D.1 and D.2 of Appendix D present the monitoring programs for direct radiation, soil, vegetation, and meteorology. Figure 7-1 presents the monitoring locations. The operational monitoring program and interim monitoring programs were designed to meet the following criteria presented in Regulatory Guide 4.14:

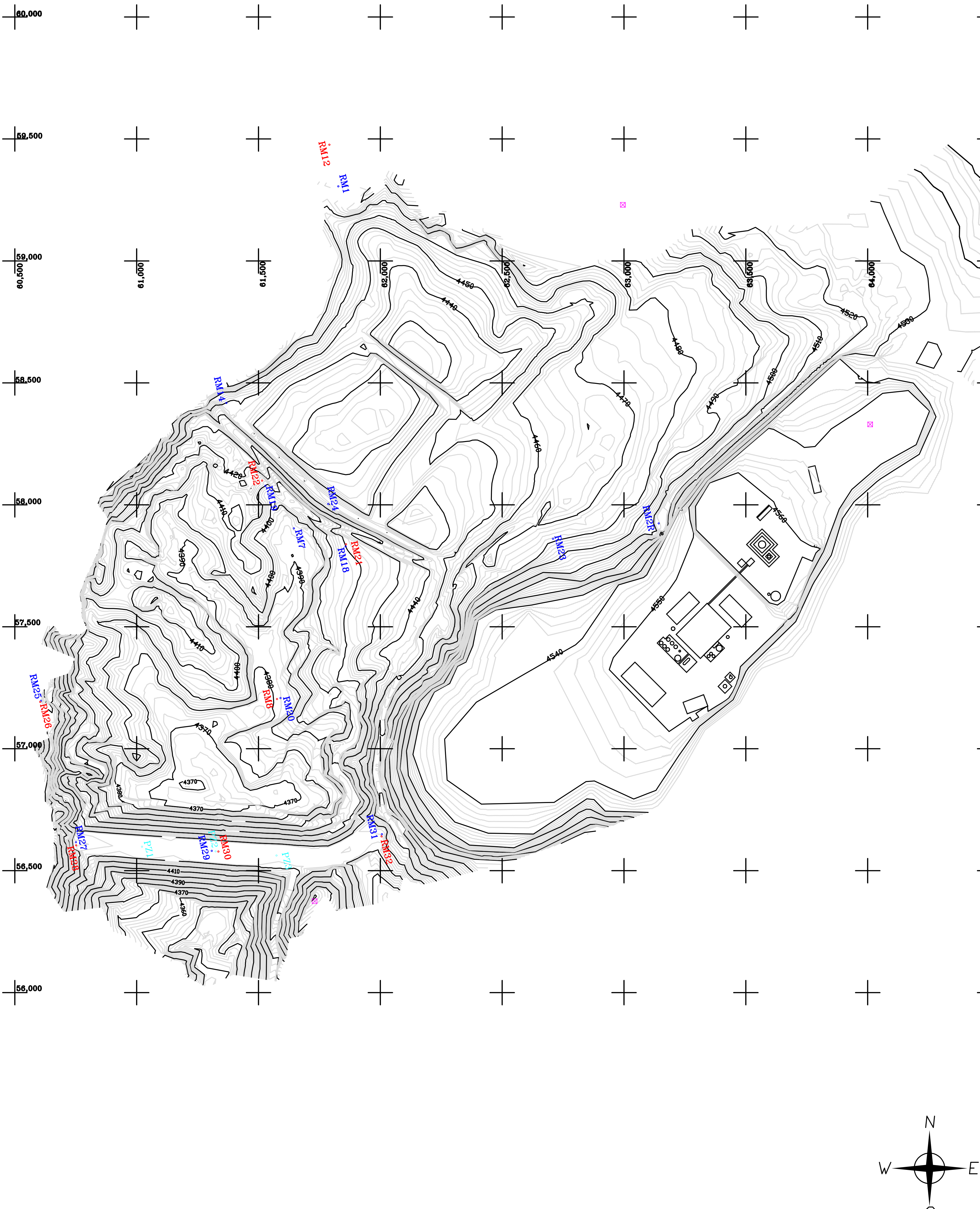
1. Sample vegetation from animal grazing areas near the mill site in the direction of the highest predicted airborne radionuclide concentrations.

2. Sample soils and measure gamma radiation at each of the locations chosen for air particulate samples.

Any increasing trend for a monitored parameter will be investigated by the ERHS or his staff to determine the cause and identify potential corrective actions.

Meteorological monitoring during operations consists of continual wind speed and direction measurements recorded on strip charts. That information is of value in the unlikely event of a puff-type release from one of the mill stacks. During the interim operational status of the mill, the monitoring program for meteorological monitoring is suspended.

Fish sampling and sediment sampling is not conducted because of the lack of streams flowing through or near the processing facility.



LEGEND

RM12 ○ UPPER ENTRADA WELL
RM1 ○ ENTRADA WELL
PZ1 ○ DAM PIEZOMETER
⊠ AIRBORNE PARTICULATE SAMPLE LOCATION

PLATEAU RESOURCES Ltd.

FIGURE 7-1. LOCATION OF MONITORING WELLS

DATE: 12-2005	MONITORING.DWG	SCALE: 1"=400'
Page 7-4	HYDRO-ENGINEERING L.L.C.	

8. CONTINGENCY PLANS

The following contingency plans are presented for the tailings facility elements. These contingency plans address plausible events that can reasonably be expected to impact the tailings facility or result in the potential release of tailings or tailings solution.

8.1 Tailings Liner – Leak Detection System

If the collection rate from the leak detection sump exceeds the allowable rate of 200 gallon per day per acre, a series of steps will be taken to reduce the rate of discharge from the leak detection system.

If the change in rate of discharge from the leak detection system is fairly abrupt and indicates a new contact with a liner puncture, recent locations of tailings placement or tailings solution ponding will be examined for liner damage. This may include excavating through recently placed tailings or evacuating ponded solution to try to expose the area of the liner where the leak is likely to be located. If a damaged section of liner is located, the liner will be repaired and tested. During this process, the location of tailings placement will be changed or the tailings placement will be suspended.

If the contributing punctures in the primary liner cannot be located, any ponded tailings solution will be pumped to an adjacent cell or to the most distant practical location within the cell. If the rate of discharge to the leak detection subsequently declines to acceptable levels, restrictions will be placed on the moisture content of tailings that can be placed with the area of the cell where the leak occurred. Only reduced-moisture tailings will be allowed to be placed in the section of the cell contributing to the sump where the allowable leak detection rate was exceeded. No ponding of solution will be allowed within the section of the cell contributing to the leak detection sump.

8.2 Tailings Liner – Evidence of Bottom Liner Loss of Integrity

If there is evidence of seepage from the tailings system detected in the ground-water monitoring program, the nature and probable location of the source of the seepage will be evaluated. All water levels in the tailings leachate collection and leak detection systems will be measured and the sumps will be continuously evacuated to the lowest possible level. If the cell or a portion of a cell can be identified as the source of the seepage, tailings placement and/or solution discharge to that area will immediately be suspended. Additional monitoring wells may be installed and a Corrective Action Program will be evaluated.

8.3 Excess Tailings Solution or Runoff Volume

Excess solution or runoff water captured within the tailings disposal cells will be transferred to the Storage/Evaporation Pond if possible. If there is not sufficient capacity in the Storage/Evaporation Pond, any fluids that cannot be evaporated in a reasonable period of time will be distributed over the tailings cell surface to increase the evaporative surface area. This distribution system may include sprinklers, sprays, and commercial fan enhanced spray units to accelerate the evaporation process.

9.0 Mill Ore Pad

9.1 Geotechnical Review

A Geotechnical review on the ore pad liner has been completed and submitted to the State of Utah Division of Radiation Control. The study found that there are 12 to 14 inches of clay material covering the ore pad. This clay material has a hydraulic conductivity of 3.7 E-06 cm/sec. The ore pad is designed so as to have the small surface drainage area diverted into the tailings facility. With the clay pad and diverted surface drainage, seepage from the ore pad is minimal. The ore pad report is presented in Section E.1 of Appendix E.

10.0 Stability of Previously Deposited Tailings Material

The previously deposited tailings material and associated radiologically contaminated material will be excavated and deposited within the lined EPPC. Single HDPE-lined ponds will be constructed within the cell on top of the deposited materials for storage and evaporation of water.

APPENDIX A

TAILINGS STABILITY AND DEFORMATION ANALYSES

APPENDIX A

TABLE OF CONTENTS

A.1 Seismic Stability Analysis, Letter Report
by Inberg-Miller Engineers, January 9, 1997

INBERG-MILLER ENGINEERS
124 EAST MAIN STREET RIVERTON, WYOMING 82501-4397 307-856-8136

January 9, 1997

7664-RX

U.S. Energy
877 North 8th West
Riverton, Wyoming 82501

ATTENTION: KEN WEBBER

SEISMIC STABILITY ANALYSIS RESULTS
STAGE I - SHOOTERING CANYON DAM
GARFIELD COUNTY, UTAH

Gentlemen:

This letter summarizes the results of a seismic stability analysis we performed for Stage I of the Shootering Canyon Dam in Utah. Our services were performed in accordance with our November 11, 1996 Service Agreement and Proposal.

You provided the following documents for our review:

- "Tailings Management Plan and Geotechnical Engineering Studies - Shootering Canyon Uranium Project", by Woodward-Clyde Consultants dated September, 1978.

- "Stage I - Tailings Impoundment and Dam - Final Design Report, Shootering Canyon Uranium Project", by Woodward-Clyde Consultants dated May 1979.

- "Stage I Tailings Impoundment and Dam Field Density Test in Zone 2 Material - Shootering Canyon Uranium Project", by Woodward-Clyde Consultants dated November 13, 1980.

- "Earthwork Quality Control Overview and As-Built Drawings - Construction of Stage I Tailings Impoundment and Dam - Shootering Canyon Uranium Project" by Woodward-Clyde Consultants dated July 28, 1982.

We developed our understanding of dam geometry, geologic conditions, and engineering properties of soils which comprise the dam according to the above documents as a basis for modeling the dam for analysis.

As requested, we also reviewed the following document which is contained in our files:

- "Seismic Hazard Analysis of Title II Reclamation Plans", by Lawrence Livermore National Laboratory dated June 26, 1994.

SLOPE CONDITIONS AND PARAMETERS

We understand the Stage I of the Shootering Canyon Dam was completed in 1982. The dam is an earthen structure designed to impound uranium mill tailings. It has a crest elevation of 4433 feet and a maximum height of approximately 85 feet. The design maximum surface elevation of impounded tailings is 4420 feet. Tailings are assumed to be saturated.

In general, the dam is comprised of 3 zones as shown on Figure 5, Section C -C from July 28, 1982 Earthwork Quality Control Overview and As-Built Drawings - Construction of Stage I Tailings Impoundment and Dam - Shootering Canyon Uranium Project. Zone 1 is the core of the dam, extending from the base to the crest, which is "silty sandy clayey" soil. Zone 1 is key-in to the rock foundation at the base. Zone 3 adjoins the core on the upstream and downstream sides, also extending from the base to the crest, which is "fine sand". Zone 2 forms the upstream and downstream face of the dam outside of Zone 3, and is described as "boulders, cobbles, gravels, and sand". We also understand an additional 2.25-foot thick layer of 18" rip-rap will extend from the downstream toe up the face a height of 15 feet. Soil descriptions for each soil zone were as defined by Woodward-Clyde Consultants in their above referenced reports. A copy of Section C-C that we referred to for modeling the slope is contained in Exhibit A.

Based on information provided by Plateau Resources Limited (PRL), we understand that the tailings will be contained by a liner and collection system. The liner system will consist of a double-layer 60 mil HDPE liner with leak detection, and will extend up the upstream face of the dam to the crest. Accordingly, our slope stability analysis assumes there is no phreatic surface through the dam.

The soil properties of the different units which are part of the dam system were taken from Table C-1 for operating conditions and seismic conditions in the May 1979 Stage I - Tailings Impoundment and Dam Final Design Report. Based on the Nov. 13, 1980, letter regarding Stage I Tailings Impoundment and Dam Field Density in Zone 2 Material by Woodward-Clyde Consultants, the unit weight of Zone 2 soil was increased from 125.0 to 131.0 pcf. A copy of Table C-1 and the Nov. 13, 1980 letter is contained in Exhibit B. The soil properties we used are summarized below:

Soil Number	Description	Unit Wt. (pcf)	Cohesion (psf)	Friction Angle (ϕ)
1	Zone 1 - Silty Sandy Clayey Soil	125	1500	0
2	Zone 2 - Boulders, cobbles, gravels, sand	131	0	40
3	Zone 3 - Fine sand	125	0	32
4	Rock Foundation	140	1000	45
5.	Tailings	100	0	10

PRL requested that we use a horizontal seismic coefficient of 0.19 g based on "Seismic Hazard Analysis of Title II Reclamation Plans", by Lawrence Livermore National Laboratory. A copy of the report section, to which PRL referred us, is contained in Exhibit C.

ANALYSIS RESULTS

We performed a slope stability analysis using the computer program PCSTABL version 5M, and the parameters which were described above. Stability analyses were performed in accordance with Bishop and Janbu methods which are available as options on PCSTABL. Per PRL's request, we analyzed the downstream slope assuming a full tailings pool (surface elevation 4420 feet). No other configurations were requested or analyzed.

The lowest safety factor (1.14) was determined using the Janbu method for the downstream face of the dam. The critical failure surface determined with PCSTABL is characterized as an "infinite slope failure" which is planar and parallel to the slope face, and typical of failure surfaces in granular soil. The safety factor calculated with PCSTABL compares favorably with manual calculations for an "infinite slope" using a soil friction angle of 40 degrees and a horizontal seismic coefficient of 0.19 g. Input and plot files for the PCSTABL critical failure surface are included in Exhibit D.

INBERG-MILLER ENGINEERS

Glen M. Bobnick, P.E.
Geotechnical Engineer

Exhibit A - Existing Conditions
Exhibit B - Soil Properties
Exhibit C - Seismic Hazard Analysis
Exhibit D - Stability Analysis Results

EXHIBIT A - EXISTING CONDITIONS

Figure 5, Section C -C from July 28, 1982 Earthwork Quality Control Overview and As-Built Drawings - Construction of Stage I Tailings Impoundment and Dam - Shootering Canyon Uranium Project

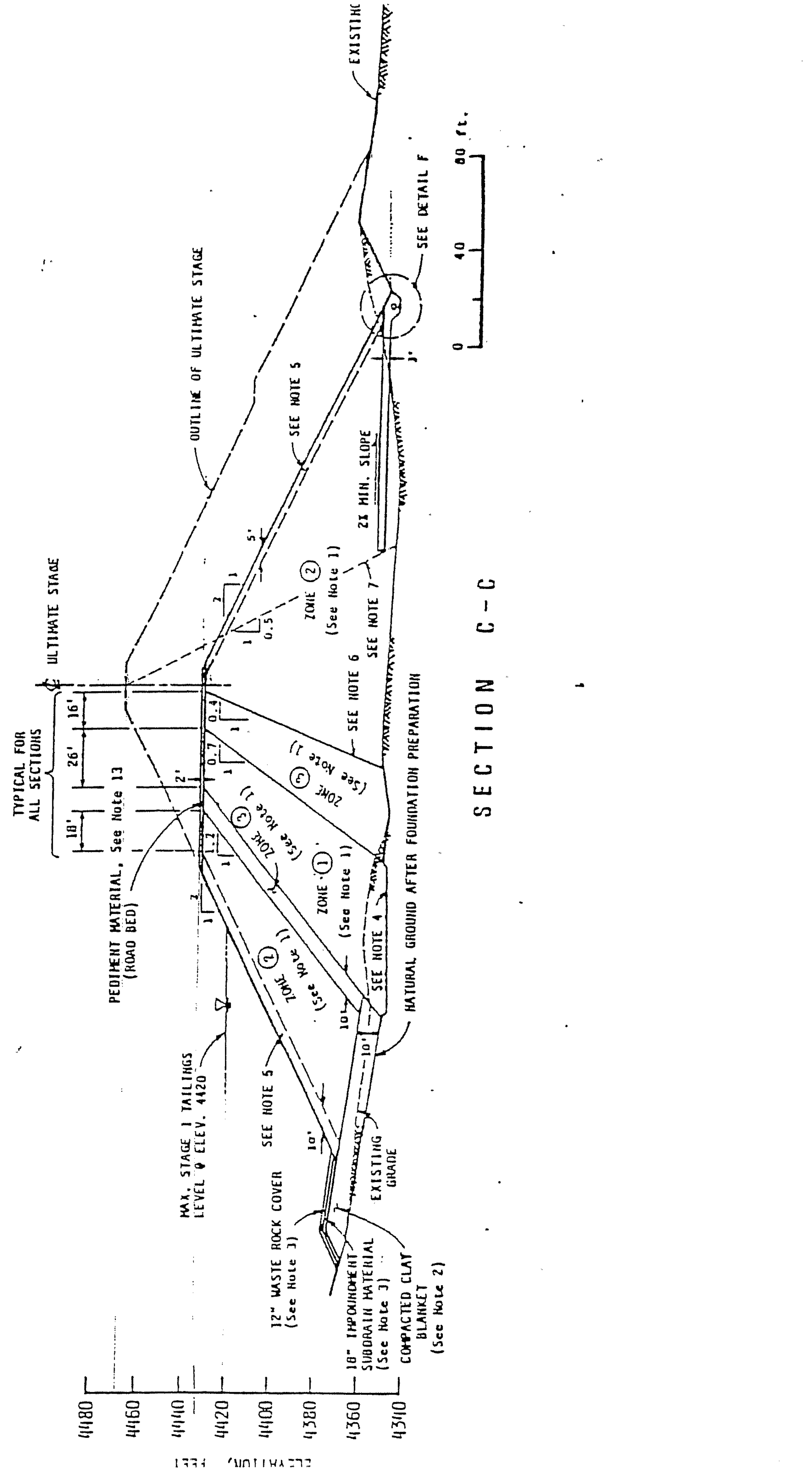

SECTION C – C
EXISTING
SEE DETAIL F
0
40
80 ft.
OUTLINE OF ULTIMATE STAGE
SEE NOTE 5
ULTIMATE STAGE
TYPICAL FOR ALL SECTIONS
16'
26'
18'
2'
5'
3'
2% MIN. SLOPE
ZONE ② (See Note 1)
SEE NOTE 7
SEE NOTE 6
ZONE ③ (See Note 1)
ZONE ① (See Note 1)
ZONE ② (See Note 1)
SEE NOTE 4
NATURAL GROUND AFTER FOUNDATION PREPARATION
PEDIMENT MATERIAL, See Note 13 (ROAD BED)
MAX. STAGE 1 TAILINGS LEVEL @ ELEV. 4420
SEE NOTE 5
10'
EXISTING GRADE
12" WASTE ROCK COVER (See Note 3)
18" IMPOUNDMENT SUBDRAIN MATERIAL (See Note 3)
COMPACTED CLAY BLANKET (See Note 2)
4480
4460
4440
4420
4400
4380
4360
4340
ELEVATION, FEET

EXHIBIT B - SOIL PROPERTIES

Table C-1 from May 1979 Stage I - Tailings Impoundment and Dam Final Design Report, and November 13, 1980 letter regarding State I Tailings Impoundment and Dam Field Density Test in Zone 2 Material

TABLE C-1

SOIL PROPERTIES USED IN STABILITY ANALYSES

Material	Soil Number (Figure D-3)	Unit Weight (pcf)	Effective Strength Parameters C'(psf)	Effective Strength Parameters Ø'(°)	Total Strength Parameter C(psf)	Total Strength Parameter Ø(°)
Zone 1*	1	125	0	26 (1)	900 (2) 2200 (4) 1500 (5)	13 (2) 0 (4) 0 (5)
Zone 2 (3)	2	125	0	40	-	-
Zone 3 (3)	3	125	0	32	-	-
Clay Blanket*	1	125	0	26 (1)	900 (2) 2200 (4) 1500 (5)	13 (2) 0 (4) 0 (5)
Tailings (3)	5	100	0	10	-	-
Rock Foundation (3)	4	140	1000	45	-	-

(1) Parameters for operating conditions - static condition

(2) Parameters for end of construction - static condition

(3) Effective strength parameters for these materials apply to all conditions

(4) Parameters for end of construction - seismic condition

(5) Parameters for operating conditions - seismic condition

* Estimates strength values to be confirmed and presented with additional stability analyses in supplemental report to be submitted by June 5, 1979.

Three Embarcadero Center, Suite 700
San Francisco, California 94111
415-956-7070

Woodward-Clyde Consultants

November 13, 1980

Project: 60255N

Plateau Resources Limited
772 Horizon Drive
Grand Junction, Colorado 81501

Attention: Mr. U.K. Gupta

Gentlemen:

STAGE 1 TAILINGS IMPOUNDMENT AND DAM
FIELD DENSITY TEST IN ZONE 2 MATERIAL
SHOOTERING CANYON URANIUM PROJECT
Garfield County, Utah

As required in Amendment No. 1 to the Source Material License SUA 1371, and as discussed during the NRC site inspection on November 5, 1980, a field density test is required in the Zone 2 material for every 50,000 cubic yards of Zone 2 material placed. Because of the wide range of grain sizes, the conventional testing being used for Zone 1 and 3 is not applicable. The first test was completed on November 6, 1980, and the results show that the Zone 2 material is being compacted to a dry density of 131 pcf. This value is well above the estimated 125 pcf used in the stability analysis for the dam (WCC Report, May, 1979), hence stability being achieved is well in excess of the minimium requirements.

Attached is a copy of the test procedures for the field density test discussed above. These procedures will also apply to the remaining density tests to be performed in the Zone 2 material. The total time required to complete the field portion of the test is about 1-1/2 hours provided all of the necessary equipment and labor is present at the onset of the test.

Plateau Resources Limited
November 13, 1980
Page Two

If you have any questions concerning the contents of this letter, please contact Mr. Bernard Gordon or the undersigned.

Sincerely yours,

Don A. Poulter
Staff Engineer

sme

Enclosure

cc: w/Enclosure
Bill Luhrs (PRL)
PRL Field File
(c/o S. Ankrum)
R. Duncan (Garco)
D. Rose (Garco)
D. Staton (MSME)
M Brown (MSME)

ZONE 2 FILL DENSITY TESTS PROCEDURES

SHOOTERING CANYON URANIUM PROJECT

Garfield County, Utah

---

1) Select a representative area approximately six to seven feet square. The area should be approximately level or require only minimal grading.

2) Excavate a pit approximately 6ft. x 6ft. x 3ft. The corners and bottom may be rounded. As the material is excavated, carefully load it into a clean, empty truck making sure that no material is wasted or lost.

3) Trim the loose material off the sides and bottom of the pit by hand. Place this material into the truck making sure that no material is wasted or lost.

4) After all of the material has been loaded into the truck, weigh the loaded truck on calibrated scales (±10 lbs. is desired); dump the material and weigh the truck empty. If the scales are not on site, the material should be covered with a tarp to minimize moisture evaporation during travel.

5) After weighing, collect a sample (approx. 2-1/2 lbs.) of the finer material (minus 2 inch) and determine its moisture content. The sample should be representative and not contain material reduced in moisture from evaporation.

6) Line the excavated pit with a flexible sheet of plastic, approximately 10 mils thick. The linear should be loosely fitted so that it may conform to the sides of the pit as it is filled with water. The plastic should overlap the top by two or three feet.

7) Using a calibrated meter or calibrated container, carefully fill the pit with a measured volume of water. Once the water level reaches the top of the pit, stop the test and record the volume of water placed in the pit. If the top of the pit is not level, measure the unfilled portion and determine its volume. (For this reason, it is best to excavate a square or rectangular pit).

SHOOTERING CANYON URANIUM PROJECT

(Continued)

---

8) After the test is completed and all of the data are recorded, empty the pit by pumping out the water, and discharge it into an area that will not adversely affect the construction or performance of the dam.

9) Backfill test pit to original grade with material recompacted to same density.

10) Calculate the density of compacted Zone 2 material, using the attached form. A copy of the completed test form should be sent to WCC.

FIELD DENSITY TEST

ZONE 2 MATERIAL

SHOOTERING CANYON URANIUM PROJECT

Garfield County, Utah

Test No: Date:

Tested by:

Supervisor(s) Present:

Weight of Truck plus Material:

Weight of Empty Truck:

Weight of Excavated Material:

Wet Weight of Moisture Sample:

Dry Weight of Moisture Sample:

Moisture Content:

Gallons of Water:

Volume of Water:

Volume of Unfilled Portion of Pit:

Total Volume of Pit:

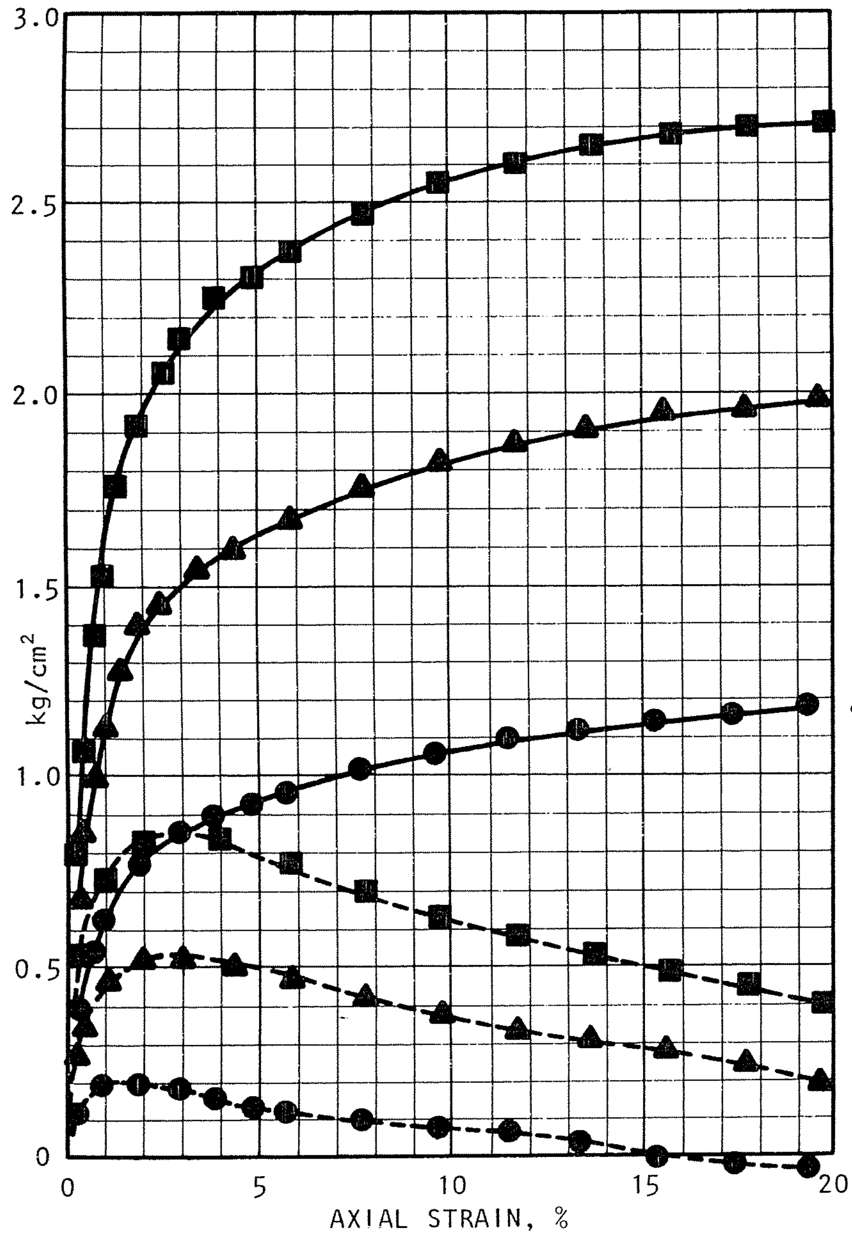
Dry Density:

Calculations:

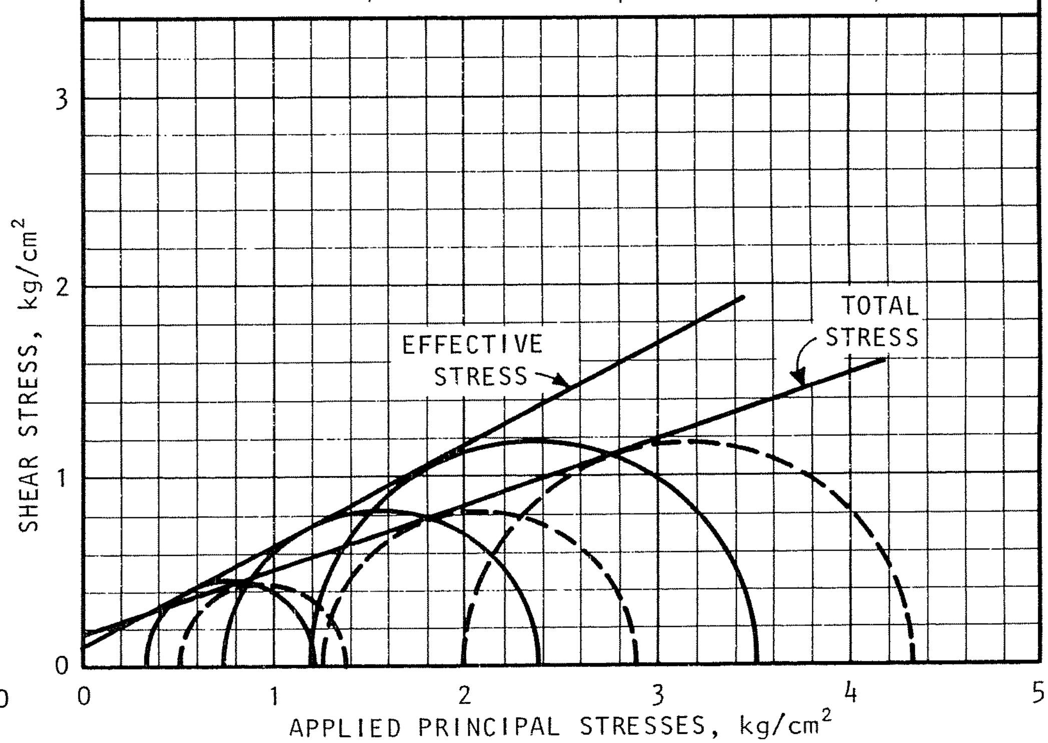
SPECIMEN: BORROW AREA GA - Sample No. 1
TYPE OF SPECIMEN: REMOLDED
TYPE OF TEST: CONSOLIDATED - UNDRAINED

SPECIMEN AND SYMBOL	INITIAL MOISTURE CONTENT (%)	INITIAL DRY DENSITY (pcf)	CONFINING PRESSURE (tsf)	DEVIATOR STRESS AT FAILURE (tsf)	PORE PRESSURE AT FAILURE (tsf)
(●)	27.5	93.5	0.50	0.87	0.16
(▲)	27.5	93.5	1.25	1.63	0.48
(■)	27.5	93.5	2.00	2.31	0.80

$c' = 0.10$ tsf $\phi' = 27.1°$ $c_T = 0.19$ tsf $\phi_T = 21.2°$



KEY:
—— DEVIATOR STRESS, $\sigma_1 - \sigma_3$
– – – PORE WATER PRESSURE, u



KEY:
—— EFFECTIVE STRESS
– – – TOTAL STRESS

Project No. 60255N

Woodward-Clyde Consultants

TRIAXIAL COMPRESSION TEST

PRL - SHOOTERING CANYON URANIUM PROJECT

Figure 1

EXHIBIT C - SEISMIC HAZARD ANALYSIS

Referenced section from June 26, 1994 Seismic Hazard Analysis of Title II Reclamation Plans", by Lawrence Livermore National Laboratory larger M~5.8 event, we use the median estimate to account for its much lower probability of occurring. This leads to an estimate for PGA of 0.19g.

Fault 2

Fault 2 trends northwest hence it is favorably oriented with the stress field. The fault is approximately 10 km long. If the entire fault ruptured in a single event this could lead to a M~6.25 earthquake. If we assume only one-half of the fault ruptures, this leads to a M~5.9 earthquake. The fault is approximately 13 km from the site. The 1-sigma estimate for PGA at the site from a M~5.9 earthquake located on what we have labeled fault 2 is 0.28g. Because of its lower probability of occurrence, we use the median estimate for M_u~6.25 which is 0.19g. The median estimate for a M~5.9 event is 0.16g.

Fault 3

This fault is almost due east of the site. The fault is listed as a possible Quaternary fault by Hecker (1993) and could have some seismicity associated with it. The fault trends northeast and hence not in the most likely direction for earthquakes. Thus it is not a likely candidate for earthquakes. However, it is included in the analysis for completeness. The fault has a length of approximately 23 km and lies approximately 35 km from the site. If we assume the entire fault ruptured, this would give rise to a 6.7 earthquake. This is larger than might be expected, at least based on the historical record. However, as we pointed out in the methodology section, it is not clear that the historical record gives a good indication of the largest event that could occur because we expect that the largest possible event would be a characteristic earthquake governed by its own characteristic return interval. If we use a distance of 35 km and M = 6.7 in the Joyner - Boore model, we get 1-sigma estimate of 0.14g.

Random Earthquake Analysis

Based on the geology and pattern of seismicity around the Plateau Resources site, we selected a source zone which seemed reasonable to use to develop our recurrence model. As described in the methodology section we applied Stepp's method to try and determine the completeness of the earthquake catalog. There is no data in the catalog before 1963 for the selected zone. Stepp's method indicated that the catalog was reasonably complete for events of about magnitude 3 for the last 10 to fifteen years. The smaller events did not appear to be complete. Fig. 7.17 shows the data for the last 30 years. Also shown is the truncated exponential model that we use with $M_u = 5.75$. The model appears to fit the data reasonably well. The simple Richter form of the model normalized to a per year basis is

$$\log N = 2.43 - 0.92M$$

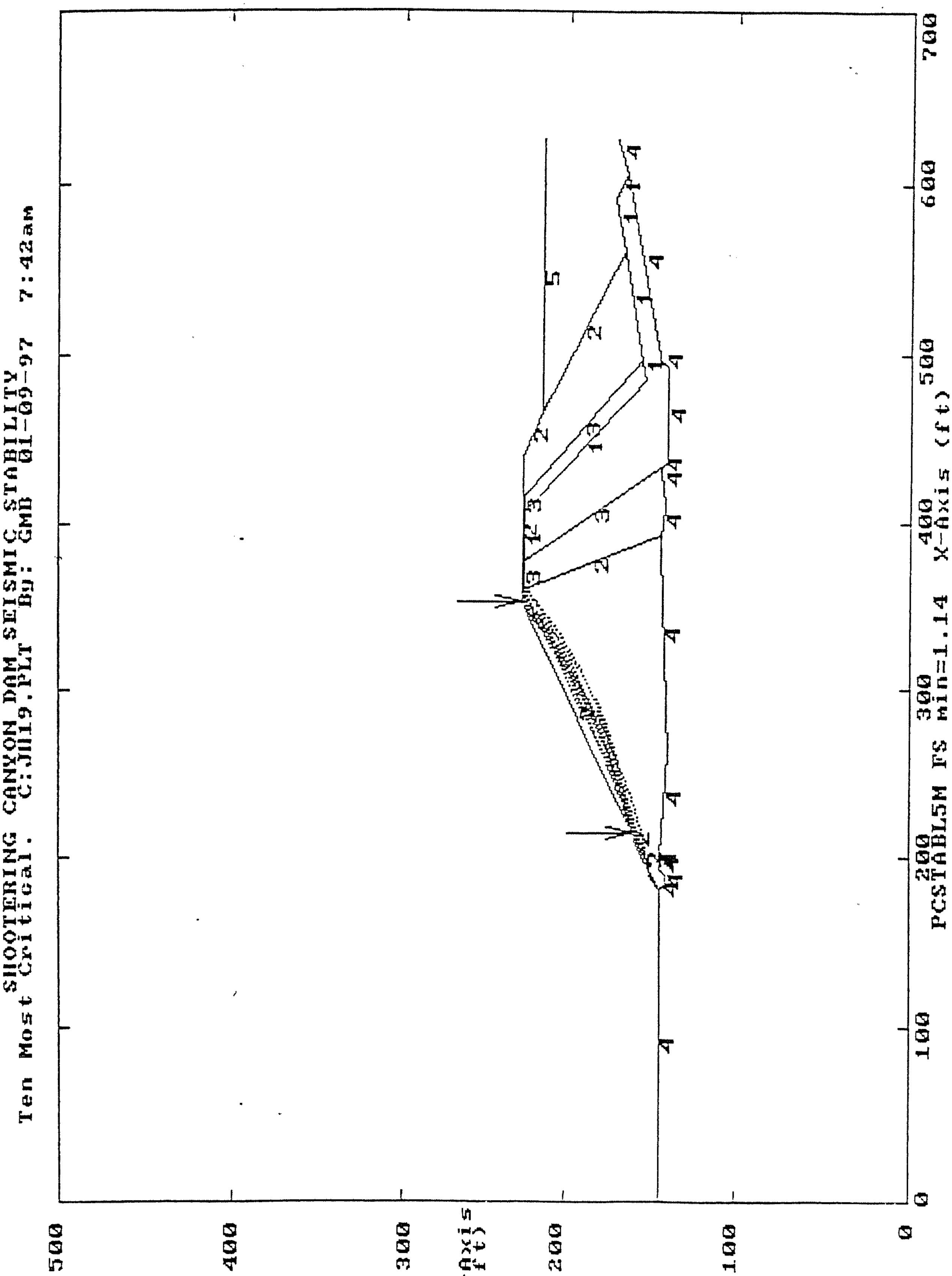
We used this recurrence model to develop the seismic hazard for the region around the Plateau Resources site as outlined in our methodology section. Fig. 7.18 gives the hazard curves for values of M_u = 5.5, 5.75, 6.25, and 7. We see from the hazard curves that at a PE level of 10^{-4} the PGA varies between 0.17g to 0.24g. As there are no major faults in the vicinity of the site our preferred choice for M_u is 5.75. This leads to 0.19g estimate for the ground motion at the site from the random earthquake at a PE level of 10^{-4}. At a PE level of 5×10^{-4} the PGA varies between 0.08g to 0.12g depending upon the choice of M_u with a value of 0.09g at $M_u = 5.75$.

7.8.5 Conclusions

There appear to be no faults through the site that could cause problems. Our deterministic analysis lead to an estimate for PGA of 0.16g to 0.3g. The random earthquake analysis gives a lower estimate of 0.17 g to 0.24 g. There is a possibility of a larger earthquake in the vicinity of the site, which is included in the analysis for random earthquakes, however the likelihood is sufficiently low that in our opinion the M~5.5 earthquake meets our criteria.

EXHIBIT D - STABILITY ANALYSIS RESULTS

Input and Plot Files for the PCSTABL Critical Failure SurfacE


SHOOTERING CANYON DAM SEISMIC STABILITY
Ten Most Critical. C:JH119.PLT By: GMB 01-09-97 7:42am
PCSTABL5M FS min=1.14
X-Axis (ft)
Y-Axis (ft)
0
100
200
300
400
500
600
700

```
PROFIL          C:JU19.IN   PCSTABL Version 5M
SHOOTERING CANYON DAM SEISMIC STABILITY
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214. 160. 353. 228. 2
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440. 228. 466. 216. 2
466. 216. 626. 216. 5
466. 216. 562. 167. 2
562. 167. 593. 173. 1
593. 173. 607. 165. 1
607. 165. 626. 171. 4
360. 226. 377. 226. 3
377. 226. 406. 226. 1
406. 226. 416. 226. 3
416. 226. 498. 156. 3
498. 156. 562. 167. 1
406. 226. 485. 154. 1
485. 154. 498. 156. 1
377. 226. 433. 144. 3
360. 226. 392. 145. 2
181. 145. 184. 141. 4
184. 141. 190. 141. 4
190. 141. 195. 144. 4
195. 144. 204. 144. 4
204. 144. 268. 140. 4
268. 140. 392. 145. 4
392. 145. 412. 142. 4
412. 142. 433. 144. 4
433. 144. 437. 141. 4
437. 141. 492. 141. 4
492. 141. 495. 145. 4
495. 145. 607. 165. 4
607. 165. 626. 171. 4
SOIL
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125. 125. 0. 32. 0. 0. 0
140. 140. 1000. 45. 0. 0. 0
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EQUAKE
0.19 0. 0.
CIRCLE-Janbu circular, search.
0
20 20
175. 225. 350. 400. 10. 25. 0. 0.
```

A.2 Seismic Stability Analysis, Letter Report
by Inberg-Miller Engineers, December 11, 1997

RECEIVED DEC 12 1997

INBERG-MILLER ENGINEERS

124 EAST MAIN STREET RIVERTON, WYOMING 82501-4397 307-856-8136

December 11, 1997 7664-RX

U.S. Energy
877 North 8th West
Riverton, Wyoming 82501

ATTENTION: DAN ARIMA

SUPPLEMENTAL SEISMIC STABILITY ANALYSIS
STAGE I - SHOOTARING CANYON DAM
GARFIELD COUNTY, UTAH

Gentlemen:

This letter supplements our January 9, 1997 letter with regard to seismic stability analysis for Stage I of the Shootaring Canyon Dam. Soil strength parameters for Zone 1 (dam core) and impounded tailings were revised based on additional information provided by U.S. Energy.

Zone 1 soil used in the analysis presented in our January 9, 1997 letter was based on Table C-1 in the May 1979 Stage I - Tailings Impoundment and Dam Final Design Report. However, the strength parameters were subject to confirmation as noted on Table C-1. U.S. Energy provided test data which was contained in a June 12, 1979 letter from their consultant, Woodward-Clyde Consultants, which presented confirmation. The test data presents soil strength parameters based on consolidated-undrained shear testing for two Zone 1 soil borrow areas (H and I). A copy of the referenced test data is contained in Attachment A to this letter. Total strength parameters were used for seismic analysis. Total strength parameters for Zone 1 changed from the Table C-1 values as indicated below:

		Soil Strength Parameter Confirmation (Woodward-Clyde, June 12, 1979 Letter)	
	Table C-1	Borrow Area H	Borrow Area I
Cohesive Strength	1500 psf	400 psf	400 psf
Friction Angle	0	16.7°	18.4°

We used Borrow Area H strength parameters for this supplemental analysis since they are more conservative. We also revised the strength of impounded tailings for our analysis. Impounded tailings were modeled without any shear strength to consider conservative limit conditions. All other parameters, including the horizontal seismic coefficient of 0.19g, remained unchanged.

The results of seismic stability analysis were unchanged from our previous report. The critical faliure surface indicates a shallow slide-plane which does not intersect either Zone 1 soil (dam core) or impounded tailings. A copy of PCSTABL input, output, and plot files are contained in Attachment B.

We are pleased to be of continued service to you on this project. Please feel free to call if you have any questions.

Sincerely,

INBERG-MILLER ENGINEERS

Glen M. Bobnick, P.E.
Geotechnical Engineer

GMB:jlw:gd\7664rx

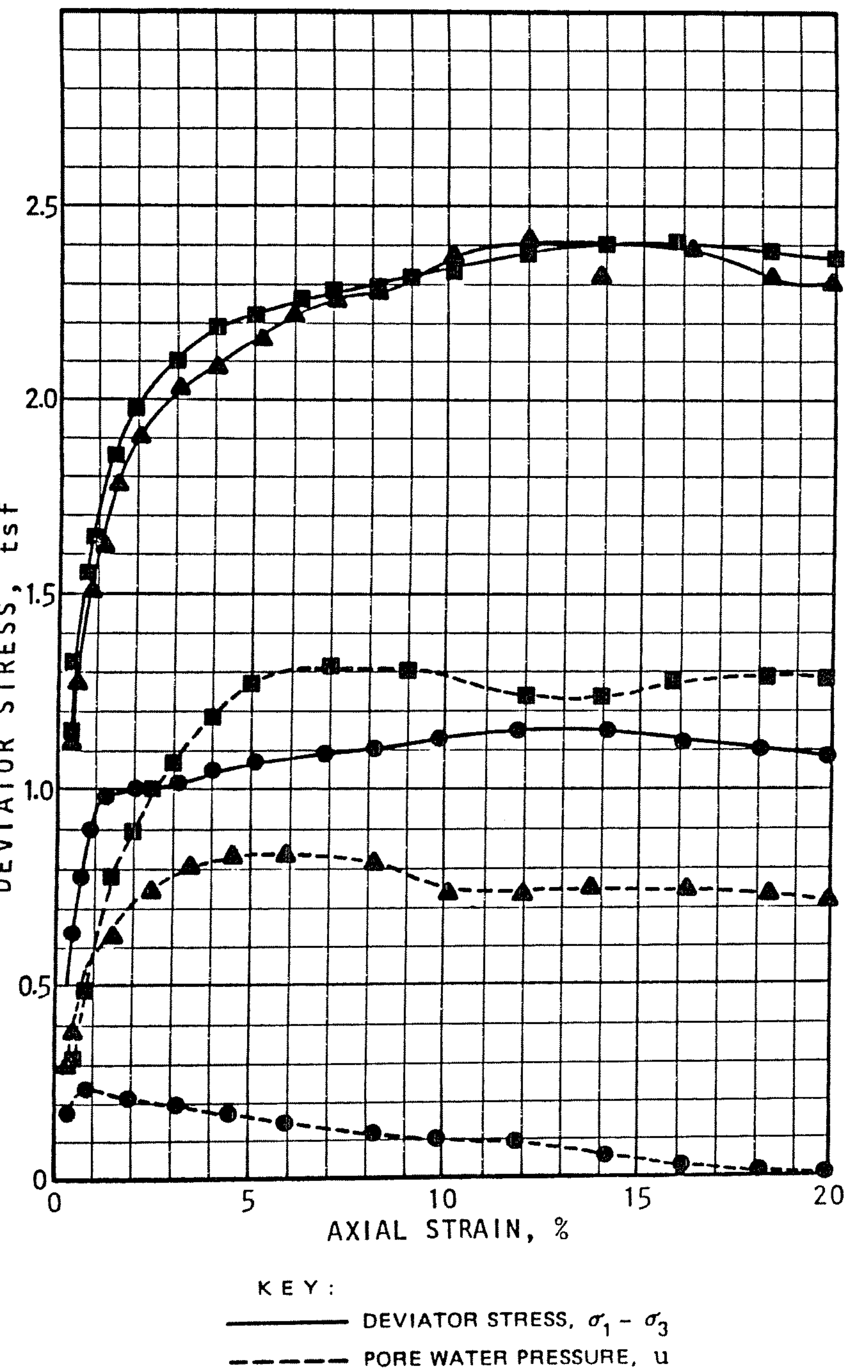
Attachment A: June 12, 1979 Woodward-Clyde Consultants Shear Strength Test Data
Attachment B: PCSTABL Input, Ouput, and Plot Files

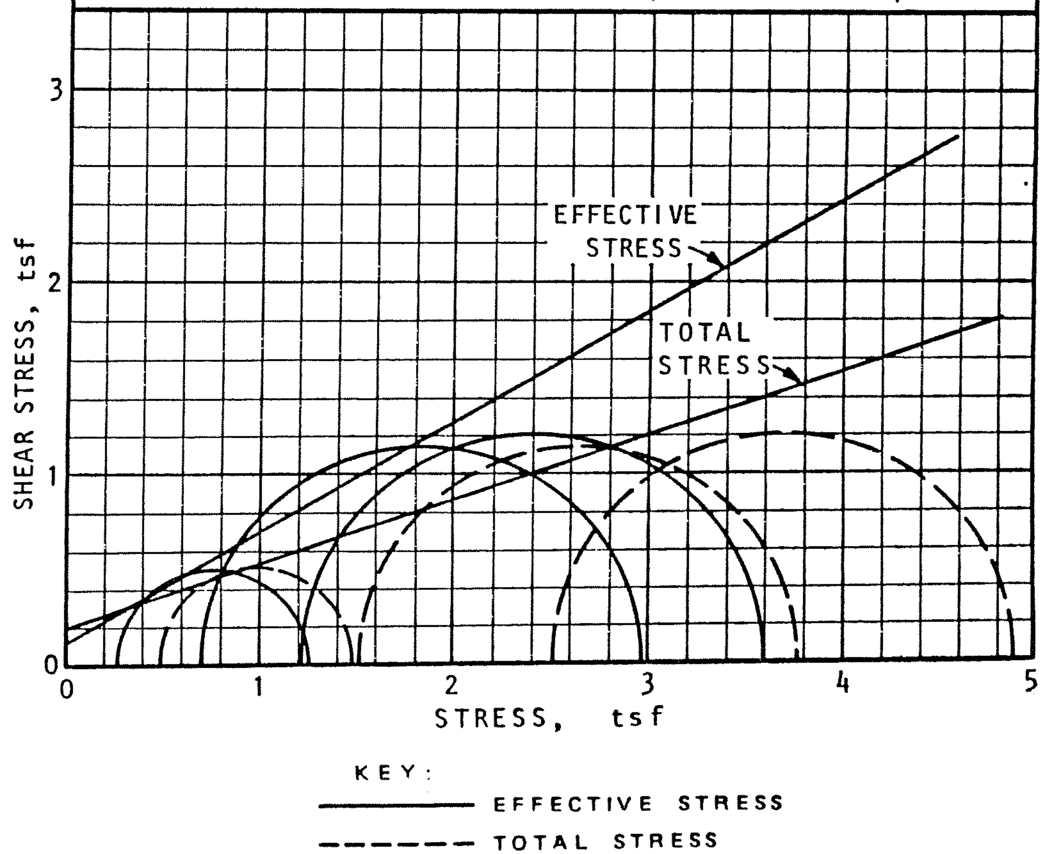
ATTACHMENT A
June 12, 1979 Woodward-Clyde Consultants
Shear Strength Test Data

SPECIMEN: Borrow Area H - Sample #1
TYPE OF SPECIMEN: Remolded
TYPE OF TEST: Consolidated-Undrained

SPECIMEN AND SYMBOL	INITIAL MOISTURE CONTENT (%)	INITIAL DRY DENSITY (pcf)	CONFINING PRESSURE (tsf)	DEVIATOR STRESS AT FAILURE (tsf)	PORE PRESSURE AT FAILURE (tsf)
1 (●)	35	83	0.5	0.97	0.23
2 (▲)	35	83	1.5	2.28	0.81
3 (■)	35	83	2.5	2.39	1.28

$c' = 0.10$ tsf $\phi' = 29.7°$ $c_T = 0.2$ tsf $\phi_T = 18.4°$

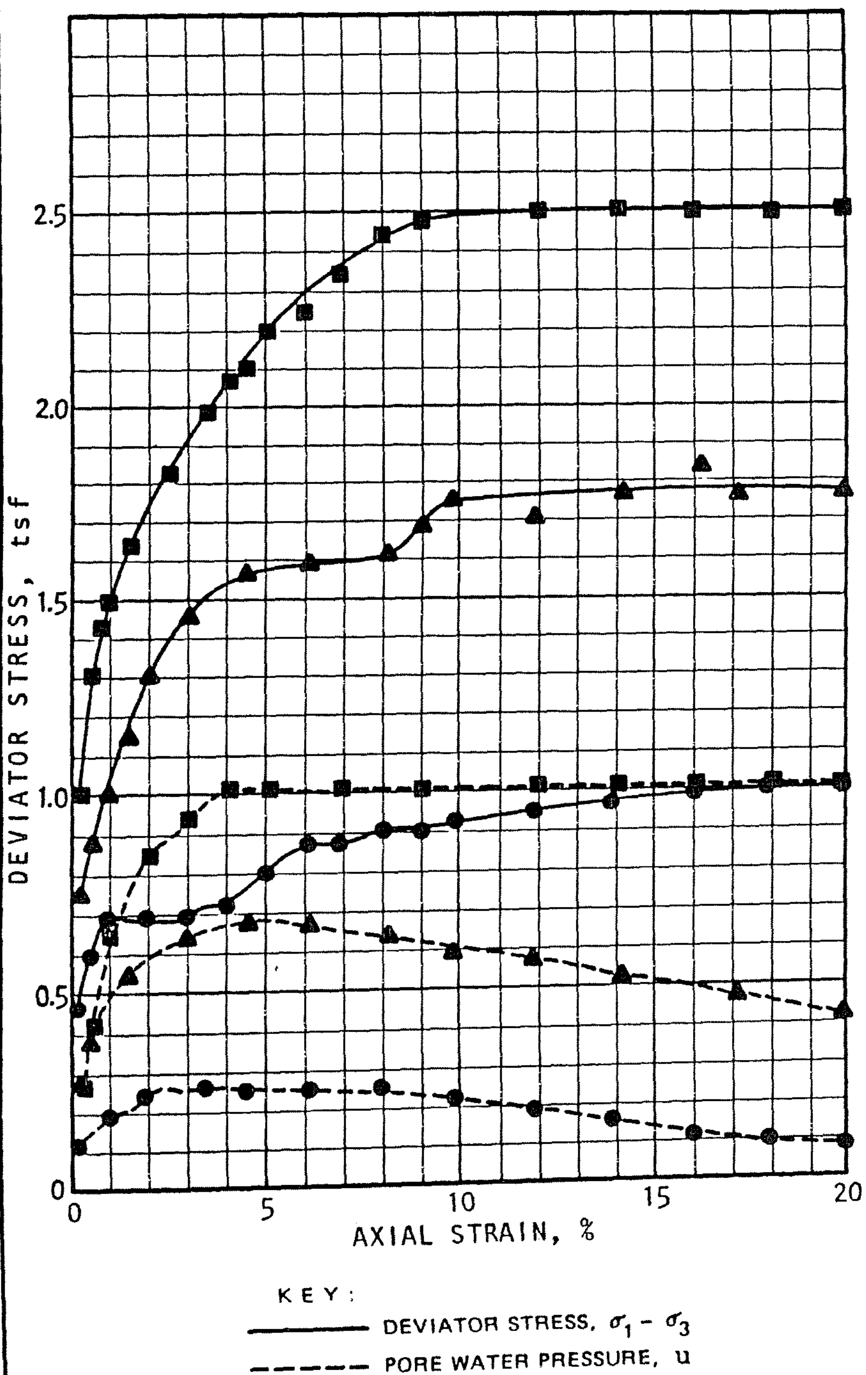




Project No. 60255J
Woodward-Clyde Consultants

TRIAXIAL COMPRESSION TEST
PRL - SHOOTERING CANYON URANIUM PROJECT

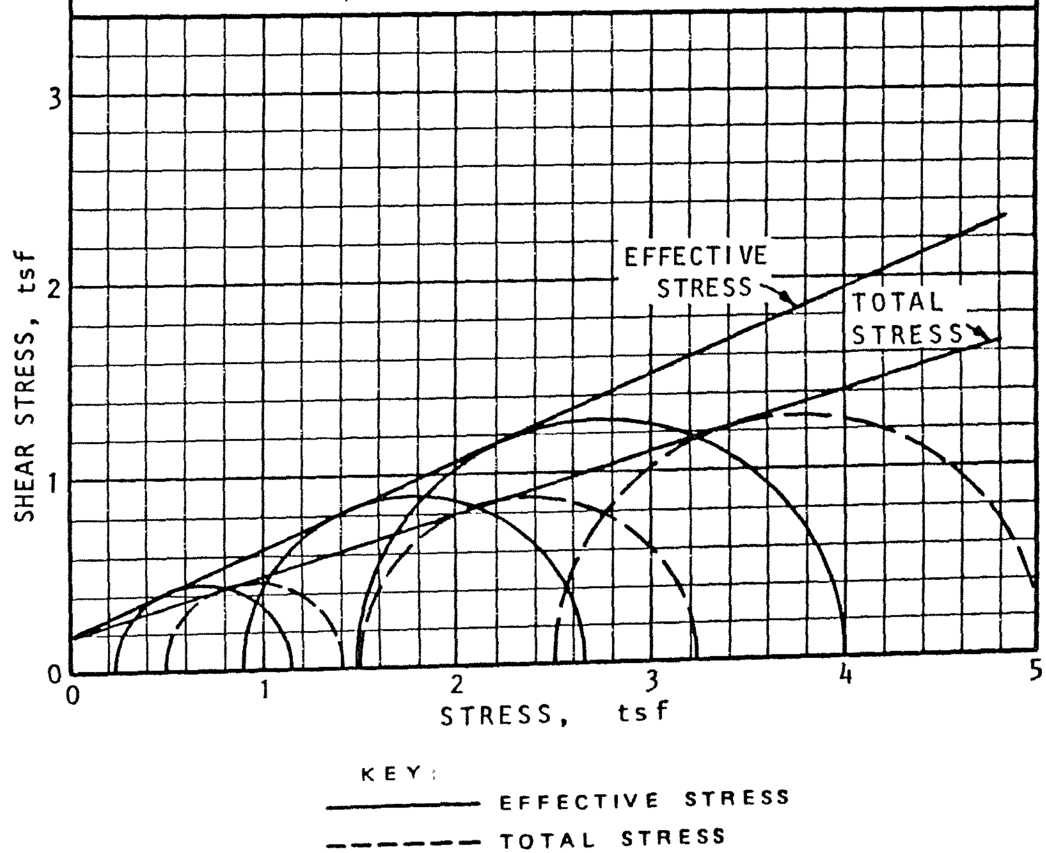
Figure 3



SPECIMEN: Borrow Area I - Sample #1
TYPE OF SPECIMEN: Remolded
TYPE OF TEST: Consolidated-Undrained

SPECIMEN AND SYMBOL	INITIAL MOISTURE CONTENT (%)	INITIAL DRY DENSITY (pcf)	CONFINING PRESSURE (tsf)	DEVIATOR STRESS AT FAILURE (tsf)	PORE PRESSURE AT FAILURE (tsf)
1 (●)	22	98	0.25	0.91	0.25
2 (▲)	22	98	0.91	1.74	0.59
3 (■)	22	98	1.48	2.52	1.02

$c' = 0.2$ tsf $\phi' = 23.6°$ $c_T = 0.2$ tsf $\phi_T = 16.7°$



Project No. 60255J **Woodward-Clyde Consultants**	TRIAXIAL COMPRESSION TEST PRL - SHOOTERING CANYON URANIUM PROJECT	Figure 4

ATTACHMENT B

PCSTABL Input, Ouput, and Plot Files

```
PROFIL        C:JU19REV.IN   PCSTABL Version 5M
SHOOTERING CANYON DAM SEISMIC STABILITY
33 7
0. 145. 181. 145. 4
181. 145. 211. 160. 2
211. 160. 214. 160. 2
214. 160. 353. 228. 2
353. 228. 440. 228. 2
440. 228. 466. 216. 2
466. 216. 626. 216. 5
466. 216. 562. 167. 2
562. 167. 593. 173. 1
593. 173. 607. 165. 1
607. 165. 626. 171. 4
360. 226. 377. 226. 3
377. 226. 406. 226. 1
406. 226. 416. 226. 3
416. 226. 498. 156. 3
498. 156. 562. 167. 1
406. 226. 485. 154. 1
485. 154. 498. 156. 1
377. 226. 433. 144. 3
360. 226. 392. 145. 2
181. 145. 184. 141. 4
184. 141. 190. 141. 4
190. 141. 195. 144. 4
195. 144. 204. 144. 4
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392. 145. 412. 142. 4
412. 142. 433. 144. 4
433. 144. 437. 141. 4
437. 141. 492. 141. 4
492. 141. 495. 145. 4
495. 145. 607. 165. 4
607. 165. 626. 171. 4
SOIL
5
125. 125. 400. 16.7 0. 0. 0
131. 131. 0. 40. 0. 0. 0
125. 125. 0. 32. 0. 0. 0
140. 140. 1000. 45. 0. 0. 0
```

```
100. 100. 0. 0. 0. 0. 0
EQUAKE
0.19 0. 0.
CIRCLE-Janbu circular, search.
0
20 20
175. 225. 350. 400. 10. 25. 0. 0.
```

** PCSTABL5M **

by
Purdue University

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer's Method of Slices

Run Date: 12-04-97
Time of Run: 3:13pm
Run By: GMB
Input Data Filename: C:JU19REV.IN
Output Filename: C:JU19REV.OUT
Plotted Output Filename: C:JU19REV.PLT

PROBLEM DESCRIPTION SHOOTERING CANYON DAM SEISMIC STABILITY

BOUNDARY COORDINATES

7 Top Boundaries
33 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	145.00	181.00	145.00	4
2	181.00	145.00	211.00	160.00	2
3	211.00	160.00	214.00	160.00	2
4	214.00	160.00	353.00	228.00	2
5	353.00	228.00	440.00	228.00	2
6	440.00	228.00	465.00	216.00	2

7	466.00	216.00	626.00	216.00	5
8	466.00	216.00	562.00	167.00	2
9	562.00	167.00	593.00	173.00	1
10	593.00	173.00	607.00	165.00	1
11	607.00	165.00	626.00	171.00	4
12	360.00	226.00	377.00	226.00	3
13	377.00	226.00	406.00	226.00	1
14	406.00	226.00	416.00	226.00	3
15	416.00	226.00	498.00	156.00	3
16	498.00	156.00	562.00	167.00	1
17	406.00	226.00	485.00	154.00	1
18	485.00	154.00	498.00	156.00	1
19	377.00	226.00	433.00	144.00	3
20	360.00	226.00	392.00	145.00	2
21	181.00	145.00	184.00	141.00	4
22	184.00	141.00	190.00	141.00	4
23	190.00	141.00	195.00	144.00	4
24	195.00	144.00	204.00	144.00	4
25	204.00	144.00	268.00	140.00	4
26	268.00	140.00	392.00	145.00	4
27	392.00	145.00	412.00	142.00	4
28	412.00	142.00	433.00	144.00	4
29	433.00	144.00	437.00	141.00	4
30	437.00	141.00	492.00	141.00	4
31	492.00	141.00	495.00	145.00	4
32	495.00	145.00	607.00	165.00	4
33	607.00	165.00	626.00	171.00	4

ISOTROPIC SOIL PARAMETERS

5 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	125.0	125.0	400.0	16.7	.00	.0	0
2	131.0	131.0	.0	40.0	.00	.0	0

3	125.0	125.0	.0	32.0	.00	.0	0
4	140.0	140.0	1000.0	45.0	.00	.0	0
5	100.0	100.0	.0	.0	.00	.0	0

A Horizontal Earthquake Loading Coefficient
Of .190 Has Been Assigned

A Vertical Earthquake Loading Coefficient
Of .000 Has Been Assigned

Cavitation Pressure = .0 psf

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.

400 Trial Surfaces Have Been Generated.

20 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 175.00 ft.
and X = 225.00 ft.

Each Surface Terminates Between X = 350.00 ft.
and X = 400.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 10.00 ft.

25.00 ft. Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial

Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Janbu Method * *

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	214.47	160.23
2	238.61	166.73
3	262.22	174.98
4	285.15	184.92
5	307.30	196.51
6	328.55	209.69
7	348.78	224.38
8	353.07	228.00

*** 1.139 ***

Individual data on the 8 slices

ce .	Width Ft(m)	Weight Lbs(kg)	Water Force Top Lbs(kg)	Water Force Bot Lbs(kg)	Tie Force Norm Lbs(kg)	Tie Force Tan Lbs(kg)	Earthquake Force Hor Lbs(kg)	Earthquake Force Ver Lbs(kg)	Surcharge Load Lbs(kg)
	24.1	8394.5	.0	.0	.0	.0	1595.0	.0	.0
	23.6	21519.1	.0	.0	.0	.0	4088.6	.0	.0
	22.9	27793.8	.0	.0	.0	.0	5280.8	.0	.0
	22.2	27600.5	.0	.0	.0	.0	5244.1	.0	.0
	21.2	21553.8	.0	.0	.0	.0	4095.2	.0	.0
	20.2	10494.4	.0	.0	.0	.0	1992.0	.0	.0

4.2	448.1	.0	.0	.0	.0	85.1	.0	.0
.1	.3	.0	.0	.0	.0	.1	.0	.0

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	198.68	153.84
2	222.31	162.01
3	245.65	170.99
4	268.66	180.75
5	291.32	191.30
6	313.62	202.62
7	335.51	214.69
8	356.98	227.50
9	357.75	228.00

*** 1.141 ***

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	198.68	153.84
2	222.86	160.20
3	246.63	167.94
4	269.92	177.03
5	292.65	187.45
6	314.74	199.15
7	336.12	212.10
8	356.73	226.27
9	358.96	228.00

*** 1.152 ***

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	188.16	148.58
2	212.58	153.92
3	236.56	161.00
4	259.96	169.78
5	282.68	180.22
6	304.59	192.25
7	325.58	205.84
8	345.54	220.90
9	353.67	228.00

*** 1.156 ***

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	198.68	153.84
2	223.06	159.40
3	247.00	166.61
4	270.39	175.44
5	293.12	185.85
6	315.09	197.78
7	336.19	211.18

8	356.33	226.00
9	358.69	228.00

*** 1.157 ***

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	185.53	147.26
2	208.88	156.20
3	232.05	165.57
4	255.05	175.38
5	277.86	185.61
6	300.47	196.28
7	322.88	207.36
8	345.07	218.87
9	361.91	228.00

*** 1.159 ***

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	182.90	145.95
2	206.44	154.34
3	229.78	163.30
4	252.90	172.81

5	275.79	182.87
6	298.43	193.48
7	320.81	204.63
8	342.91	216.30
9	363.82	228.00

*** 1.164 ***

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	217.11	161.52
2	241.85	165.06
3	266.05	171.33
4	289.41	180.25
5	311.62	191.72
6	332.43	205.58
7	351.56	221.68
8	357.56	228.00

*** 1.172 ***

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	214.47	163.23
2	238.71	166.35

3	262.54	173.93
4	285.86	182.93
5	308.60	193.32
6	330.67	205.07
7	351.98	218.13
8	366.09	228.00

*** 1.176 ***

Failure Surface Specified By 8 Coordinate Points

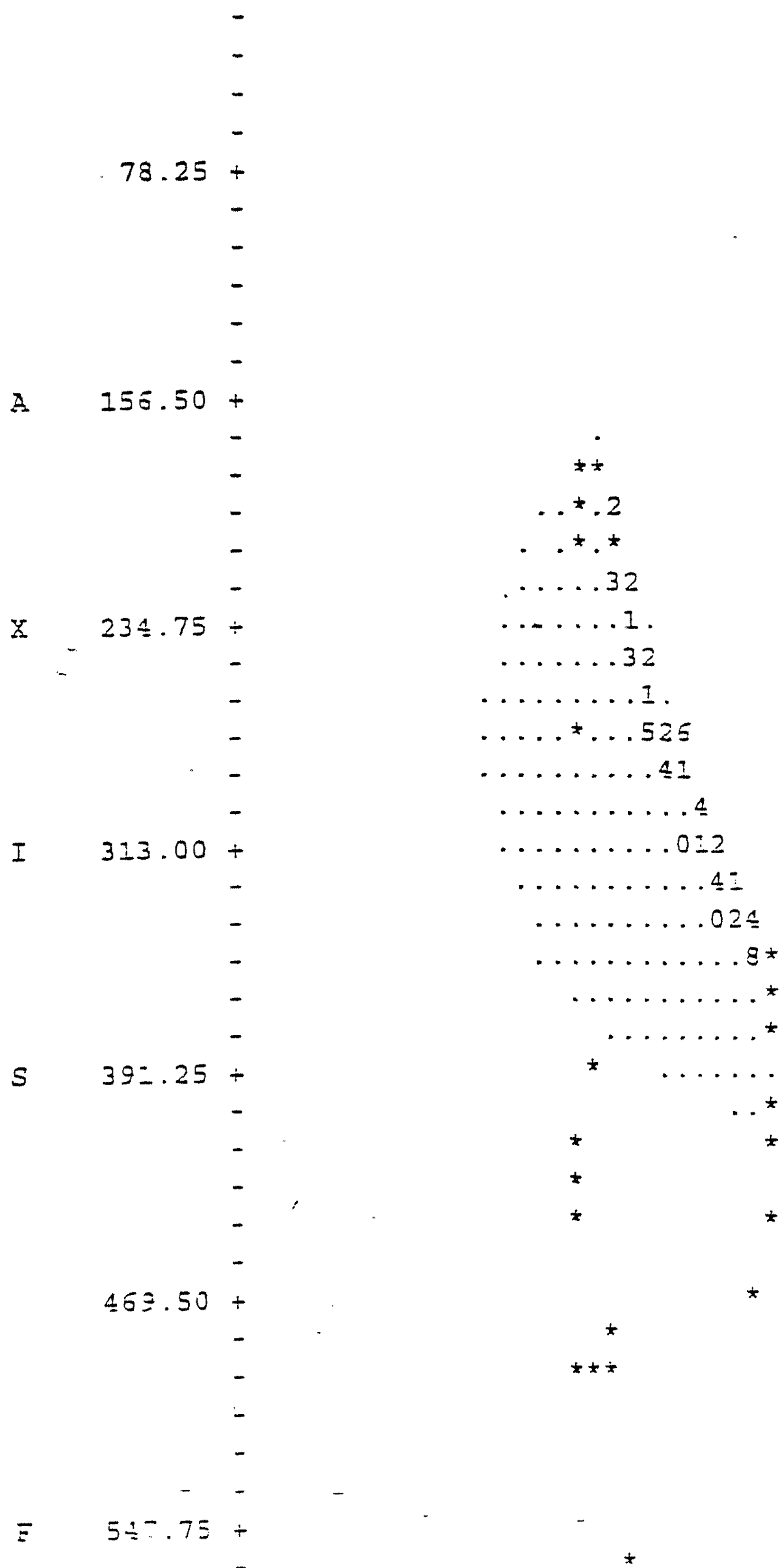
Point No.	X-Surf (ft)	Y-Surf (ft)
1	217.11	161.52
2	241.77	165.61
3	265.94	172.01
4	289.40	180.64
5	311.95	191.44
6	333.38	204.30
7	353.51	219.13
8	363.46	228.00

*** 1.182 ***

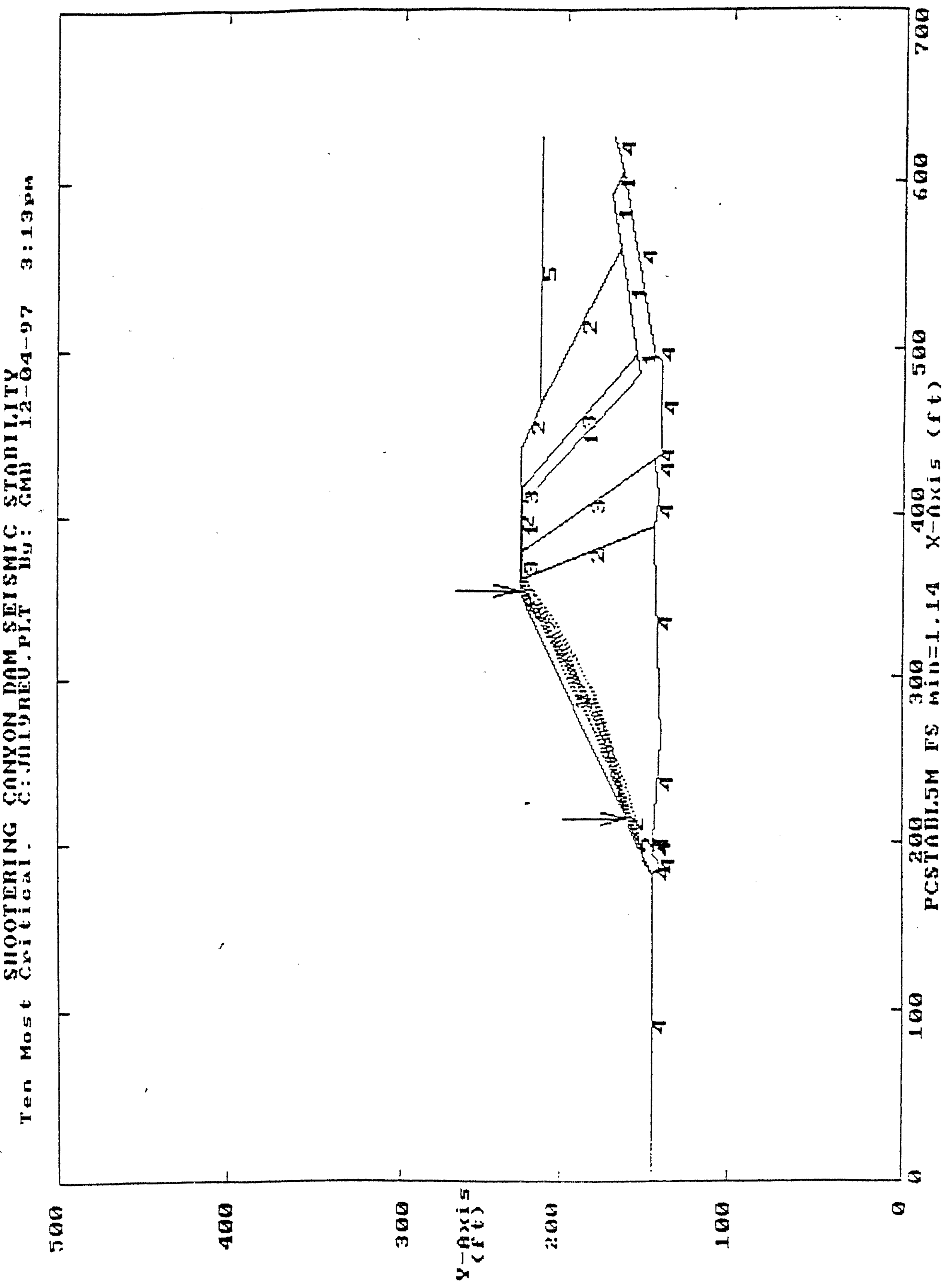
Y A X I S F T

.00 78.25 156.50 234.75 313.00 391.25

X .00 +---------+---------*+--------------------+-----------+


78.25
A 156.50
X 234.75
I 313.00
S 391.25
469.50
F 547.75

```
                   -                   *
                   -
                   -                  *
                   -
T       626.00     +                   *       *
```


SHOOTERING CANYON DAM SEISMIC STABILITY
Ten Most Critical. C:\JH19REU.PLT By: GMB 12-04-97 3:13pm
PCSTABL5M FS min=1.14
X-Axis (ft)
Y-Axis (ft)
0
100
200
300
400
500
600
700

A.3 Slope Stability Analysis Cross Valley Berm, Letter Report
by Inberg-Miller Engineers, June 14, 1999

INBERG-MILLER ENGINEERS
124 EAST MAIN STREET RIVERTON, WYOMING 82501-4397 307-856-8136

May 2, 1997
Revised June 14, 1999

7664-RX

U.S. Energy Corporation
877 N. 8th West
Riverton, Wyoming 82501

ATTENTION: FRED CRAFT

RE: SLOPE STABILITY ANALYSIS
CROSS VALLEY BERM
SHOOTARING CANYON URANIUM PROJECT, UTAH

Dear Sir:

This letter summarizes the results of a slope stability analysis that we performed for the Cross Valley Berm at the proposed Shootaring Canyon Uranium Project located in southeast Utah. A summary of project background, basis for analysis, slope stability analysis results, and recommendations for berm earthwork are presented herein.

BACKGROUND

Inberg-Miller Engineers performed a slope stability analysis for the existing sedimentation dam at the Shootaring Canyon Uranium Project, the results of which are contained in our January 9, 1997 letter report. You subsequently requested we also perform a slope stability analysis for an existing cross valley berm located upgradient of the sedimentation dam. We understand the cross valley berm is a temporary tailings impoundment which will ultimately be covered by tailings as the pool elevation rises behind the sedimentation dam.

We understand the cross valley berm was installed in about 1981. You provided an April 17, 1997 topographic map of the berm, a subsequent updated topographic berm map dated March 18, 1999 typical berm cross section, and a copy of compaction test dated for soil which comprises the berm. Based on information you provided, we understand the existing berm has the following geometry at maximum berm height:

Crest Elevation:	4448
Upstream Toe Elevation:	4430
Downstream Toe Elevation:	4408
Upstream Slope:	3 horizontal: 1 vertical
Downstream Slope:	Varies from 1.1: 1 at the toe to 3: 1 at the crest
Crest Width:	14 feet
Base Width:	145 feet

You indicated that the berm would be reworked to adjust the upstream and downstream slope to a minimum of 1 horizontal to 1 vertical. You also indicated that the crest elevation would be raised 10 feet. The downstream berm toe would remain at its current location to maintain an existing drainage system. The crest and upstream berm toe would be relocated upstream of the

BACKGROUND, Continued

current position to accommodate the increase in crest elevation. Reworking the slopes would involve removal of soil from the downstream slope and placement of fill on the upstream slope. An illustration of proposed berm modifications is presented in Attachment A.

BASIS FOR ANALYSIS

The basis for slope stability analysis includes analytical method, soil parameters, groundwater conditions, and seismic conditions. A discussion of each of these items follows.

Analytical Method

Slope stability analysis was performed using the computer program PCSTABL. The slope was analyzed using the Bishop and Janbu methods. The slope was modeled based on the proposed geometry (e.g. 10-foot higher crest elevation and 2:1 outslopes). We assumed the tailings pool is at the proposed crest elevation. Separate analyses were performed for static and seismic conditions. Refer to our January 9, 1997 report for further discussion of the basis for slope stability analysis.

Soil Parameters

According to information you provided, the berm is substantially comprised of compacted sand, similar to the material described as Zone 3 – Fine Sand modeled in the sedimentation dam analysis. We understand the sand was compacted to a minimum of 95% of the maximum density determined in accordance with ASTM D698. The berm is founded on compacted clay subgrade which is the same soil described as Zone 1 – Silty Sandy Clayey Soil used in the sedimentation dam analysis. Compacted clay is immediately underlain by native "rock foundation" which is the same material modeled in the sedimentation dam analysis. A topographic map and berm cross-section is presented in Attachment A. Based on the topographic maps you provided, the berm slopes are actually steeper than indicated on the cross-section. Actual slopes for the maximum section are described under the background section above. Soil numbers assigned to each of the units identified above are as follows:

Soil 1:	Sand
Soil 2:	Clay
Soil 3:	Rock Foundation
Soil 4:	Tailings

The soil properties used for sedimentation dam stability analysis as documented in our January 9, 1997 letter report also apply to the cross valley berm except for Soil 1. You provided Inberg-Miller Engineers with a sample of the sand representing Soil 1 and requested we perform a direct shear test to determine strength parameters. The sample was tested based on remolding

BASIS FOR ANALYSIS, Continued

Soil Parameters, Continued

specimens to 95% of the maximum dry density of 110.2 pounds per cubic foot as reported on the compaction test date you provided. Direct shear test results of Soil 1 are presented in Attachment B.

Engineering properties we used for this slope stability analysis are tabulated below.

Soil No.	Description	Moist Density (pcf)	Effective Friction Angle	Effective Cohesive Strength (psf)
1	Sand	115.0	38	0
2	Clay	125.0	0	1,500
3	Rock Foundation	140.0	45	1,000
4	Tailings	100.0	10	0

Groundwater Conditions

We understand that the impoundment will be lined with an HDPE liner, therefore, we have assumed for the analysis that no phreatic surface will develop through the berm.

Seismic Conditions

The basis for seismic conditions is the same as described in our January 9, 1997 letter report. In general, a horizontal seismic coefficient of 0.19g was used for this analysis.

RESULTS

Slope stability analysis that were performed using the Janbu method typically produced the lowest safety factors. We calculated a minimum safety factor of 1.02 for seismic conditions and 1.56 under static conditions. A copy of our PCSTABL input files and plots of the critical failure surfaces for static and seismic conditions is presented in Attachment C. Filenames are REMCVBEQ and REMCVB for seismic and static conditions, respectively.

RECOMMENDATIONS

You requested recommendations for fill placement on the upstream slope face which will provide soil conditions that would result in slope safety factors with at least the values estimated above. We anticipate a portion of the fill on the upstream slope will originate from cut on the

RECOMMENDATIONS, Continued

downstream slope and will consist of the Sand modeled as Soil 1. You indicated that other fill soil may be collected from areas located in the proposed impoundment area. Other fill soil could include clay, sand and rock. We recommend the following:

1) Separate fill soils as much as practical based on soil type and moisture condition. Clay, sand, and rock should not be mixed together. Soils with a moisture content over 3% plus or minus of optimum should also be kept separate to permit moisture conditioning before placement as fill.

2) Remove loose soil, debris, and vegetation from the upstream face of the existing berm. The exposed subgrade should be compacted to a minimum of 95% of the maximum density determined in accordance with ASTM D698 (Standard Proctor).

3) Sand excavated from the downstream slope should be classified by a qualified geotechnical engineer to verify that it is consistent with Soil 1 modeled in our analysis. If downstream soils are not consistent with Soil 1, we should be contacted immediately to discuss other options.

4) Provided that sand excavated from the downstream face is consistent with Soil 1 and it has a moisture content within plus or minus 3% of the optimum moisture content, it should be placed before other fill on the upstream slope. If moisture content is outside the recommended range, it should be wetted and mixed, or loosened and air dried, as applicable. Fill should be compacted to a minimum of 95% of the maximum density determined in accordance with ASTM D698 (Standard Proctor).

5) Fill other than Soil 1 needed to achieve a final upstream slope of 2:1 should be approved by a geotechnical engineer. Fill which meets the requirements of Envelop A (See Attachment D) which is compacted as described in Item 4 above may be suitable for use as fill subject to approval of the geotechnical engineer. Fill not meeting Envelope A requirements may have properties not consistent with those used for our slope stability analysis. Fill requirements for non-Envelope A soil should be established on a case-by-case basis by a geotechnical engineer as sources are identified and classified. Coarse soil such as gravel, cobbles and boulders may be subject to placement at the slope toe and protection from infiltration into voids by finer-grained overlying soil by enclosing within

RECOMMENDATIONS, Continued

filter fabric. For fine soil, such as silts and clays, it may not be practical to achieve high enough strength to provide a stable slope at 2:1. If fine soil fill is proposed, we recommend that strength testing be performed to verify whether or not it has sufficient strength to be used on the proposed slope.

Please feel free to call if you have any questions. We are pleased to be of continued service to you on this project.

Sincerely,

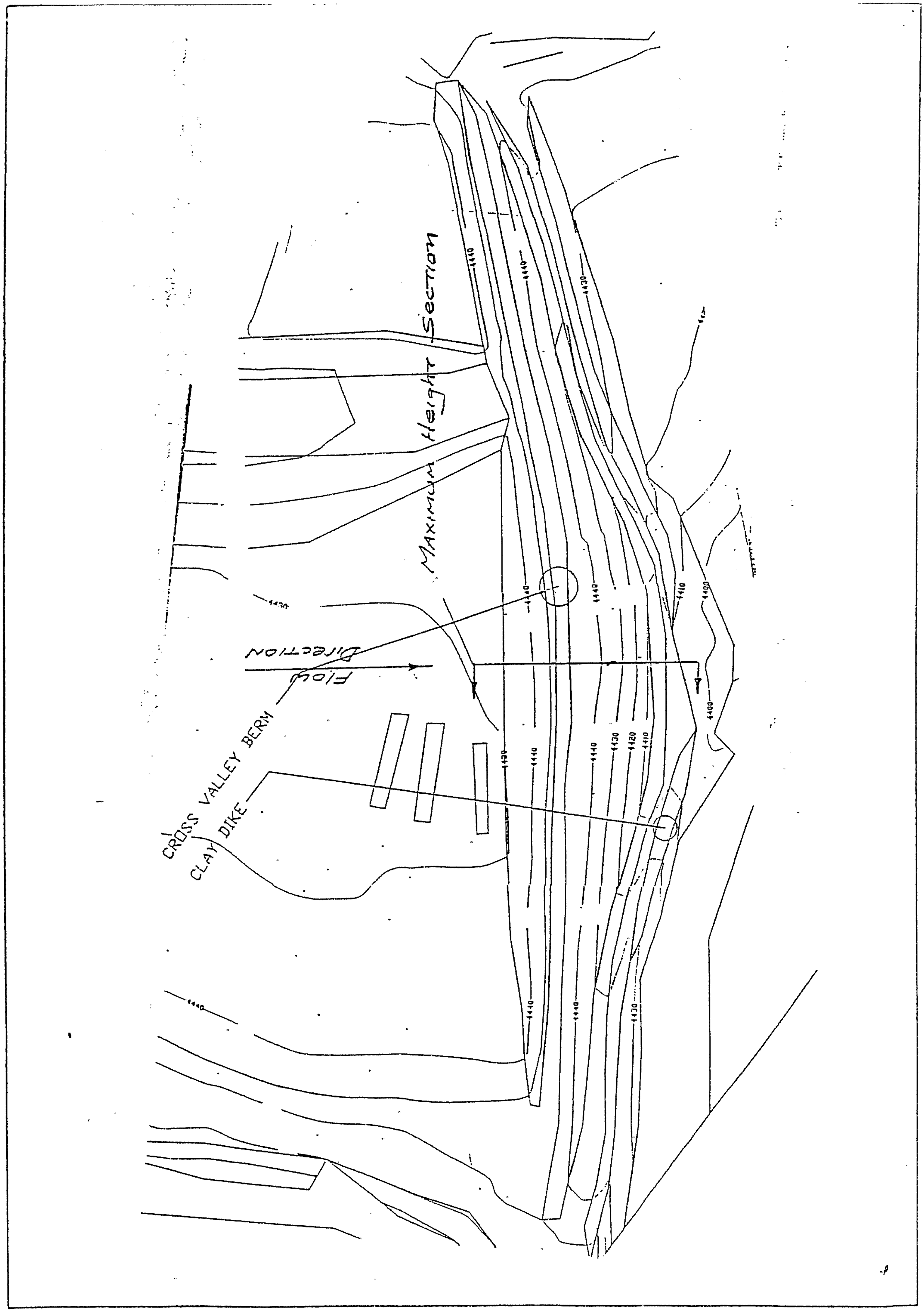
INBERG-MILLER ENGINEERS

Glen M. Bobnick, P.E.
Geotechnical Engineer

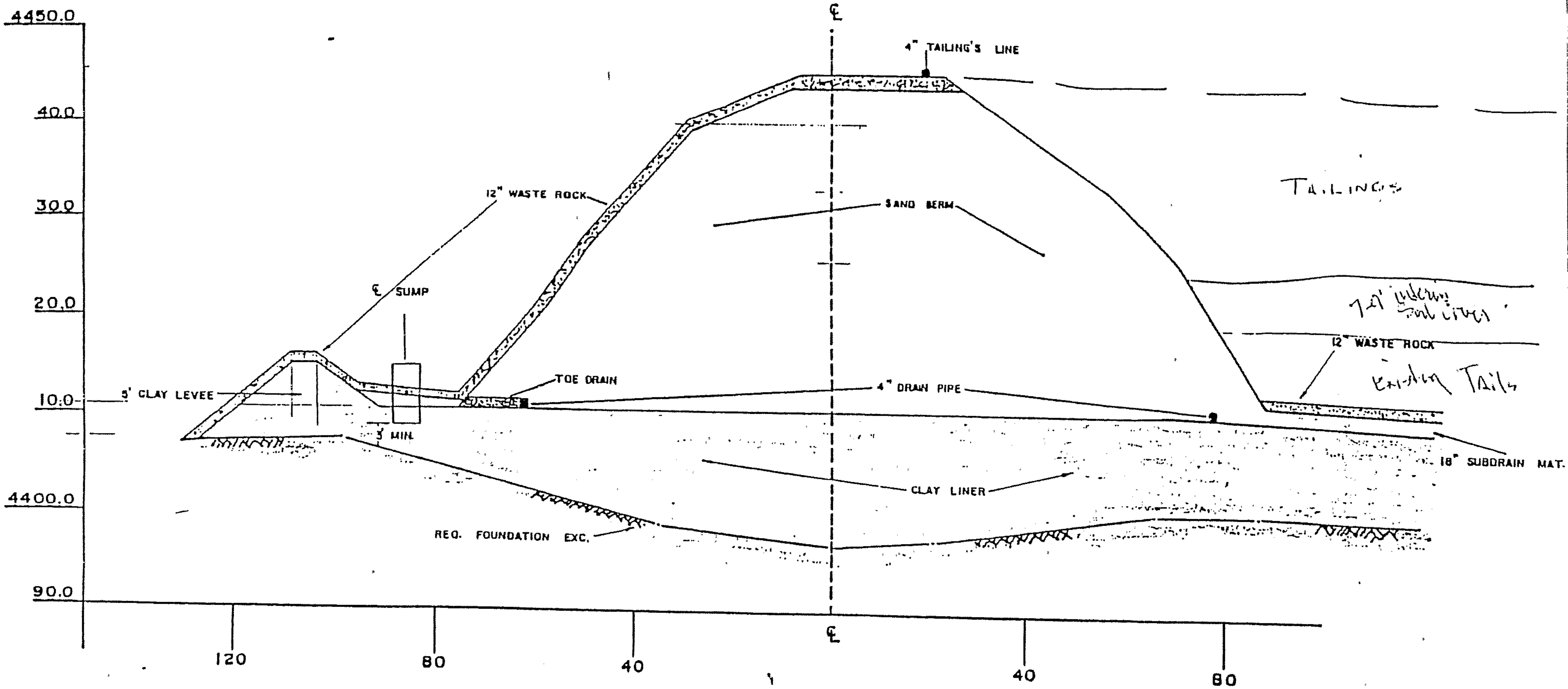
GMB:jlw:client letters\7664-RX-summary letter

Enclosures:	Attachment A -	Typical Berm Plan and Cross-Sections
	Attachment B -	Laboratory Test Results
	Attachment C -	PCSTABL Input and Critical Section Plots

Attachment A
Typical Berm Cross-Section



Maximum Height Section
Flow Direction
CROSS VALLEY BERM
CLAY DIKE
4440
4430
4420
4410
4400

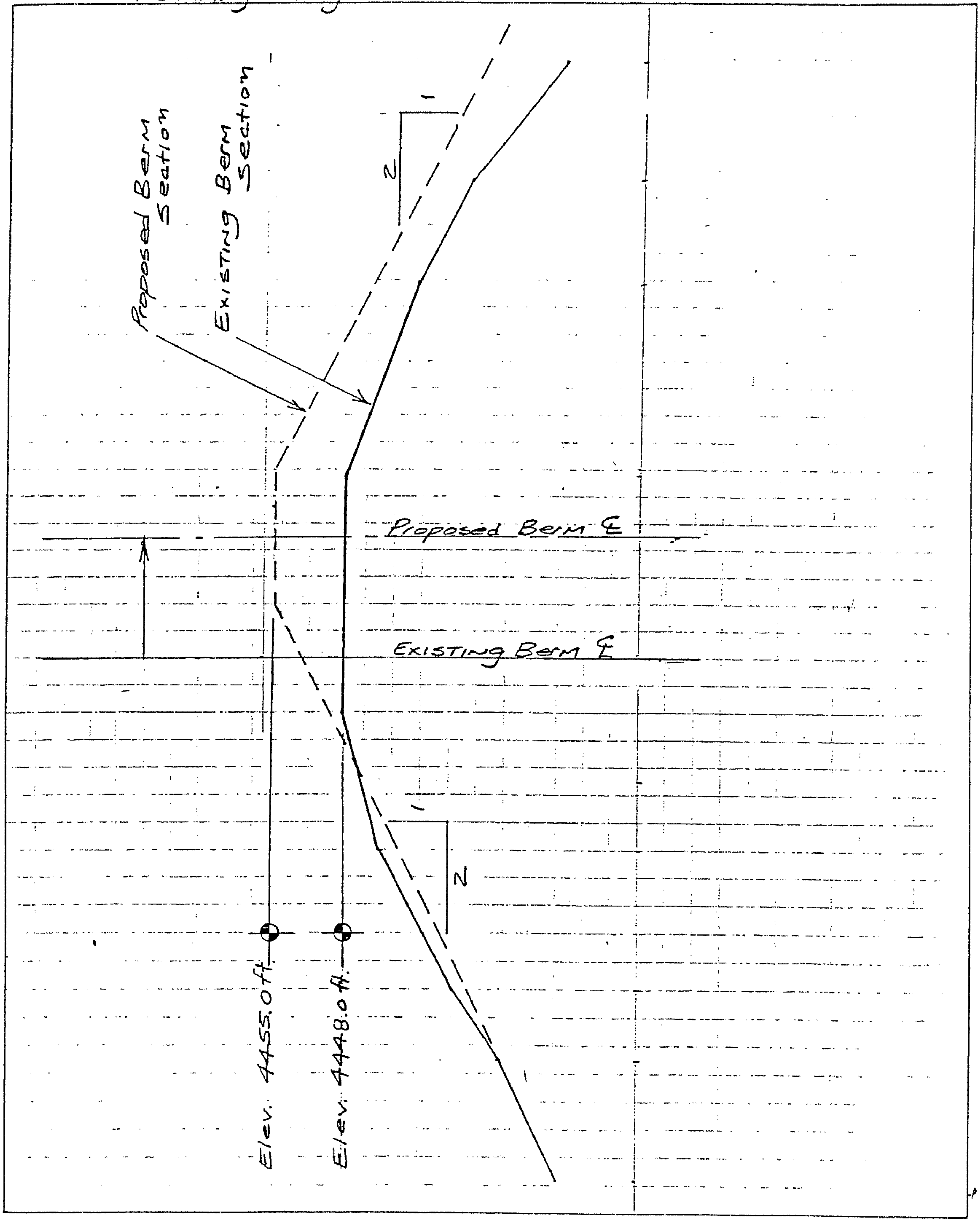


DRAWN	PLATEAU RESC'S LTD.	DRAWING TITLE	mountain states enghrs	
CHECKED	URANIUM FACILITY	TYPICAL SECTION	TUCSON	ARIZONA
JOB ENGR:	SHOOTERING CANYON	CROSS VALLEY	SCALE 1" = 10 V 1" = 20' H	REV. NO
DEPT HD:	UTAH	BERM	II-6	
CONST MGR:			JOB NO. 435	3-15-81
PROJ MGR: 3-17-81				

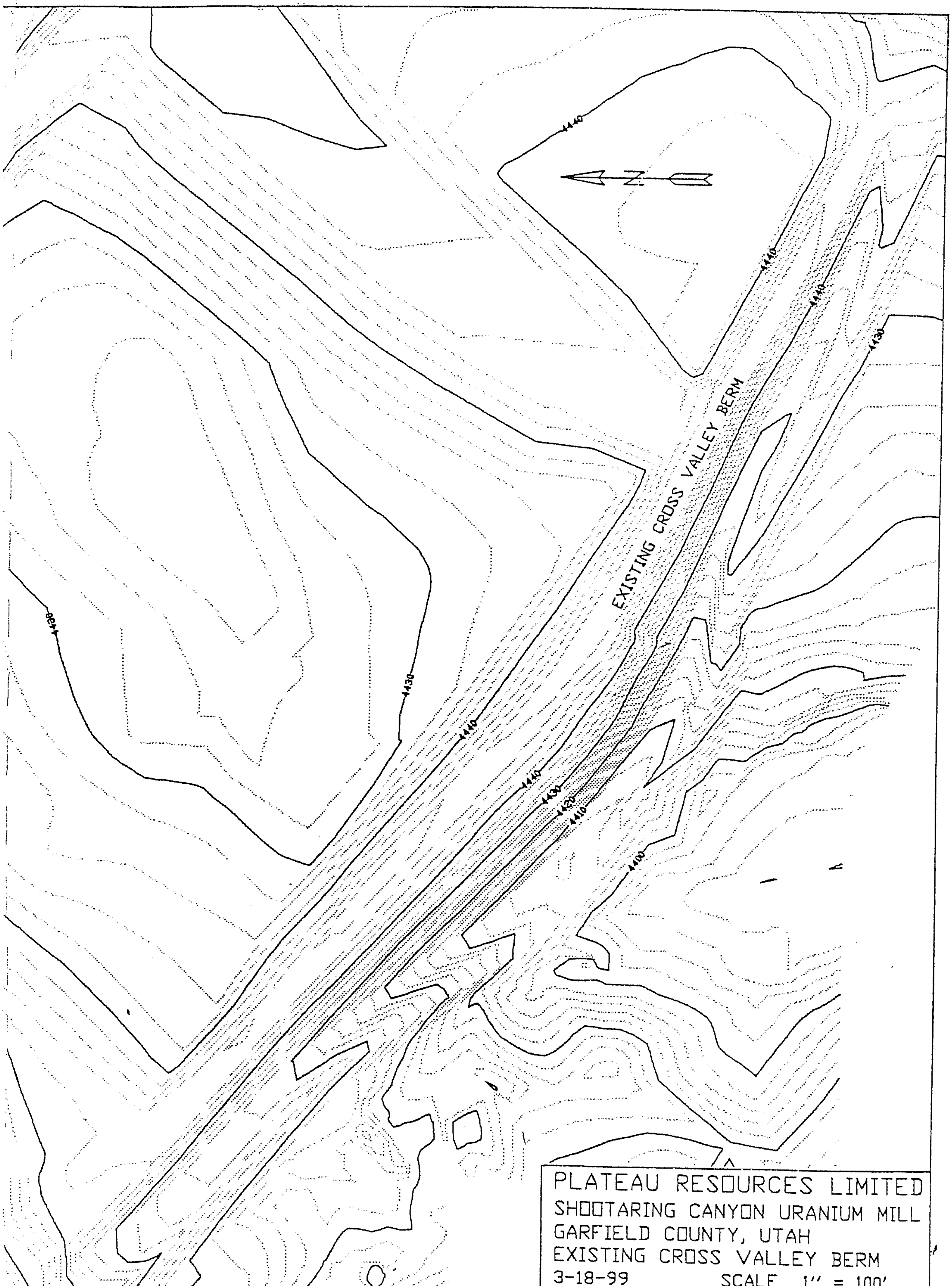
SUBJECT *Berm Modifications* PROJECT NO. *7664 RX* PAGE *1/1*

CLIENT *US Energy* DATE *6-11-99* BY *GMB*

PROJECT *Shootaring Canyon* CHECKED BY



INBERG-MILLER ENGINEERS

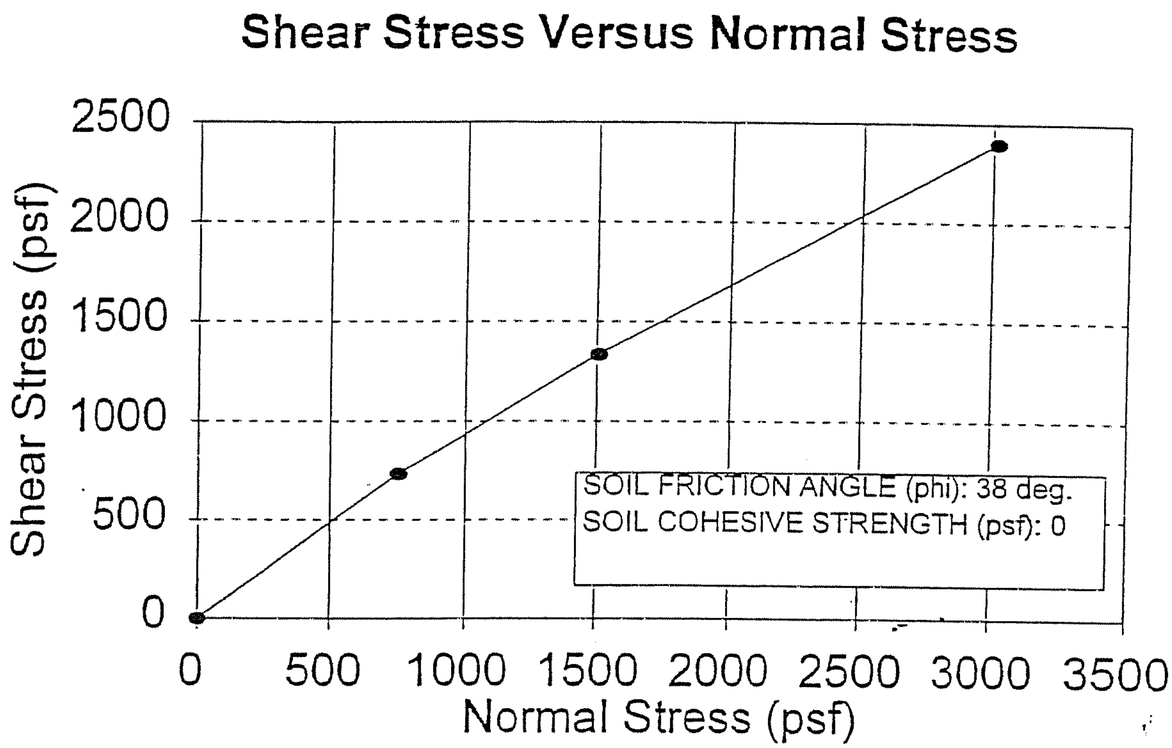

EXISTING CROSS VALLEY BERM
4440
4430
4420
4410
4400
4438
PLATEAU RESOURCES LIMITED
SHOOTARING CANYON URANIUM MILL
GARFIELD COUNTY, UTAH
EXISTING CROSS VALLEY BERM
3-18-99
SCALE 1'' = 100'

Attachment B

Laboratory Test Results

PROJECT: Shootering Canyon Dam

CLIENT: U.S. Energy Corporation



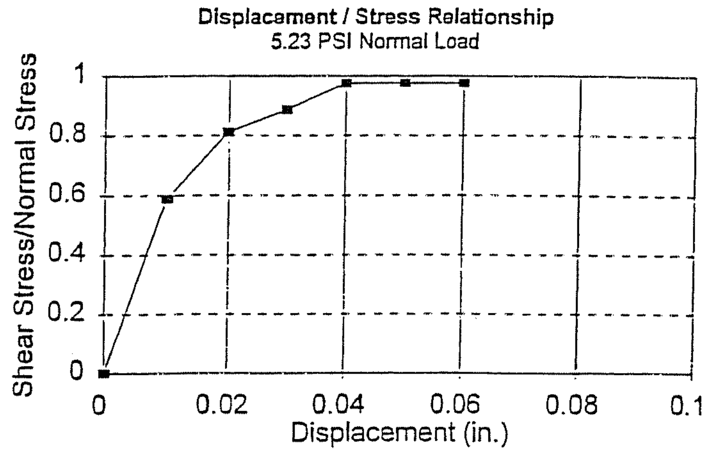
TEST DATE: 4/17/97

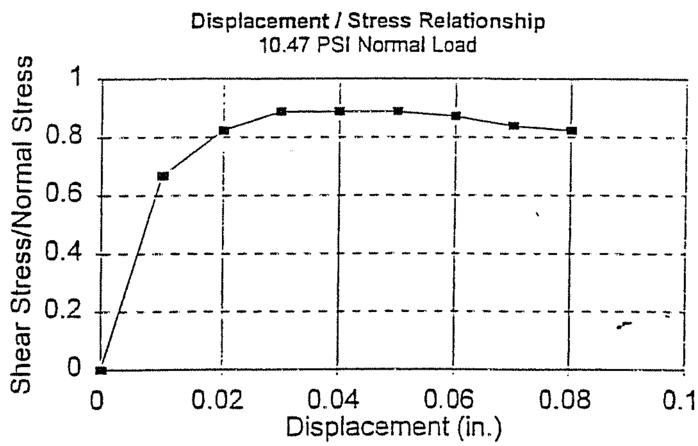
SAMPLE DESCRIPTION: Light Brown Fine Grained Sand

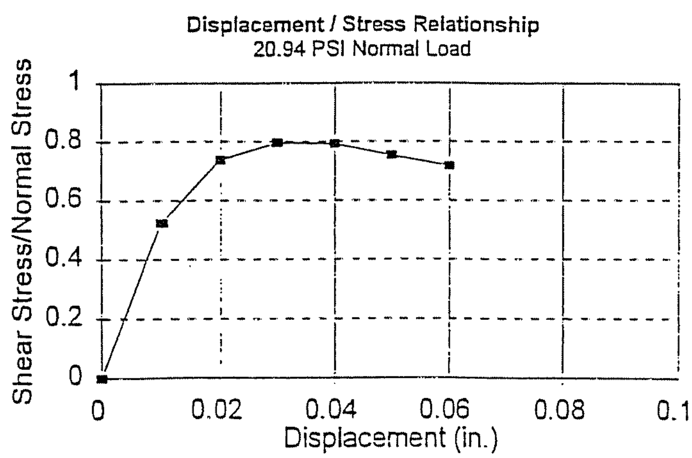
SOURCE: Cross Valley Berm

TECHNICIAN: DSD/GLM

PROJECT: Shootering Canyon Dam CLIENT: U.S. Energy Corporati







TEST DATE: 4/17/97 TECHNICIAN: DSD/GLM

SAMPLE DESCRIPTION: Light Brown Fine Grained Sand

SOURCE: Cross Valley Berm

INBERG-MILLER ENGINEERS

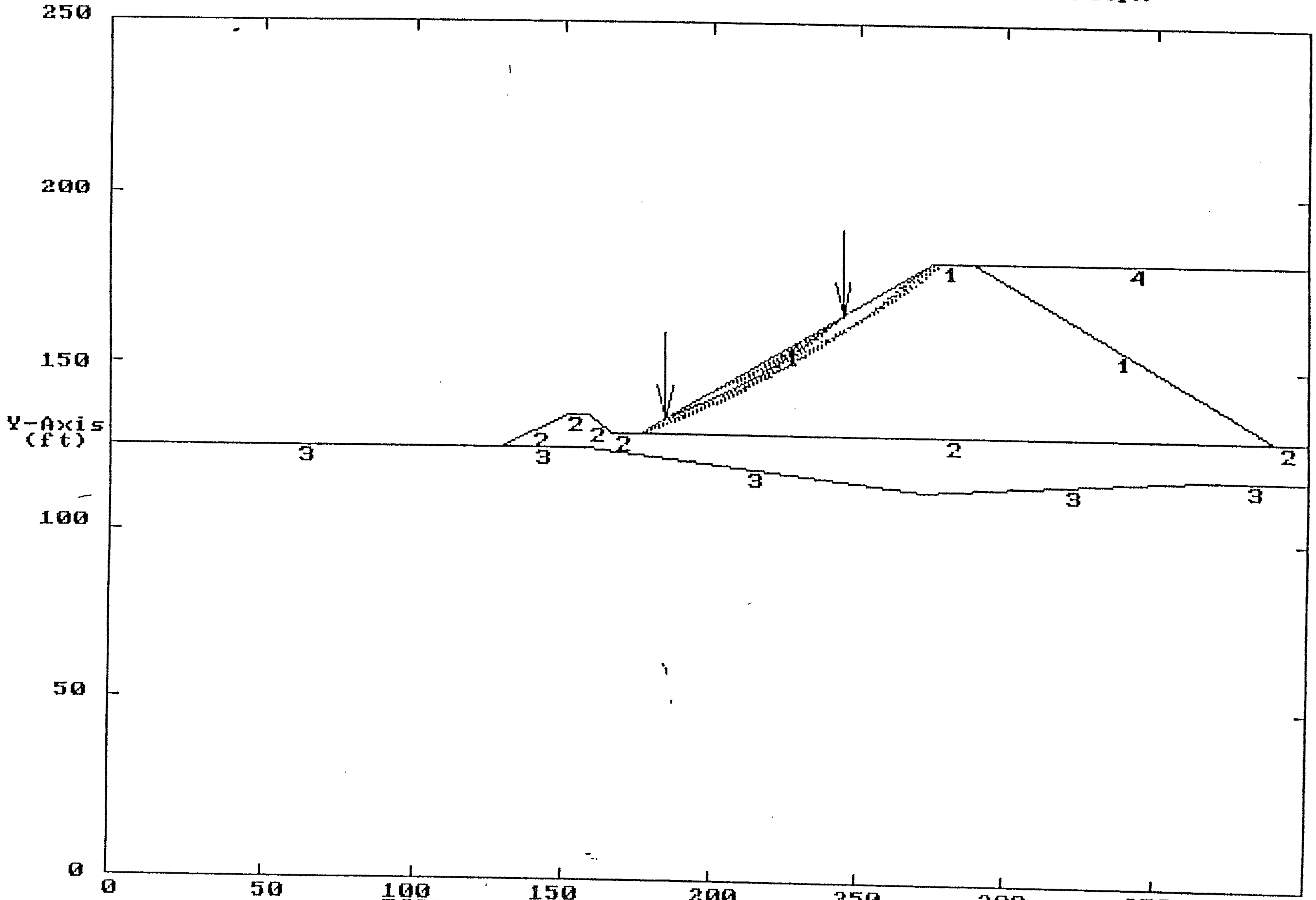
Attachment C

PCSTABL Input and Critical Section Plots

```
PROFIL        C:REMCVBEQ.IN  PCSTABL Version 6
SHOOTERING CANYON                        CROSS VALLEY BERM STABILITY AN
SIS
15 8
0. 126. 129. 126. 3
129. 126. 151. 135. 2
151. 135. 158. 135. 2
158. 135. 166. 130. 2
166. 130. 176. 130. 2
176. 130. 275. 180. 1
275. 180. 289. 180. 1
289. 180. 400. 180. 4
289. 180. 390. 130. 1
176. 130. 390. 130. 2
390. 130. 400. 130. 2
129. 126. 158. 126. 3
158. 126. 274. 114. 3
274. 114. 368. 119. 3
368. 119. 400. 119. 3
SOIL
4
115. 115. 0. 38. 0. 0. 0
125. 125. 1500. 0. 0. 0. 0
140. 140. 1000. 45. 0. 0. 0
100. 100. 0. 10. 0. 0. 0
EQUAKE
0.19 0. 0.
CIRCLE-Janbu circular, search.
20 20
150. 200. 230. 280. 0. 15. 0. 0.
```

SHOOTERING CANYON CROSS VALLEY BERM STABILITY ANALYSIS

Ten Most Critical. C:REMCVBEQ.PLT By: gmb 04-23-97 3:44pm



PCSTABL5 FS min=1.02

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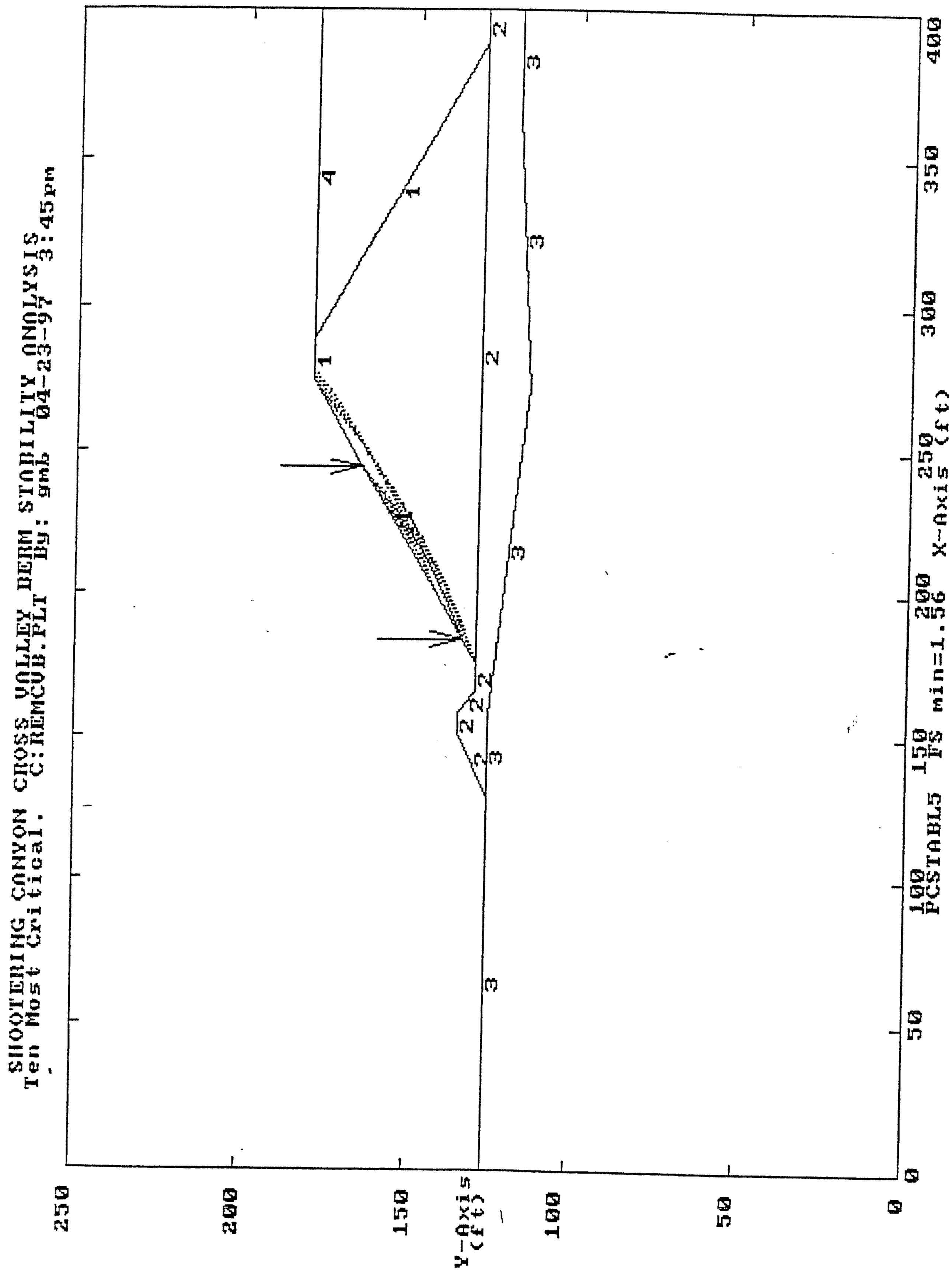
PROFIL        C:REMCVB.IN  PCSTABL Version 6
SHOOTERING CANYON                          CROSS VALLEY BERM STABILITY AN
SIS
15 8
0. 126. 129. 126. 3
129. 126. 151. 135. 2
151. 135. 158. 135. 2
158. 135. 166. 130. 2
166. 130. 176. 130. 2
176. 130. 275. 180. 1
275. 180. 289. 180. 1
289. 180. 400. 180. 4
289. 180. 390. 130. 1
176. 130. 390. 130. 2
390. 130. 400. 130. 2
129. 126. 158. 126. 3
158. 126. 274. 114. 3
274. 114. 368. 119. 3
368. 119. 400. 119. 3
SOIL
4
115. 115. 0. 38. 0. 0. 0
125. 125. 1500. 0. 0. 0. 0
140. 140. 1000. 45. 0. 0. 0
100. 100. 0. 10. 0. 0. 0
CIRCLE-Janbu circular, search.
20 20
150. 200. 230. 280. 0. 15. 0. 0.
```


SHOOTERING CANYON CROSS VALLEY BERM STABILITY ANALYSIS
Ten Most Critical. C:REMCUB.PLT By: gmb 04-23-97 3:45pm
PCSTABL5 FS min=1.56
X-Axis (ft)
Y-Axis (ft)

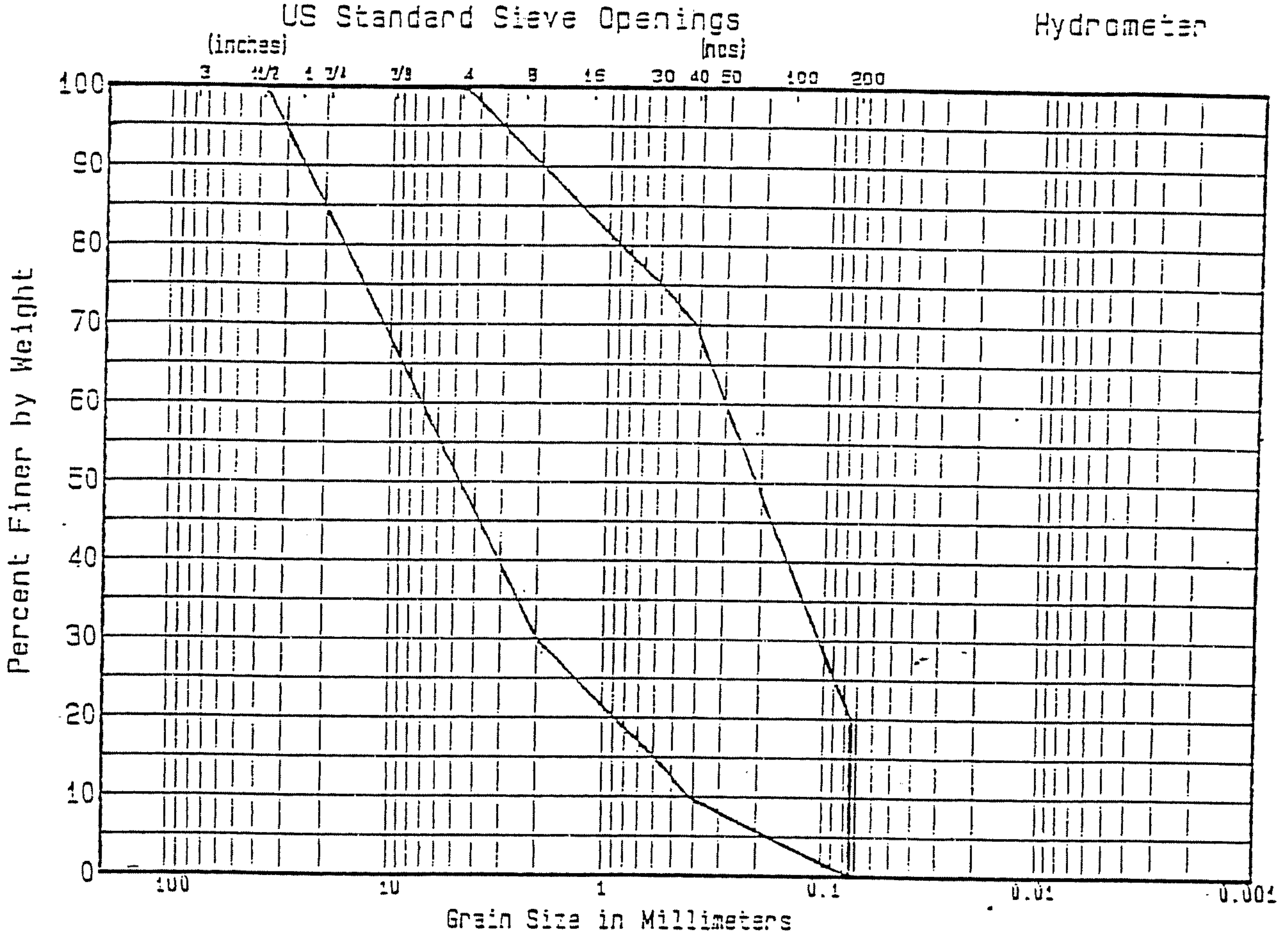
Attachment D
Envelope A

GRADATION ENVELOPE A

Project: Shootering Canyon

Client: U.S. Energy Corp.

Job No.: 7664 RX



Cobbles	Coarse Gravel	Fine Gravel	Coarse Sand	Medium Sand	Fine Sand	Silt	Clay

Unified Soil Classification System (ASTM D2487)

Material Description (Envelope A): GRANULAR FILL

Recommended Gradation :

Sieve Size	% Passing
1.5 in.	100
# 4	50 - 100
# 10	30 - 90
# 30	15 - 75
# 40	10 - 70
# 200	0 - 20

INBERG - MILLER ENGINEERS

A.4 Deformation Analysis, Letter Report
by Inberg-Miller Engineers, January 28, 1999

INBERG-MILLER ENGINEERS
124 EAST MAIN STREET RIVERTON, WYOMING 82501-4397 307-856-8136

January 28, 1999 7664-RX

U.S. Energy Corporation
877 N. 8th West
Riverton, Wyoming 82501

ATTENTION: FRED CRAFT

RE: NEWMARK ANALYSIS
SHOOTARING CANYON DAM (UT00417)

Dear Sir;

This letter summarizes the results of a deformation analysis that we performed for the above referenced project pursuant to the July 1, 1998 letter of review comments by the State of Utah.. We understand that an evaluation of seismic deformation based on a magnitude 6.5 earthquake with a peak ground acceleration of 0.33g is required. These services are in addition to previous slope stability analyses that we performed for the above project.

SUMMARY OF APPROACH

The deformation analysis method is described in the following reference:

> N.M. Newmark, 1965, "Effects of Earthquakes on Dams and Embankments" *Geotechnique, Vol. 15, Issue 2, pp. 139-160*

We understand that the deformation analysis estimates ground displacement due to seismic forces. The above reference suggests methodology for evaluating cumulative displacement and resultant deformation of sloping soils exposed to repetitive forces, as in the case of an earth dam experiencing seismic shaking.

Displacement is estimated according to the following equation:

$$(V^2/(2gN)) \times (A/N)$$

where:

V = velocity of ground motion
g = acceleration due to gravity
$N = ((\tan\phi/\tan\theta) - 1)\sin\theta$
ϕ = Internal soil friction angle
θ = Embankment slope angle
A = Percent of peak acceleration of ground motion

We are able to readily establish the basis for all of the above parameters except velocity.

GROUND MOTION VELOCITY

Velocity of ground motion for the subject site is apparently not available. We spoke with Robert Smith of the University of Utah-Geology Department and Dave Perkins of the U.S. Geological Survey, and neither were aware of any recordings of strong ground motion within an applicable distance of the project site where velocity could be determined. Based on information provided in the above referenced publication (Newmark, 1965), velocities between 8.3 and 13.7 in/sec were recorded in Pacific Coast states.

In order to establish the basis for an appropriate velocity, we reviewed the following document:

> David J. Leeds, 1992, "Recommended Accelerograms for Earthquake Ground Motions", *Miscellaneous Paper S-73-1, Report 28, prepared for Department of the Army*

The above document provides recommended ground motion velocity based on the parameters of earthquake magnitude, distance from the epicenter, focal depth, and whether the site is hard or soft.

As a basis for evaluating parameters for the subject site, we referenced the following map:

> "Earthquakes in Utah, 1889-1985", *United States Geological Survey – National Earthquake Information Center, 1990*

According to the above map, the closest epicenter to the site for the range of earthquake magnitudes in Utah are listed below:

Mag 6.0	165 km
Mag 4.9	34 km
Mag 3.9	6 km

The map indicates that focal depth for all earthquake data is less than 25 km. Based on our knowledge of site geology, the site is underlain by sedimentary bedrock that meets the definition of a "hard site".

For the purpose of establishing a conservative velocity for use in analysis, we utilized the following parameters in conjunction with Figure 20c of "Recommended Accelerograms for Earthquake Ground Motions" (see attached):

Earthquake Magnitude	6.5
Distance to Epicenter	10 km
Focal Depth	<19 km
Site Conditions	Hard

Accordingly, a velocity of 50 cm/sec (20 in/sec) for mean velocity plus one standard deviation appears conservative and appropriate.

DEFORMATION ANALYSIS RESULTS

Values used for each parameter for deformation analysis are summarized as follows:

V = 20 in/sec
g = 386.4 in/sec^2 (32.2 ft/sec^2)
N = 0.30
$\phi = 40^\circ$ (as previously established for this site)
$\theta = 26.6^\circ$ (for 2 H: 1V dam face)
A = 0.33 (per the attached USGS Peak Acceleration Map)

We calculate a displacement of 1.9 inches based on the above parameters and references. In our opinion, the displacement as indicated does not appear significant to the integrity and performance of the subject dam.

Please feel free to call if you have any questions.

Sincerely,

INBERG-MILLER ENGINEERS

Glen M. Bobnick, P.E.
Geotechnical Engineer

GMB:jlw:geotech\7664-RX

Enclosures as stated

_ from "Recommended Accelerograms for
_ Earthquake Ground Motions"

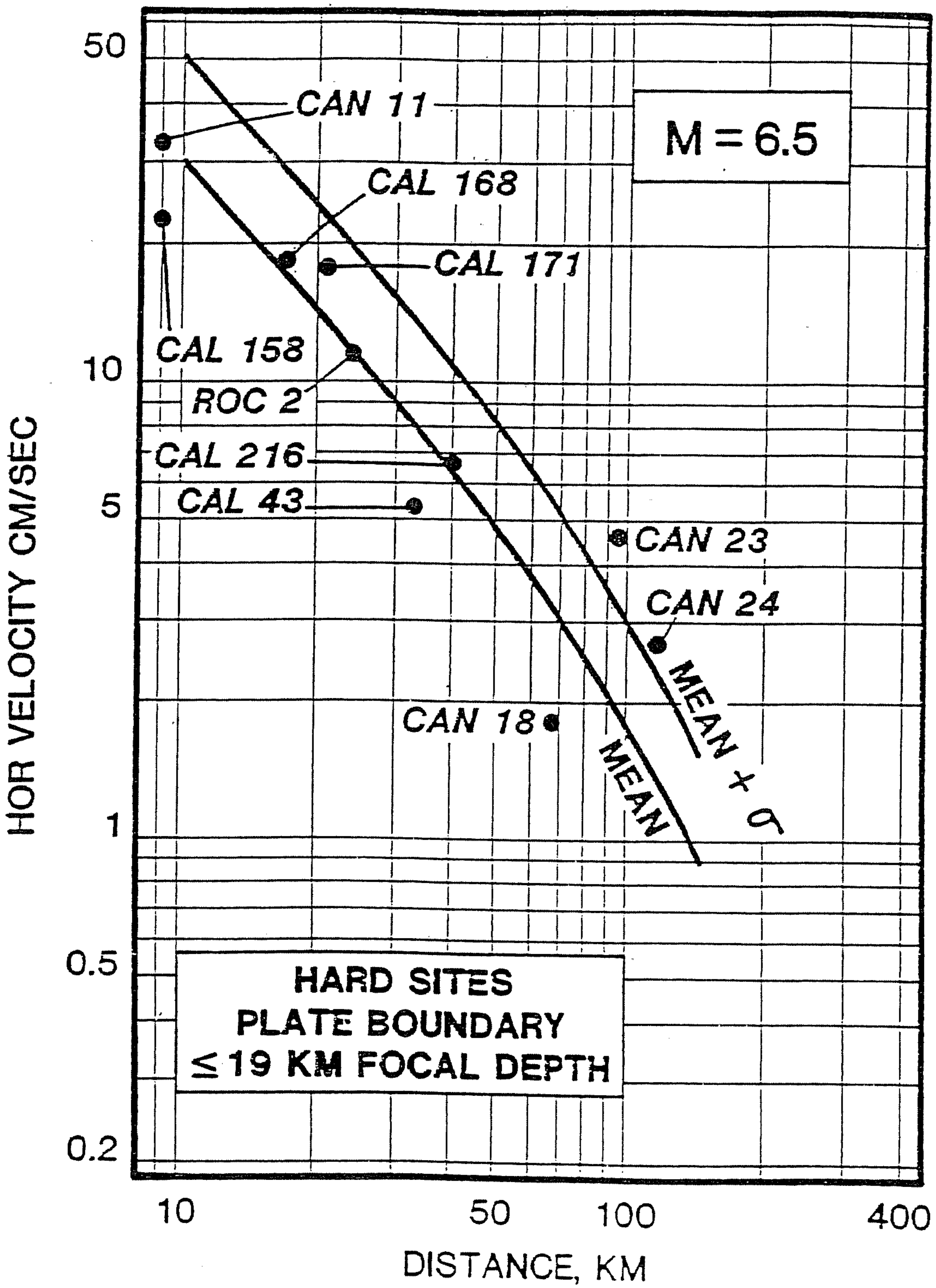


Figure 20c. Accelerograms for velocity, M - 6.5, and distance from source for shallow earthquakes at hard sites. (See Table 20c.)

no fault-specific sources; site: NEHRP B-C boundary

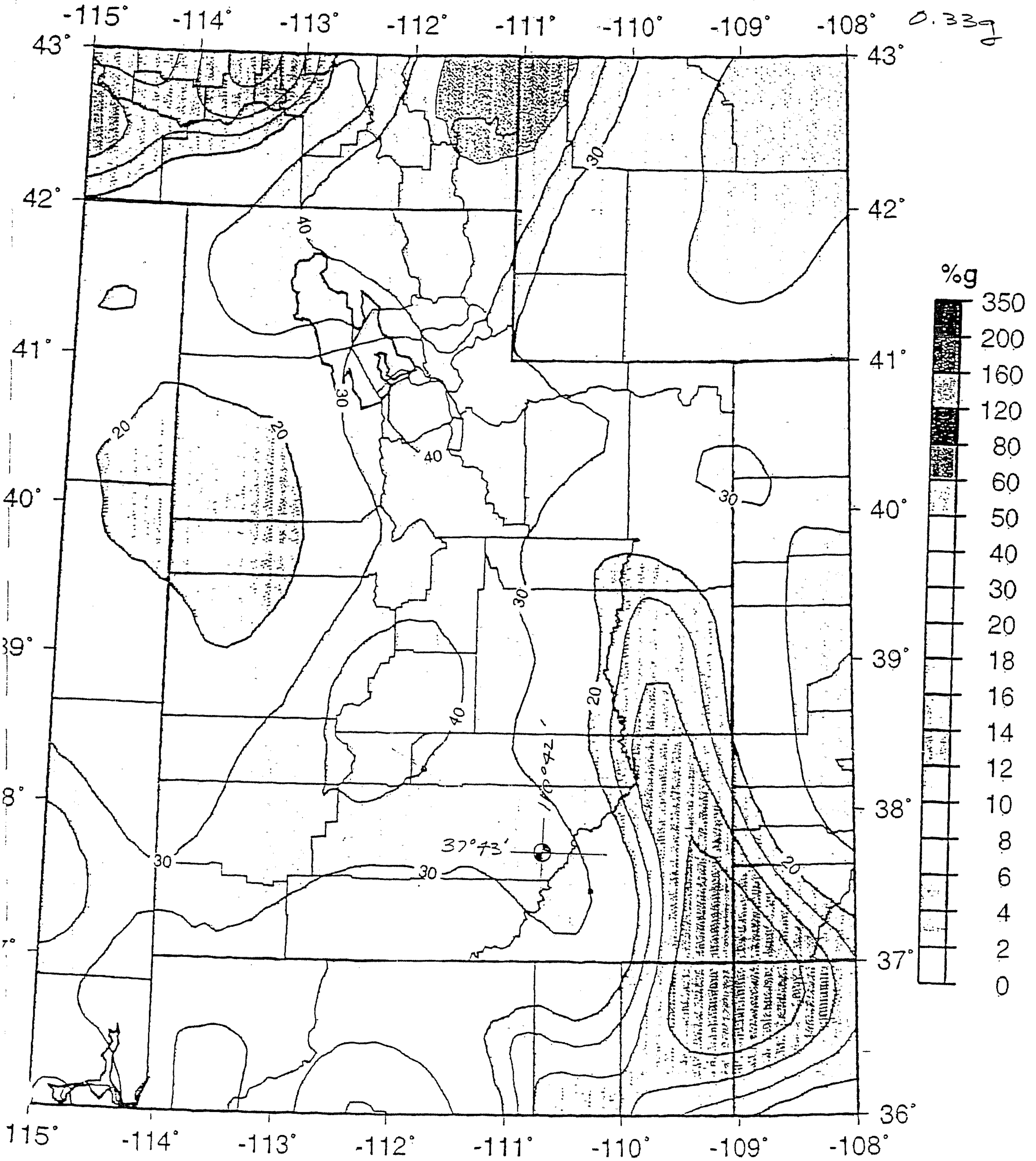
U.S. Geological Survey

National Seismic Hazard Mapping Project

23/77 = 0.3

0.3×10 = 3

0.33g



A.5 Newmark Analysis, Letter Report
by Inberg-Miller Engineers, June 14, 1999

INBERG-MILLER ENGINEERS

124 EAST MAIN STREET RIVERTON, WYOMING 82501-4397 307-856-8136

June 14, 1999 7664-RX

U.S. Energy Corporation
877 N. 8th West
Riverton, Wyoming 82501

ATTENTION: FRED CRAFT

RE: NEWMARK ANALYSIS
CROSS VALLEY BERM
SHOOTARING CANYON URANIUM PROJECT, UTAH

Dear Sir:

This letter summarizes the results of a deformation analysis that we performed for the above referenced project pursuant to your request. We understand that an evaluation of seismic deformation based on a magnitude 6.5 earthquake with a peak ground acceleration of 0.33g is required. These services are in addition to previous slope stability analyses that we performed for the above project.

SUMMARY OF APPROACH

The deformation analysis method is described in the following reference:

> N.M. Newmark, 1965, "Effects of Earthquakes on Dams and Embankments" *Geotechnique, Vol. 15, Issue 2, pp. 139-160*

We understand that the deformation analysis estimates ground displacement due to seismic forces. The above reference suggests methodology for evaluating cumulative displacement and resultant deformation of sloping soils exposed to repetitive forces, as in the case of an earth dam experiencing seismic shaking.

Displacement is estimated according to the following equation:

$$(V^2/(2gN)) \times (A/N)$$

where:

V = velocity of ground motion
g = acceleration due to gravity
N = $((\tan\phi/\tan\theta) - 1)\sin\theta$
ϕ = Internal soil friction angle
θ = Embankment slope angle
A = Percent of peak acceleration of ground motion

We are able to readily establish the basis for all of the above parameters except velocity.

GROUND MOTION VELOCITY

Velocity of ground motion for the subject site is apparently not available. We spoke with Robert Smith of the University of Utah-Geology Department and Dave Perkins of the U.S. Geological Survey, and neither were aware of any recordings of strong ground motion within an applicable distance of the project site where velocity could be determined. Based on information provided in the above referenced publication (Newmark, 1965), velocities between 8.3 and 13.7 in/sec were recorded in Pacific Coast states.

In order to establish the basis for an appropriate velocity, we reviewed the following document:

> David J. Leeds, 1992, "Recommended Accelerograms for Earthquake Ground Motions", *Miscellaneous Paper S-73-1, Report 28, prepared for Department of the Army*

The above document provides recommended ground motion velocity based on the parameters of earthquake magnitude, distance from the epicenter, focal depth, and whether the site is hard or soft.

As a basis for evaluating parameters for the subject site, we referenced the following map:

> "Earthquakes in Utah, 1889-1985", *United States Geological Survey – National Earthquake Information Center, 1990*

According to the above map, the closest epicenter to the site for the range of earthquake magnitudes in Utah are listed below:

Mag 6.0	165 km
Mag 4.9	34 km
Mag 3.9	6 km

The map indicates that focal depth for all earthquake data is less than 25 km. Based on our knowledge of site geology, the site is underlain by sedimentary bedrock that meets the definition of a "hard site".

For the purpose of establishing a conservative velocity for use in analysis, we utilized the following parameters in conjunction with Figure 20c of "Recommended Accelerograms for Earthquake Ground Motions" (see attached):

Earthquake Magnitude	6.5
Distance to Epicenter	10 km
Focal Depth	<19 km
Site Conditions	Hard

Accordingly, a velocity of 50 cm/sec (20 in/sec) for mean velocity plus one standard deviation appears conservative and appropriate.

DEFORMATION ANALYSIS RESULTS

Values used for each parameter for deformation analysis are summarized as follows:

V = 20 in/sec
g = 386.4 in/sec^2 (32.2 ft/sec^2)
N = 0.25
$\phi = 38^{\circ}$ (as previously established for this site)
$\theta = 26.6^{\circ}$ (for 2 H: 1V dam face)
A = 0.33 (per the attached USGS Peak Acceleration Map)

We calculate a displacement of 2.7 inches based on the above parameters and references. In our opinion, the displacement as indicated does not appear significant to the integrity and performance of the subject dam.

Please feel free to call if you have any questions.

Sincerely,

INBERG-MILLER ENGINEERS

Glen M. Bobnick, P.E.
Geotechnical Engineer

GMB:jlw:client letters\7664-RX

Enclosures as stated

— from "Recommended Accelerograms for Earthquake Ground Motions"

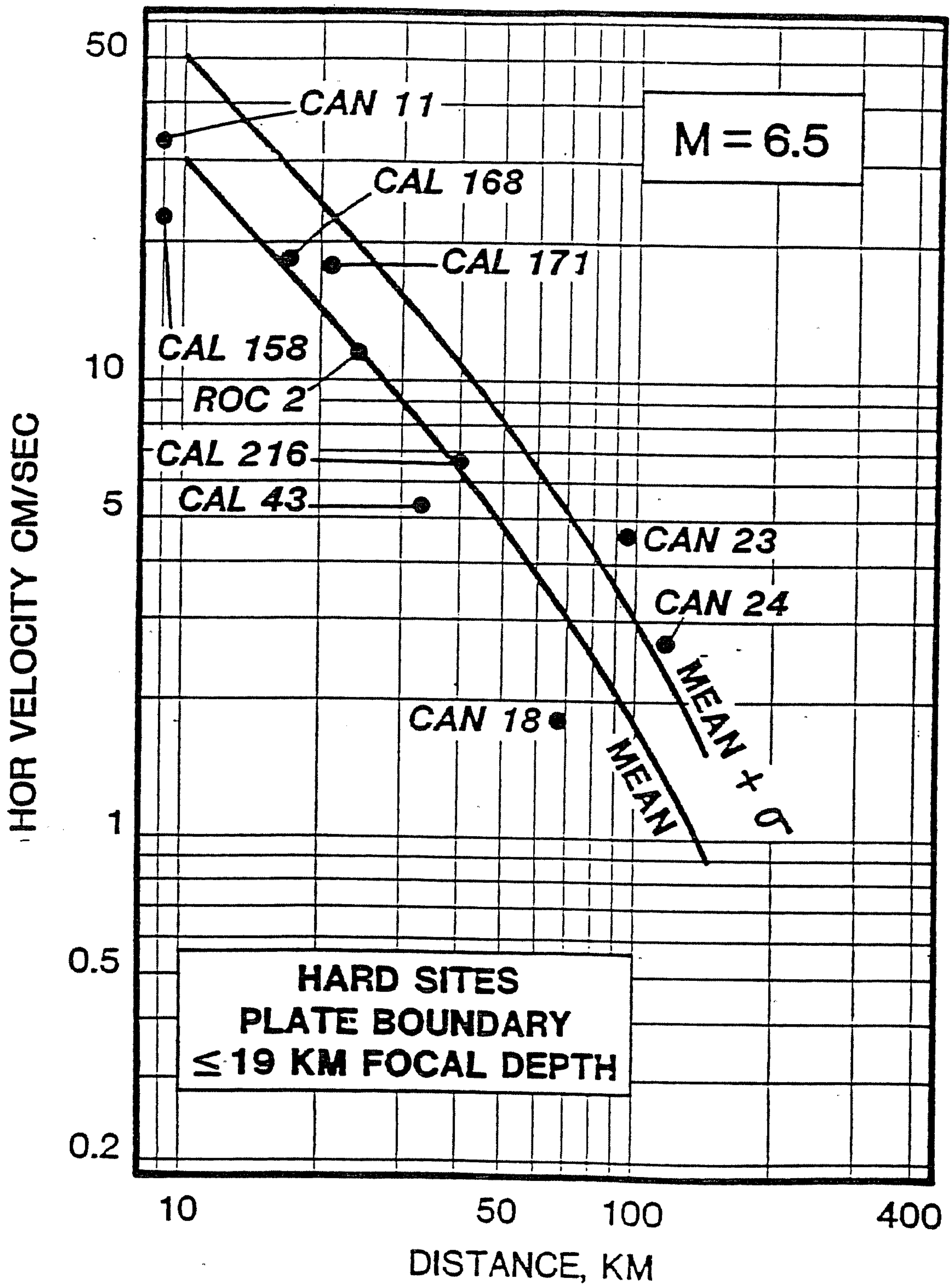
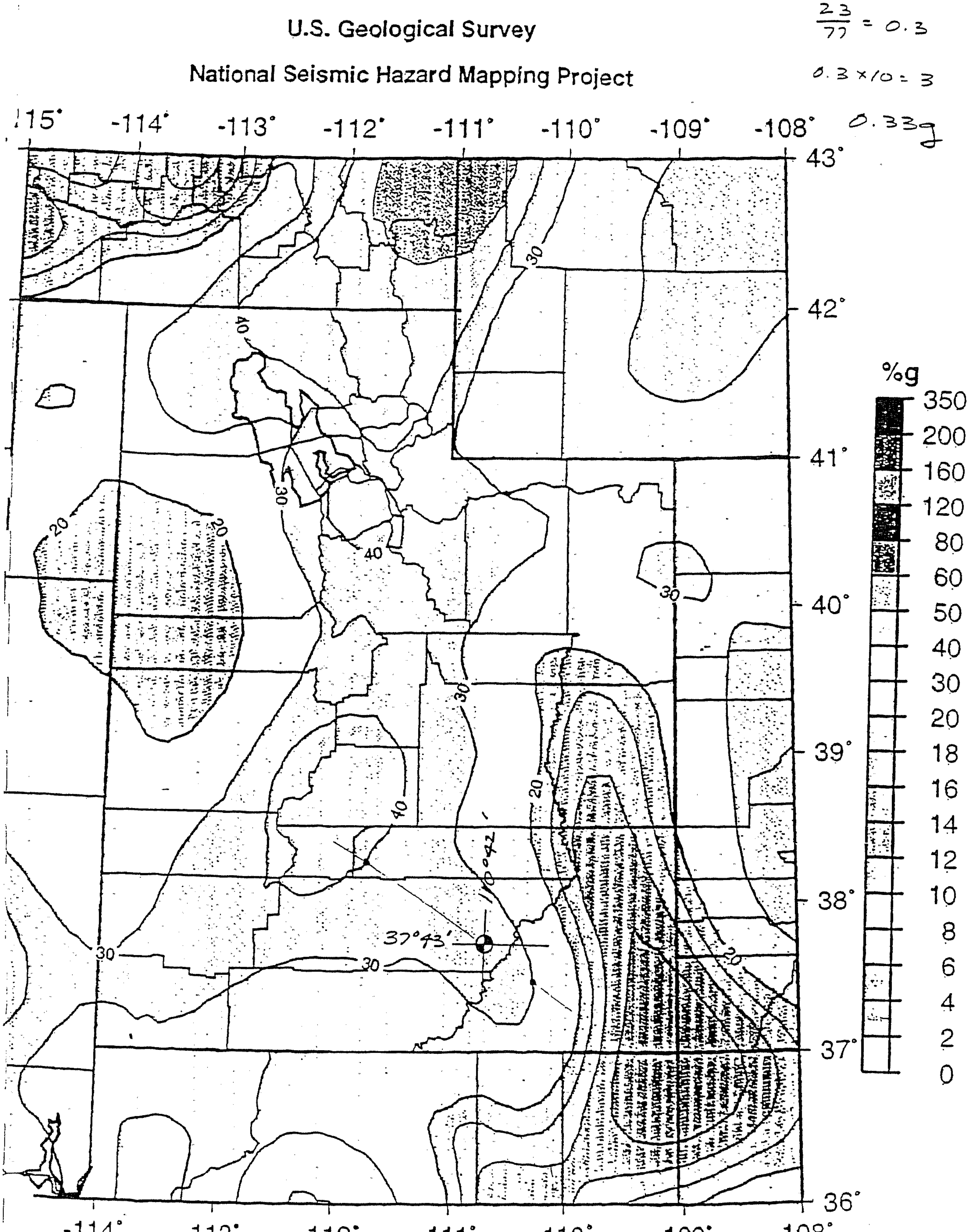


Figure 20c. Accelerograms for velocity, M - 6.5, and distance from source for shallow earthquakes at hard sites. (See Table 20c.)

no fault-specific sources; site: NEHRP B-C boundary

U.S. Geological Survey

National Seismic Hazard Mapping Project



A.6 Tailings Dam Stability Approval Letter
from State of Utah
Department of Natural Resources Division of Water Rights,
State Engineer, March 8, 1999

State of Utah
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF WATER RIGHTS

Michael O. Leavitt
Governor
Ted Stewart
Executive Director
Robert L. Morgan
State Engineer

1594 West North Temple, Suite 220
Box 146300
Salt Lake City, Utah 84114-6300
801-538-7240
801-538-7467 (Fax)

RECEIVED MAR 1 1 1999

March 8, 1999

F.R. Craft
Plateau Resources LTD.
877 North 8th West
Riverton, WY 82501

Re: Shootaring Canyon Mill Tailings Dam/UT00417 - Stability Analysis

We have completed our review of the information submitted with your letter of June March 4, 1998. Based on our review, we find the explanations and analyses to be acceptable, and the Shootaring Canyon Mill Tailings Dam meets the stability criteria adopted by this office.

If you have any questions concerning the preceding information, please feel free to contact Richard Hall, (801) 538-7373 of our Dam Safety Section.

Sincerely,

FOV Robert L. Morgan, P.E.
State Engineer

RLM/rbh/jm

pc: Mark Page - Regional Engineer

APPENDIX B

DRAINAGE FILTER ANALYSIS

APPENDIX B

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APPENDIX B

Drainage Filter Analysis

B.0 Introduction

A three-layer drainage filter will be installed in the tailings cells as a primary component of the drainage collection system. This drainage filter will protect the HDPE liner and serve as a means of conveying drainage from the tailings to a collection pipe for eventual discharge to a collection sump. The properties of the drainage filter layers are specified to provide both the necessary filtration and conveyance functions.

B.1 Drainage Filter Configuration

The planned drainage system includes a perforated pipe network that is installed within a three-layer drainage blanket that will be installed over the pond base. The bottom layer of the drainage blanket will consist of six (6) inches of Entrada sand. One of the primary purposes of this bottom Entrada sand layer is to protect the upper HDPE liner from puncture by stones within the middle layer which will consist of a six (6) in thick sand and gravel material produced from the quarry area. The uppermost drainage blanket layer will consist of six (6) inches of Entrada sand. In addition to providing a protective layer for the HDPE liner, the use of two distinct materials has the advantage of providing a more robust drainage blanket. The sand and gravel material from the quarry area is generally slightly coarser and should have a somewhat greater permeability, and the presence of the upper Entrada sand layer should prevent intrusion of tailings fines into the coarser middle layer. The use of two materials with differing mineralogy also reduces the potential for degradation of the entire drainage blanket by an adverse geochemical process.

The two major functions of the three layer drainage blanket are:

> To convey tailings solution to the drainage pipe network or directly to the sump and thereby prevent the accumulation of excess head over the HDPE liner.
>
> To prevent excessive intrusion of the tailings into the drainage blanket or piping system. Intrusion of fines into the blanket could eventually result in plugging of the blanket and drain system.

Underground drainage system filter/envelope design criteria were used in evaluating the suitability of the proposed materials. These criteria are presented in “Drainage of Agricultural Land” which is published by the Water Information Center Inc. The criterion which limits the fine fraction to no more than 10% passing a No. 60 sieve is waived because a fabric sock will be used to restrict movement of fines into the piping system. Chapter 26 (“Gradation Design of Sand and Gravel Filters”) of the USDA-

NRCS National Engineering Handbook also presents relevant design criteria that were considered in the evaluation of the proposed filter materials.

B.2 Entrada Sand and Possible Tailings Properties

Sieve analysis was conducted on two Entrada sand samples during evaluation of the existing tailings facility. The results of this analysis are presented in Figure B-1 along with gradations for three tailings samples. Entrada sand is a very uniform fine sand with only a very small silt and clay fraction. In contrast, the gradation of uranium tailings can range from a slime with more than 85% passing the #200 screen, to a medium to coarse sand with a relatively small fines fraction. The coarsest of the tailings samples in Figure B-1 was taken from the existing tailings at the Shootaring site. The other two samples were taken from a uranium tailings facility in central Wyoming. The three tailings samples generally span the expected range of tailings gradations.

The Entrada sand will be used as the lower and upper layers of the drainage filter system. As the lower layer, the Entrada sand will serve as the bedding for the perforated pipe equipped with a filter sock. Because the Entrada sand is free of stones and other debris, this lower layer will also serve to guard the upper HDPE liner. The upper drainage layer of Entrada sand should be very effective in preventing the intrusion of tailings into the drainage layer.

From the standpoint of penetration of fines into the drainage layer and piping collection system, the critical tailings material is fine-grained slime tailings. Entrada sand is very uniform and there is no concern for a gap-graded material, so the applicable filter criterion is related to the maximum D_{15} of the Entrada sand. According to the criteria described in Chapter 26 of the USDA-NRCS National Engineering Handbook for a fine silt and clay base soil, the maximum D_{15} of the filter is less or equal to 9 x d_{85} of the slime tailings base soil. Based on the gradations presented in Figure B-1, the D_{15} of the Entrada sand is suitable for tailings with a d_{85} as small as 0.01 mm. The minimum D_{15} is a function of the desired permeability of the filter material. Harr (1962) lists typical permeabilities of fine sand ranging from 0.001 to 0.05 cm/sec. Because the gradation of Entrada sand is very uniform, the permeability is likely 0.01 cm/sec or greater. Therefore, the properties of Entrada sand represent a reasonable compromise between filtration of fine tailings and the conveyance of drainage to the collection system.

B.3 Sand and Gravel Filter Properties

The middle layer of the drainage filter will consist of a processed material from the rocky soil in the quarry area near the mill site. There are large stones present in this rocky soil so the processing will necessarily include screening to remove stones larger than approximately three (3) inches in diameter. Because there will be a protective Entrada sand layer between the sand and gravel filter and the synthetic liners, the presence of coarse gravel-sized stones is acceptable. However, the size of the individual stones in the sand and gravel filter will be limited to approximately three (3) inches to facilitate placement within a six (6) inch thick layer. There will also be a layer of Entrada sand above the sand and gravel filter, so there is no concern for penetration of tailings into the sand and gravel filter. The primary function of the sand and gravel filter is to provide lateral and vertical conveyance of the drainage from the tailings to the drainage collection system.

Figure B-2 presents a comparison of the Entrada sand gradation with three gradations of potential sand and gravel filters. The Quarry Fines sample was taken as the less than ½ inch fraction from the QU3 sample taken during a 2002 evaluation of the site. This gradation is generally coarser than the Entrada sand, and represents the finest material that would be considered for the sand and gravel filter. The Screened Rocky Soil gradation was generated by a virtual recombining of the Quarry Fines with the material between ½ inch and 3.25 inches from the original QU3 sample. This reflects the expected product that will result from a single screening operation the removes the larger than 3 inch fraction. The third sand and filter gradation (Double Screened Rocky Soil) represents the expected product when the quarry material is processed through a double screen to remove the larger than 3 inch fraction and a significant portion of the smaller than ¼ inch fraction. Since it is not necessary to remove all fines from sand and gravel filter, and the presence of some fine to coarse sand is desirable, it was assumed that the screening operation would be operated at a feed rate that resulted in the removal of 70% by weight of the less than ¼ inch fraction.

The gradations for the Screened Rocky Soil and Double Screened Rocky Soil represent the target range for the sand and gravel filter. This material is significantly coarser than the Entrada sand, which should result in a greater permeability. However, the presence of even a very small sand fraction within the screened quarry material will keep the D_{15}/d_{85} ratio generally in the range of 0.8 to 5. Significant intrusion of the Entrada sand into the sand and gravel filter is unlikely, but minor intrusion at the interface to the internal filter layer will not adversely affect the filter system performance. Depending on the processing operations, the proposed sand and gravel filter may be slightly gap-graded. However, it is the internal layer in a three layer filter system, and will be placed at a thickness of approximately six (6) inches, which should allow easy detection and correction of placement operations that result in segregation or other adverse placement conditions.

It would be possible to eliminate any gap grading from the sand and gravel filter by more aggressive screening to remove sand, silt and clay from the quarry area rocky soil. Figure B-3 presents a possible gradation for such a highly processed material. This material is generally less desirable as a sand and gravel filter material because the differential in size when compared with Entrada sand is so great that the intrusion of Entrada sand into the middle filter layer will be dramatic. If the Entrada sand does dramatically intrude into the gravel filter layer, the resulting filter system would likely be less permeable than the situation where the separation of the layers is maintained. However, the gradation shown in Figure B-3 does indicate that it may be possible to produce a gravel material for the collection sumps with additional processing of the quarry area material.

B.4 Discussion

The combination of Entrada sand and a processed rocky soil material for a three layer filter results in a drainage filter system that should meet all performance objectives. The Entrada sand upper and lower filter layers will: prevent intrusion of tailings into the drainage collection system, guard the HDPE liner, and provide sufficient permeability to convey drainage to the collection system. The screened sand and gravel filter adds: enhanced permeability to rapidly convey drainage to the collection system, and multiple materials in the filter system to avoid compromising the entire system in the event of unforeseen chemical or physical degradation of a particular material.

B.5 References

Harr, M.E., 1962, “Groundwater and Seepage”, McGraw-Hill, New York.

USDA - NRCS, 1994, Part 633 – National Engineering Handbook, Chapter 26 - Gradation Design of Sand and Gravel Filters, U.S. Department of Agriculture, Washington D.C.

USDA - SCS, 1973, “Drainage of Agricultural Land”, Water Information Center, Inc. Port Washington, New York.

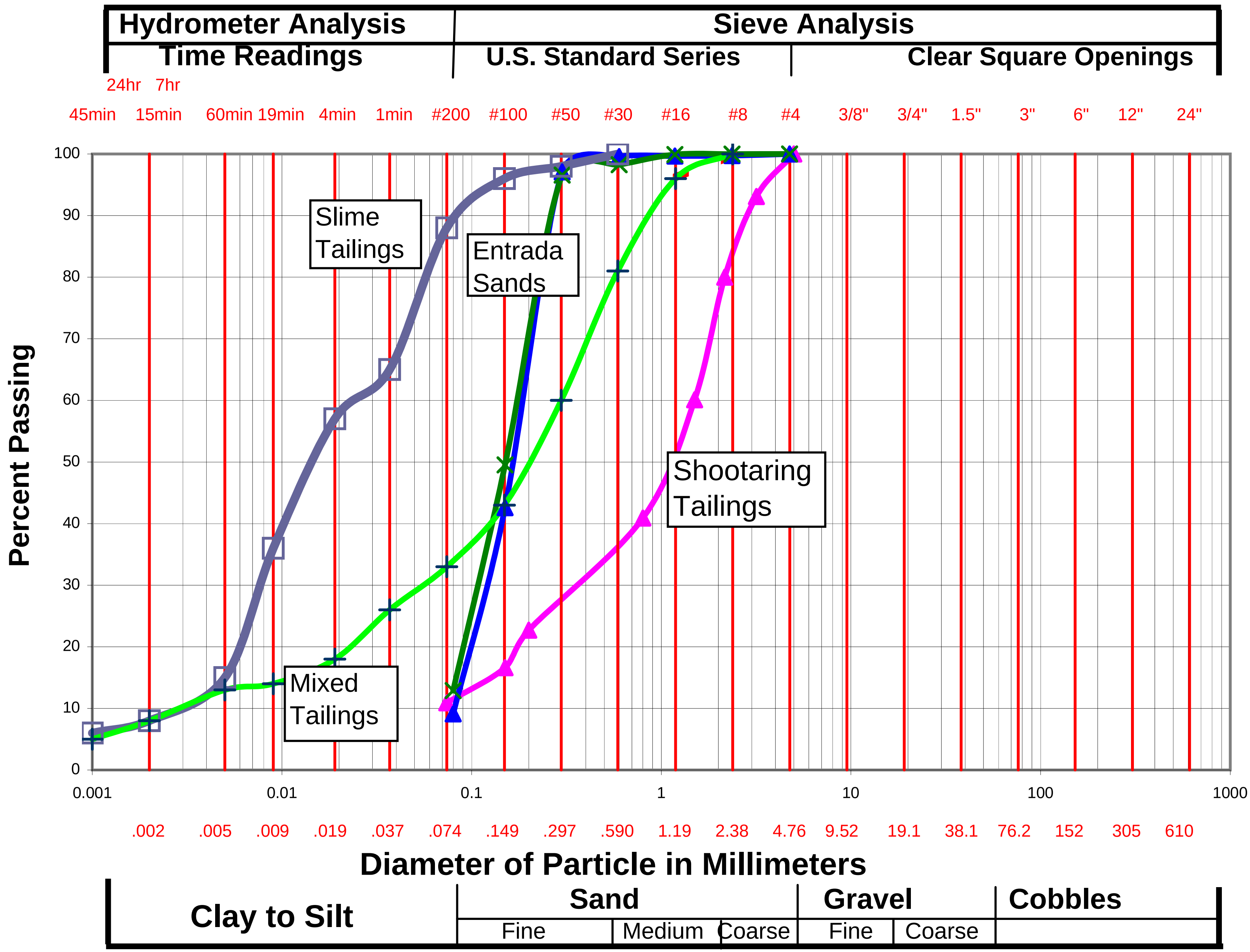

FIGURE B-1. ENTRADA SAND AND TAILINGS GRADATIONS

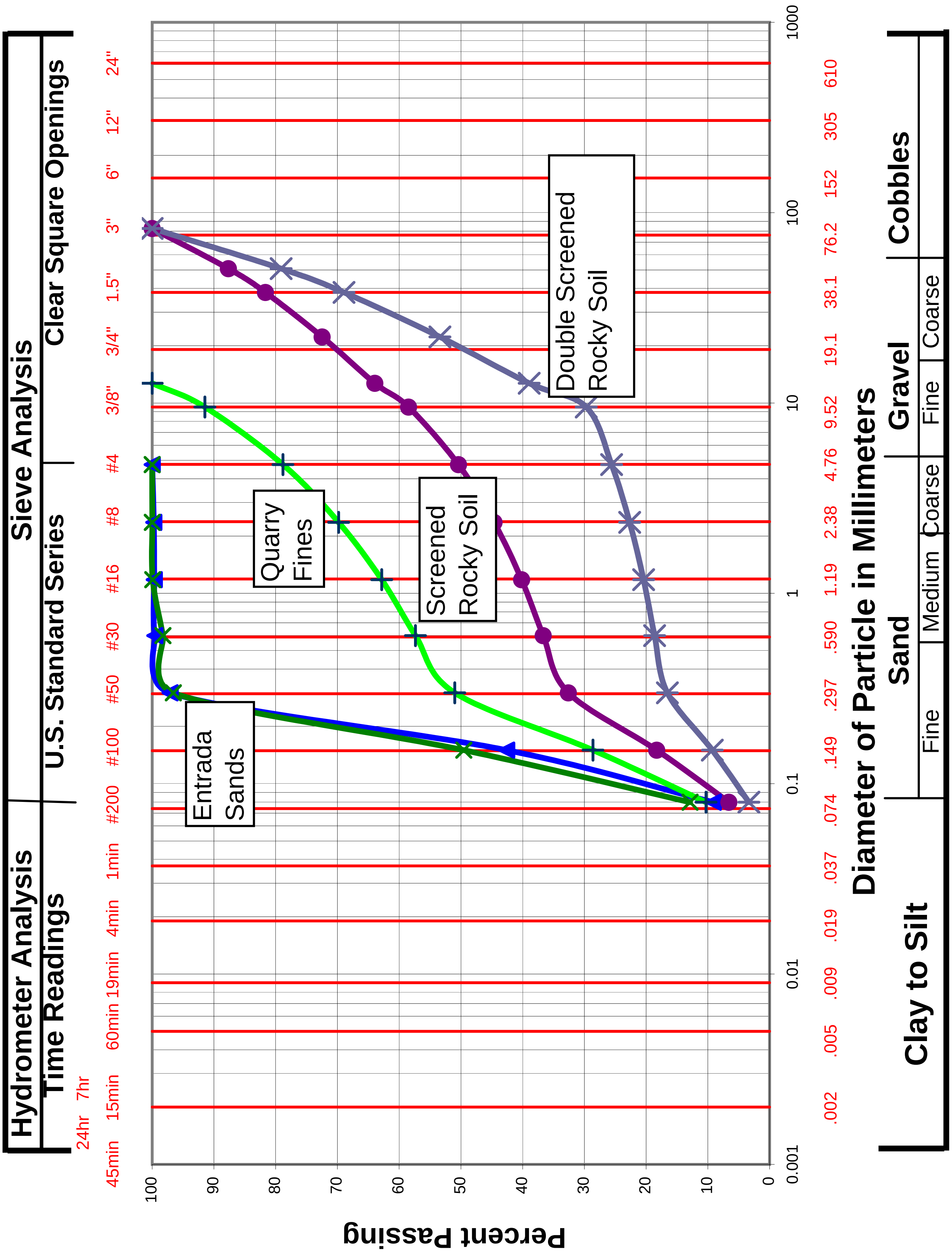

FIGURE B-2. ENTRADA SAND AND GRAVEL FILTER GRADATIONS

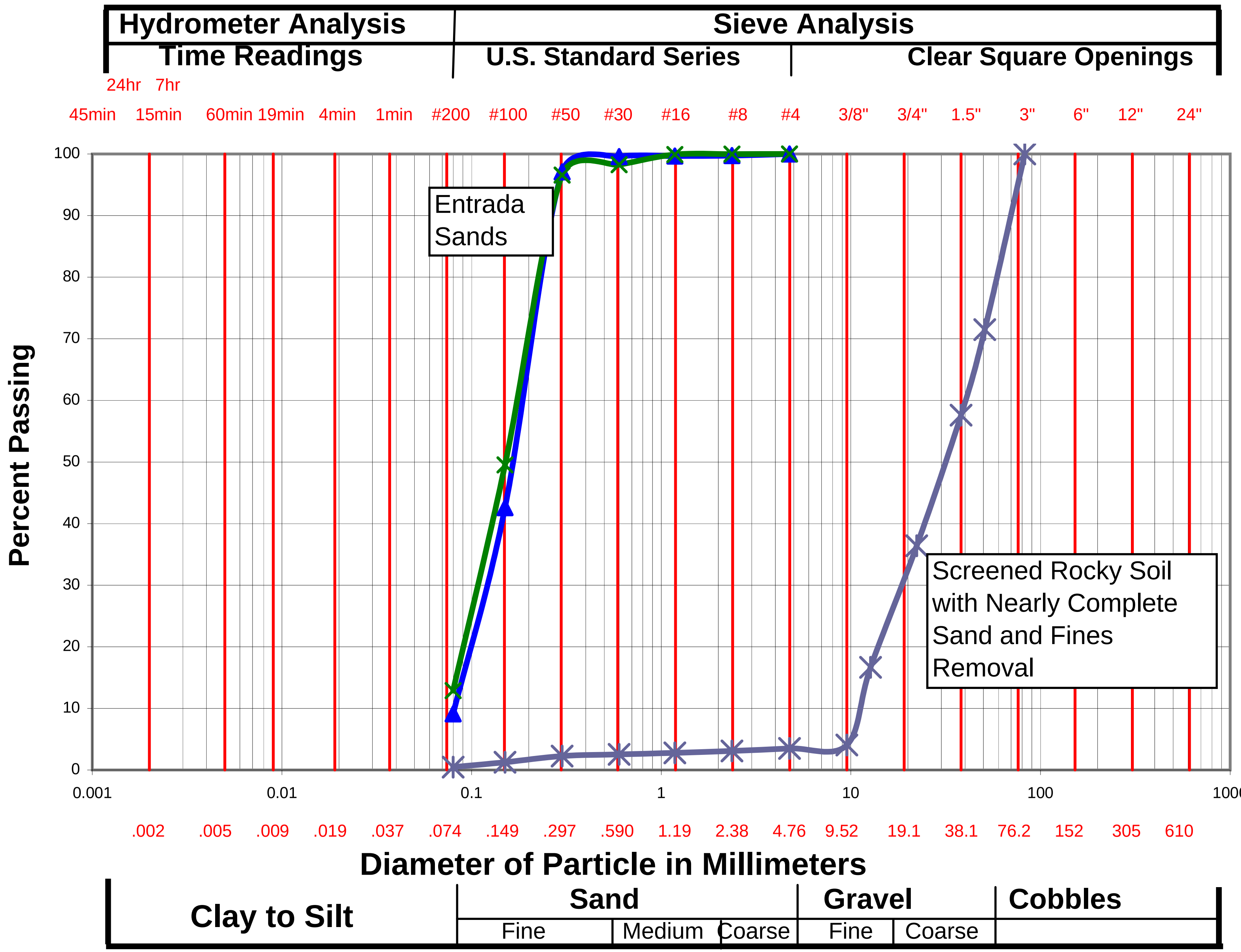

FIGURE B-3. HIGHLY PROCESSED SAND AND GRAVEL FILTER GRADATION

APPENDIX C

TAILINGS CONSTRUCTION CONTROL AND QUALITY ASSURANCE

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ATTACHMENTS

1.0 SCOPE OF QUALITY PLAN

The Quality Plan for the Tailings Impoundment Liner construction hereinafter referred to as the Quality Plan describes the implementation of the Construction Quality Control/Quality Assurance (QC/QA) methods and procedures. The Quality Plan shall be comprised of the following:

- Surveys, Inspections, Sampling and Testing
- Changes and Corrective Actions
- Documentation Requirements
- Construction Verification Program
- Quality Control Procedures

2.0 QUALITY PLAN OBJECTIVES

The main objectives of the Quality Plan for this project are to effectively control the quality of work performed, to verify that any and all construction activities are performed in accordance with the Plans and Specifications and to provide cross checks and audits to assure proper implementation of the quality control activities. Proper implementation of these objectives will provide detailed documentation of the project and assure that construction activities have been truly performed as specified in the Plans and Specifications.

3.0 DEFINITIONS

Compliance Report: A report prepared by the Quality Control Officer upon completion of a Construction Segment. Any subsequent Construction Segment that is dependent upon successful completion of a specific Construction Segment cannot not be initiated until a Compliance Report is prepared and approved for the previous dependent Construction Segment. The Compliance Report requires approval by the Design Engineer and the Site Manager. Compliance Reports are to be completed on Form No. PR-20.

Construction Task: A feature of the Construction Project involving a specific construction activity.

Construction Segment: An essential construction component consisting of one or more Construction Tasks of the Project. Upon completion of a Construction Segment, a Compliance Report is required to verify that this project component was constructed in accordance with the Final Plans and Specifications.

Construction Project: The total authorized/approved project, as defined in the Plans and Specifications, that requires several Construction Segments to complete.

Design Change: Any change made in the Construction Project that alters or changes the intent of the Plans and Specifications. Design changes require approval from the Design Engineer and the Site Manager or his designated representative. Design Changes are to be reported on Form No. PR-22.

Field Change: Changes made during construction to fit field conditions that do not alter the intent of the Final Plans and Specifications. Field changes require approval from the Site Manager or his designated representative. Field changes are to be reported on Form No. PR-21.

Final Construction Report: A report prepared by the Design Engineer or his designated representative upon completion of the construction project. This report shall contain "as-built" drawings, material tests, summaries, Compliance Reports and photographs of the construction activities associated with the Construction Project.

Quality Assurance: A planned system of activities and audits that establishes and exercises control over the reliability of any data produced, in terms of precision, accuracy, completeness and comparability.

Quality Control: A planned system of activities, tests and inspections by the designated Quality Control Officer or representative(s), used to directly monitor and control the quality of construction activities set forth in the Plans and Specifications.

4.0 QUALITY CONTROL/QUALITY ASSURANCE

4.1 Methodology

4.1.1 <u>Flow of Activities</u>

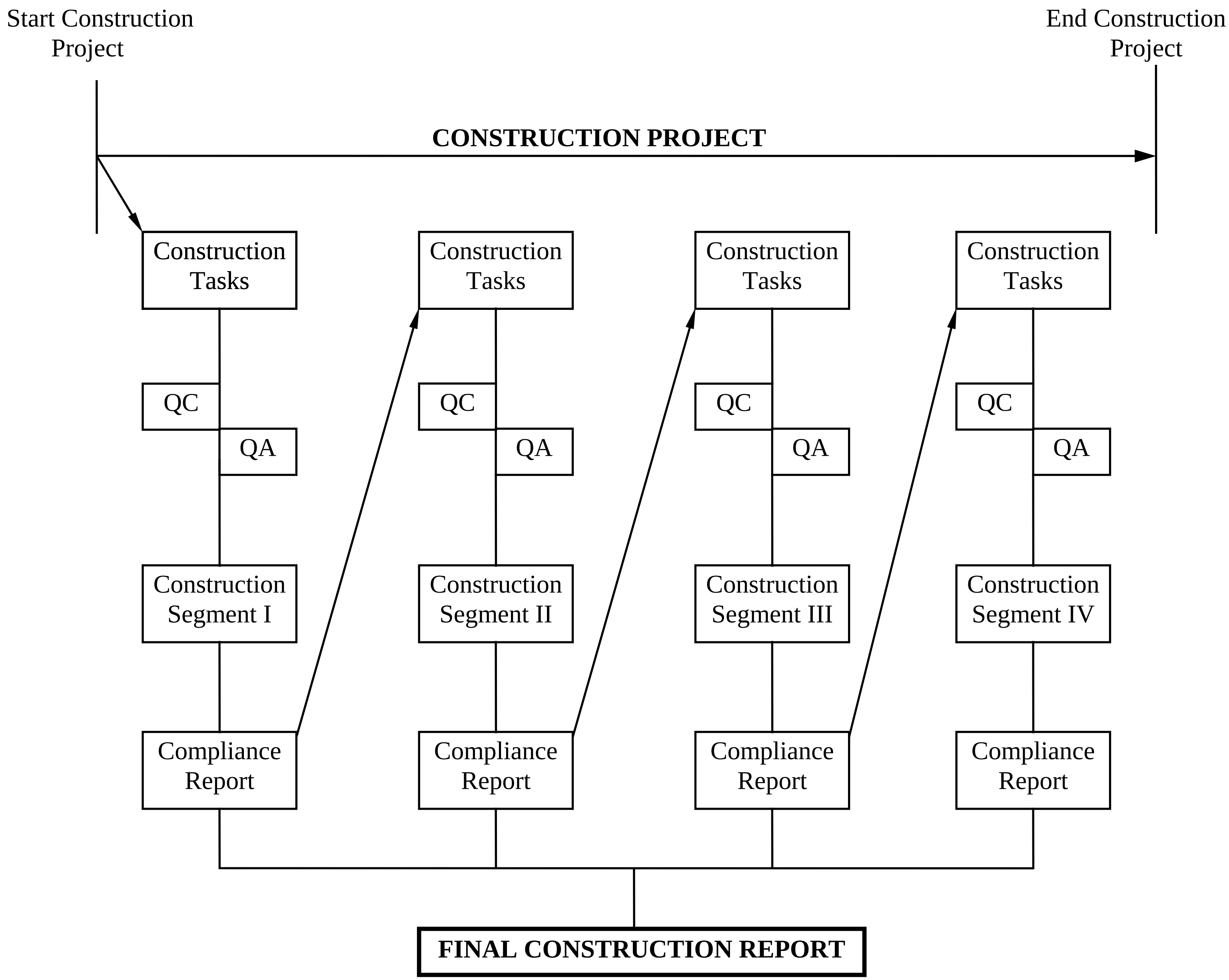
Figure 1 illustrates the general relationship between Quality Control and Quality Assurance activities and construction elements for any given project. The Quality Control activities, implemented with standardized Quality Control procedures provide the necessary tests and observations for construction monitoring and sampling. Quality Assurance audits and data validation will provide independent oversight of the Quality Control activities.

4.1.2 <u>Compliance Reports</u>

The Quality Plan requires a Compliance Report to be submitted upon the successful completion of a Construction Segment. The Construction Tasks that make up any Construction Segment shall be determined to be in compliance with the Plans and Specifications by the Quality Control Officer (hereinafter referred to as QC Officer). A Compliance Report along with all applicable support data will be prepared by the QC Officer and submitted to the Design Engineer and the Site Manager for approval before the next phase of construction can begin.

Upon completion of the Construction Project, a Final Construction Report shall be prepared by the Design Engineer or his designee for submittal to the proper Regulatory Agencies.

FIGURE 1 - TYPICAL FLOW CHART for CONSTRUCTION QUALITY CONTROL and ASSURANCE



4.2 Quality Control

4.2.1 General

Quality Control (QC) will be conducted under the direction of the QC Officer or his designee. The QC Officer will implement and administer the QC Program. The QC Officer may be an employee of the company or a Consultant, providing all qualifications are met.

4.2.2 Duties of the Quality Control Officer

The Quality Control Officer shall be responsible for the overall implementation and management of the Quality Control Program. He shall supervise field and laboratory Quality Control Technicians and control documentation of construction, quality control and quality assurance activities. He shall have specific authority and responsibility to reject any work or materials, to stop work, to require removal or replacement of unsatisfactory workmanship or materials, to specify and require appropriate corrective action if it is determined that the personnel, instructions, controls, tests or records are not in conformance to the Quality Control Program. The Quality Control Officer's signature shall be required on all Compliance Reports, inspections and tests.

The Quality Control Officer shall be familiar with the existing facilities and acceptable Quality Control/Quality Assurance methodologies. As Quality Control Officer, his responsibilities shall include the following:

- Conduct inspections and quality control testing to verify and document compliance with the Plans and Specifications.
- Must be familiar with all documents, requirements, equipment, and procedures relating to the project construction.
- Provide and document Quality Control Technician training.
- Prepare Compliance Reports.
- Arrange consultation with staff, the QA Officer, Site Manager, and/or Design Engineer to resolve problems or needs in order to keep the project running smoothly and on track.
- Identify invalid, unacceptable or unusable data.
- Take corrective action if Quality Control inspections and testing indicate that construction is not meeting the Plans and Specifications.
- Assure all documentation is complete, accurate and up-to-date.
- Interact and cooperate with construction and QA personnel.

4.2.3 Quality Control Technicians

The QC Technicians shall be classified as follows:

- Field Technicians

- Laboratory Technicians

Quality Control Technicians may be qualified for and perform the duties required for field, laboratory or both upon approval of the QC Officer.

The QC Officer shall supervise or appoint a supervisor for each classification to provide scheduling, to verify equipment calibrations and to assure documentation of the field observations and laboratory tests. The number of technicians in each classification will depend on project needs as the work progresses. The Quality Control Technicians shall satisfactorily complete a training program or demonstrate knowledge of construction testing and receive on-the job training as required under the direction of the QC Officer.

4.2.4 Quality Control Activities

Quality Control activities are presented in Section 7 of the Quality Plan. A verification program will assure that the construction activities are inspected and documented in a logical organized manner so that any or all data and results are easily retrievable.

The Quality Control activities will be implemented with standardized Quality Control Procedures. These Quality Control Procedures include field sampling, testing, laboratory testing procedures, observation and monitoring procedures. The Quality Control Procedures are included in the Quality Plan.

4.3 Quality Assurance

4.3.1 General

The effectiveness of the QC program will be verified by the Quality Assurance Officer (hereinafter referred to as the QA Officer) by means of internal audits on the sampling and testing equipment, calculations, documentation and personnel qualifications.

The QA Officer shall review all areas of deficiency identified within the QC activities and the subsequent corrective actions taken. QA audit reports will be prepared by the QA Officer and submitted to the Design Engineer. These audit reports will be kept in the project files and made available for review.

4.3.2 Duties of the Quality Assurance Officer

The Quality Assurance Officer shall implement the Quality Assurance functions that include pre-qualification of QC personnel, verification of test procedures and results, equipment checks and review calculations, documentation and Compliance Reports. The QA Officer will be appointed by the Design Engineer. Responsibilities of the QA Officer will include the following:

- Be familiar with all documents, requirements, equipment and procedures relating to the project.
- Certify that the QC Officer is qualified to conduct the various test and monitoring procedures and observations.
- Review calculations and documentation of all Quality Control testing and determine reliability of data produced in terms of precision, accuracy, completeness, and comparability.
- Shall conduct thorough spot checks, re-tests, equipment checks and review of calculations and documentation. Verify that testing procedures, monitoring and observations are being performed correctly and accurately in accordance with the Specifications.
- Consult with QC Officer, Site Manager and Design Engineer to resolve any problems or deficiencies that arise.
- Prepare QA audit reports for review by the Design Engineer.

5.0 CHANGES AND CORRECTIVE ACTIONS

5.1 Scope

This section deals with methods or means of changes and corrective actions.

5.2 Authority of Personnel

The Site Manager, Design Engineer and/or the Quality Control Officer has the authority to reject material or work, to require removal or replacement, to specify and require appropriate actions if it is determined that the Quality Control/Quality Assurance, personnel, instructions, controls, test, records are not conforming to the Specifications.

5.3 Methodology

5.3.1 <u>Field and Design Changes</u>

Any changes in locations or alignments of construction features that do not alter design features or concepts shall be approved by the Design Engineer or his designated representative. These changes will require a Field Change Order (Form PR-21).

Should a change in design be necessary, (any change that alters or changes the intent of the Plans and Specifications) approval from the Design Engineer and Site Manager shall be required. These changes will be documented on a Design Change Order (Form PR-22).

All changes will be recorded in the Final Construction Report including the “as-built” drawings of the project.

5.3.2 Nonconformance and Corrective Actions

Nonconformances will be identified and verified by the QC Officer or his designee. The Construction Task or Segment shall stop work until specific corrective action is performed to alleviate the problem(s) that has evolved. The QA Officer or other qualified person can and may be contacted as needed to identify the importance of the nonconformance and issue the necessary corrective action to be taken if required.

The designated corrective action will be implemented before additional related work is permitted. The QC Officer will verify the corrective action appropriate by measurements, tests and/or other permanent documentation.

6.0 DOCUMENTATION

6.1 Scope

Documentation requirements shall include the following:

- Identify the person who has authority to provide for the submittal and/or storage of all survey, test and inspection reports.
- Shall provide a description of record keeping to document construction methods and results, surveys, sampling, testing and inspection of the project.

6.2 Document Control

Sampling, test inspections and construction records shall be maintained in the project files. A list of required reports are listed on Table 1.

A Construction Activity Report, recording quantities, thickness and locations of fill placed shall be maintained daily. Any significant events or conditions that affect placement or properties of the fill placed shall also be recorded on the daily Construction Activities Report. Each QC Technician shall complete a Construction Activities Report for each day's work. Forms shall contain all pertinent and important events of that day relating to the construction project. The minimum data required on all forms and/or notebooks shall include the project number, date, technician's signature and the signature of the QC Officer or his designee, indicating the work was reviewed and approved.

Table 2 lists titles of forms to be used for the Quality Control procedures. Examples of forms to be used during the construction project are attached to the appropriate Quality Control procedure. Similar forms may be substituted with approval from the QC Officer.

TABLE 1 - REQUIRED REPORTS

Report Type	Frequency	Originator	Approval
Construction Activities	Daily during construction	QC Technician	QC Officer
Field sampling and laboratory testing	Report for each respective test as required by the test procedure	QC Technician	QC Officer
Compliance Report	Upon Construction Segment Completion	QC Officer	Site Manager Design Engineer
Final Construction Report	After completion of the Construction project	Design Engineer	Regulatory Agency

TABLE 2 - LIST of FORMS

Form No.	Title
PR-1	Construction Activities Report
PR-2	Soil Sampling Log
PR-3	Gradation Analysis Worksheet
PR-4	Gradation Analysis with Hydrometer Worksheet
PR-5	Gradation Test Results
PR-6	Moisture Content Worksheet
PR-7	Atterberg Limits Worksheet
PR-8	Laboratory Compaction Test Worksheet
PR-9	Rock and Moisture Correction Calculations
PR-10	Moisture Density Relationship
PR-11	Summary of Laboratory Test Results
PR-12	Nuclear Density Test Data
PR-13	Field Density Tests (Sand Cone)
PR-14	Panel Placement Log
PR-15	Geomembrane Field Trial Log
PR-16	Geomembrane Seaming Record
PR-17	Geomembrane Seam Air Pressure Test Log
PR-18	Repair Log
PR-19	Geomembrane Seam Destructive Sample Log
PR-20	Compliance Report
PR-21	Field Change Order
PR-22	Design Change Order

7.0 CONSTRUCTION INSPECTION and TESTING

7.1 General

This section describes the minimum engineering practices, testing, inspection and record keeping controls considered satisfactory for implementation of the Quality Control Plan. Acceptable construction shall be verified by means of visual examination, measurements and testing. The extent of the inspection and testing programs shall be sufficient to provide adequate quality control, to satisfy all requirements of the Plans and Specifications and to furnish necessary permanent records. It is also essential that all personnel performing the inspection and testing are qualified, defined by training and experience, to perform this professional job.

The QC Officer will be responsible for establishing and maintaining the inspection and testing program. He will also assure that the inspection and testing activities are properly documented and are conducted in accordance with the Plans and Specifications.

Construction activities involved during construction of the tailings impoundment and the attendant Compliance Reports for construction are as follows:

Construction Activity	Compliance Report
1. Earthwork - Excavation and Placement	PR-TP-CR1
2. Leak Detection/Leachate Removal System	PR-TP-CR2
3. Clay Soil Liner	PR-TP-CR3
4. Synthetic Liner System	PR-TP-CR4

7.2 Performance Standards for Earthwork Construction Activities

The following QC/QA program shall be implemented for all earthwork including: preparation of the foundation, excavation and placement of materials during any phase of construction (i.e. construction of embankments, backfilling trenches, finish grading). The minimum standards for Earthwork Construction are as follows:

- Clearing, grubbing and stripping of the area shall be accomplished prior to construction of the tailings pond. After removal of the organic materials, the area will be bladed with a motorgrader or equivalent piece of equipment, to create a relatively smooth surface, free of rocks and sharp angular edges.

- Prior to placing the first layer of fill on the foundation, a final inspection of the subgrade shall be performed to assure there are no cavities, separations, or irregularities. The QC Officer shall ensure the foundation has been prepared by leveling, moistening, and compaction so the surface materials of the foundation are stable and provide a satisfactory bonding surface with the first layer of fill to be placed.

- Assure that excavations are made to the lines, grades and dimensions shown on the Drawings. Documentation of any measurements and surveys shall be reviewed by the QC Officer.

- Placement of all fill materials shall be performed in accordance with the Specifications. Items including soil uniformity, lift thickness, compaction equipment, compactive effort and production of materials placed will be continuously observed and documented. Any soils placed with scrapers, trucks or equivalent pieces of equipment are not placed in lifts exceeding eight (8) inches prior to compaction. Distribution and gradations of each material shall be, as far as practicable, free of lenses, pockets, streaks or layers of materials differing substantially in texture, gradation or moisture content from surrounding materials or subsequent lifts. Fill soils placed beneath the synthetic liners and in areas immediately adjacent to the lined cells will be compacted to at least 95 percent of the Standard Proctor maximum density (ASTM D698) at a moisture content between plus and minus two percent of the Optimum Moisture Content (ASTM D2216). Compaction can be obtained by tamping foot (sheepsfoot) roller or by splitting tracks with rubber-tired equipment or other approved methods. If the compacted surface of any layer of fill is too dry or smooth to bond properly with the layer of material to be placed thereon, it will be moistened and/or re-worked with a harrow, disk, scarifier or other suitable equipment to provide a relatively uniform moisture content and satisfactory bonding surface prior to placing the next layer of fill. If the compacted surface is too wet for proper compaction of the fill material to be placed thereon, it will be allowed to dry or be re-worked with a harrow, disk, scarifier or other suitable piece of equipment to reduce the moisture content to an allowable level. The re-conditioned layers/lifts shall all be re-compacted and re-tested to the specified requirements.

- No fill material shall be placed under adverse weather conditions, including freezing temperatures, or during or immediately after heavy precipitation events. Authorized personnel or the QC Officer shall determine when these adverse conditions exist.

7.2.1 Quality Control Procedures and Frequencies

Quality Control procedures to be utilized during construction are attached. A list of the tests and the procedures required for any Earthwork Excavation and Placement and the testing frequencies are presented below.

Procedure	**Procedure No.**
Field Inspection	QC-PR-1
Sampling of Soils and Aggregates	QC-PR-2
Particle Size Analysis	QC-PR-3
Moisture Content of Soils	QC-PR-4
Atterberg Limits	QC-PR-5
Soil Classification for Engineering Purposes	QC-PR-6

Laboratory Compaction Tests	QC-PR-7
In-place Density Tests	QC-PR-8
Compacted Soil Layer Thickness	QC-PR-9

- Field density and moisture tests shall be not less than one test for every 500 cubic yards of fill placed and in accordance with ASTM D1556, ASTM D2922, ASTM D3017, and/or ASTM D4643. There will be at the minimum at least one field density test and moisture test for each lift of material placed and for every full shift of compaction operations.

- During construction, one-point Proctor tests shall be taken at a frequency of one test for every five (5) field density tests to ensure that the correct laboratory Standard Proctor is being used.

- Gradations and Atterberg limits of compacted materials shall be performed at a frequency of not less than each 1,000 cubic yards of placed fill in accordance with ASTM D422, ASTM D2216, ASTM D4318, and/or ASTM D4643.

- The frequencies for laboratory Standard Proctor compaction tests will be such that maximum densities are determined for the entire range of materials being placed during construction, however, the frequency for compaction tests shall not be less than one test for each 5,000 cubic yards of compacted fill in accordance with ASTM D698 and/or ASTM D1557 as applicable.

- If the nuclear density gauge is used for field density and moisture content determination, a correlation test shall be taken for every ten (10) nuclear gauge tests. The Sand Cone method (ASTM D1556) shall be used for correlation for density determination and the Oven Drying method (ASTM D2216) for moisture content. Alternate methods may be used, such as, the Rubber Balloon method (ASTM D2167) for density correlation and the Microwave Oven method (ASTM D4643) for moisture content with approval by the QC Officer or Design Engineer. Density and moisture correlations shall be evaluated in accordance with the method as described in USBR 7230, Section 9.

7.3 Performance Standards for Installation of the Leak Detection/Leachate Removal System

The following QC/QA program shall be implemented for excavation and installation of each component for the Leak Detection/Leachate Removal System. Backfilling of the trenches/ditches will be monitored to be in accordance with Earthwork Construction quality procedures (Section 7.2). The minimum standards for installation of the Leak Detection/Leachate Removal System are as follows:

- Verify that materials to be utilized for installation satisfy the specified requirements. The QC Officer shall document on the proper form and transmittal sheets, acceptance of the materials or reasoning for non-acceptance.

- Ensure that excavations of the leak detection drains are made to the lines, grades, and dimensions shown on the Drawings. Documentation of any measurements and surveys shall be reviewed by the QC Officer prior to placement of pipe or drainage materials.

- Check that the installation of the drain pipe and sump are in conformance with the Specifications. Any pipe used for the system shall be joined together in accordance with the manufacturer's recommendation.

- Verify that the correct type of drainage material with the specified gradations is placed. The placed material should be clean and free of unsuitable material, placed in a manner that minimizes segregation and placed to the lines and grades as designated in the Specifications and on the Drawings.

7.3.1 Quality Control Procedures

Quality Control Procedures to be utilized during construction are attached. A summary of the tests and the procedures required for installation of the Leak Detection/Leachate Removal System are listed below:

Procedure	**Procedure No.**
Field Inspection	QC-PR-1
Sampling Aggregate and Soils	QC-PR-2
Particle Size Analysis	QC-PR-4

Any backfilling of the trenches/ditches shall be inspected and tested in accordance with the Earthwork Construction procedures and frequencies.

7.4 Performance Standards for Construction of the Clay Liner

The following QC/QA program shall be implemented for excavation, conditioning, placement and compaction of the clay liner system. The minimum standards for construction of the Clay Liner are as follows:

- Ensure that final grading and preparation of the subgrade has been performed in accordance with the Specifications and to the lines and grades shown on the Drawings. The QC Officer shall review the documentation of any measurements and surveys prior to clay liner placement.

- A final inspection of the foundation is to be performed to assure that it has no deterioration due to frost action, erosion, rutting, areas of subsidence, or drying out of the surface. The inspection shall also verify that the foundation material has been moistened, but there is no standing water on the surface. Any unacceptable surface material will either be removed or re-compacted to the Specifications.

- Laboratory tests shall be conducted on the materials obtained from the borrow site to ensure the materials are within the limits specified in the Specifications. Clay soils used for construction of the clay liner shall classify as CL, CH, or SC by the Unified Classification System and conform to the following physical requirements:

    1. At least 30 percent passing the No. 200 sieve.

    2. Maximum particle size of 1 inch.

    3. Liquid limit of the material shall be at least 25 percent with a minimum plasticity index of 10 in accordance with ASTM D4318.

    4. Maximum hydraulic conductivity of 1E-7 cm/sec when compacted to 95 percent of Standard Proctor maximum dry density within the specified moisture range as determined by ASTM D698 and ASTM D2216.

- As far as practicable, the soils will be brought to the proper moisture content prior to placement. Conditioning of the clay can be achieved by disking and adding water in a stockpile, processing with a "pug mill" or any other similar method approved by the QC Officer.

- Clay placement shall be performed in accordance with the Specifications. Items including soil uniformity, lift thickness, compaction equipment, compactive effort and production of materials placed shall be observed and documented. Lifts shall not exceed eight (8) inches prior to compaction. Distribution shall be, as far practicable, free of lenses, pockets, streaks or layers differing substantially in moisture content from subsequent lifts. The clay will be compacted to at least 95 percent of the Standard Proctor maximum dry density in accordance with ASTM D698, at a moisture content between minus two (-2) and plus four (4) of the optimum moisture content as determined by ASTM D2216 or ASTM D4643 (if approved by the QC Officer). Compaction can be obtained by tamping foot (sheepsfoot) rollers or equivalent types of equipment. After placing the clay, maintenance of the moisture content must be addressed at all times.

- Placement of the clay shall be accomplished in a manner to alleviate loss of moisture. Once the first lift has been placed over an area, and been compacted and tested, the subsequent lift should be placed directly over that area that has passed the compaction and moisture specifications. The entire clay liner system shall be constructed by alternating the first and final lifts in areas sufficient in size to minimize congestion between equipment placing and compacting the clay liner. This method or an approved alternate should be performed throughout the placement of the clay liner system. After the final lift has been placed, the clay shall be kept moist by application of water from a water truck or water wagon. Continuous visual monitoring of the placed clay shall be performed. Any areas that are suspected to have dried will be re-tested and a moisture content shall be obtained with either a nuclear density gauge (ASTM D3017) or a sample obtained for a laboratory test (ASTM D2216 or ASTM D4643). Documentation of any re-testing is mandatory. The Lining Contractor should be scheduled so that commencement of the synthetic liner system begins as soon as possible after the clay liner has been constructed.

- No disking will be allowed on the first lift of placed clay. It will be necessary to remove the dried clay and re-condition it off of the floor or slope of the cell. Disking or scarifying the initial lift could allow mixing of the clay with the foundation materials altering the permeability coefficient of the clay materials. If any of the compacted lifts, other than the first, are too dry or smooth to bond properly with the next layer to be placed thereon, it will be moistened and/or re-worked with a harrow, disk, scarifier or other equivalent piece of equipment to provide a relatively uniform moisture and satisfactory bonding surface prior to placing the next layer of clay. If any of the compacted lifts, other than the first, are too wet for proper compaction of the clay to be placed thereon, it will be allowed to dry or re-worked with a harrow, disk, scarifier or other piece of suitable piece of equipment to reduce the moisture content to an allowable level. That layer or lift will then be re-compacted and re-tested to the specified requirements. The final lift of clay shall be graded and compacted with a smooth-drum roller in order to prepare a smooth surface for the installation of the geomembrane liner.

- In areas where the existing clay liner will be preserved and used for the clay liner for the newly constructed cell, the upper one foot thickness of clay will conform to the same specifications as newly placed clay. Disking or scarifying and in-place moisture conditioning will be allowed provided there is no penetration of the clay or other mixing with unsuitable material.

- No clay shall be placed under adverse weather conditions, including freezing temperatures or immediately or during heavy precipitation events. Authorized personnel or the QC Officer shall determine when these adverse conditions exist.

7.4.1 <u>Quality Control Procedures and Frequencies</u>

Appendix F contains the Quality Control procedures to be utilized during construction of the clay liner. A list of the tests and procedures required during this phase of construction and the testing frequencies are presented below.

Procedure	Procedure No.
Field Inspection	QC-PR-1
Soil Sampling Log	QC-PR-2
Particle Size Analysis	QC-PR-3

Moisture Content of Soils	QC-PR-4
Atterberg Limits	QC-PR-5
Soil Classification for Engineering Purposes	QC-PR-6
Laboratory Compaction Tests	QC-PR-7
In-place Density Tests	QC-PR-8
Compacted Soil Layer Thickness	QC-PR-9

- Field density and moisture tests shall be not less than one test for every 500 cubic yards of clay placed and in accordance with ASTM D1556, ASTM D2922, ASTM D3017, and/or ASTM D4643. There will be at the minimum at least one field density test and moisture test for each lift of material placed and for every full shift of compaction operations.

- During construction, one-point Proctor tests shall be taken at a frequency of one test for every five (5) field density tests to ensure that the correct laboratory Standard Proctor is being used.

- Gradations and Atterberg limits of compacted materials shall be performed at a frequency of not less than each 1,000 cubic yards of placed fill in accordance with ASTM D422, ASTM D2216, ASTM D4318, and/or ASTM D4643.

- The frequencies for laboratory Standard Proctor compaction test will be such that maximum densities are determined for the entire range of materials being placed during construction, however, the frequency for compaction tests shall not be less than one test for each 5,000 cubic yards of compacted fill in accordance with ASTM D698 and/or ASTM D1557 as applicable.

- If the nuclear density gauge is used for field density and moisture content determination, a correlation test shall be taken for every ten (10) nuclear gauge tests. The Sand Cone method (ASTM D1556) shall be used for correlation for density determination and the Oven Drying method (ASTM D2216) for moisture content. Alternate methods may be used, such as, the Rubber Balloon method (ASTM D2167) for density correlation and the Microwave Oven method (ASTM D4643) for moisture content with approval of the QC Officer or Design Engineer. Density and moisture correlations shall be evaluated in accordance with the method as described in USBR 7230, Section 9.

- For every 10,000 cubic yards of clay placed, clay liner composite samples of the placed clay shall be collected and tested for hydraulic conductivity. These samples shall re-molded and compacted to 95 percent of the Standard maximum dry density at a moisture content between minus 2 (-2) and plus four (4) as determined by ASTM D698 and ASTM D2216 respectively.

7.5 Performance Standards for Installation of the Synthetic Liner System

The following QC/QA program shall be implemented during installation of the synthetic liner system. The minimum standards are as follows:

- The Lining Contractor shall use adequate numbers of skilled workmen whom are thoroughly trained and experienced in the necessary skills and methods for placement of the liner system. At least one seaming operator “Master Welder”, shall have a minimum of 10,000,000 square feet of geomembrane seaming experience using the same type of seaming apparatus to be utilized for the project. The “Master Welder” shall provide direct supervision, as required, over less experienced operators. No seaming operations will be permitted if the Contractor’s quality control and supervisory personnel are not onsite to direct and/or observe production welding. Other seaming operators shall have seamed a minimum of 1,000,000 square feet of geomembrane. Apprentice seamers shall be qualified by completion of at least two successful geomembrane test seams performed under similar weather conditions and seaming procedures used for production seaming. These tests must be witnesses by the QC Officer or his representative.

- Prior to installation of the lining system, the Lining Contractor shall provide written approval verifying the subgrade has been properly prepared and is acceptable for lining installation. If any deficiencies are noted, arrangements to correct the deficiencies, to the satisfaction of the Lining Contractor shall be administered. The area on which the liner is to be placed shall be smooth and free of projections or depressions that may cause puncturing or stretching.

- The synthetic liner material shall be new, first quality product manufactured for the purpose of liquid containment. The materials shall be free of holes, blisters, undispersed raw materials or contamination by any foreign material. Geomembrane material shall be shipped and delivered in rolls free of seams. Delivery of the geomembrane must be made in the original wrappings indicating the name of the manufacturer, product identification, roll number, roll thickness, roll dimensions, resin type and date of manufacture. The Lining Contractor also shall submit proper certification from the manufacturer that all synthetic materials meet or exceed all the physical property criteria for the intended application. The QC Officer or his designee shall verify shipment of all materials and ensure Roll Numbers match the Invoice or Bill of Lading.

- Sand bags will be utilized to hold the liner in place during installation. On-site materials may be used to fill the bags as long as the materials are free of rocks or other sharp particles that could puncture the lining. The QC Officer shall ensure that there are adequate provisions on-site to protect the synthetic materials from wind displacement during installation.

- Anchor trenches shall be excavated just prior to installation of the liner system. The anchor trenches shall be excavated to the lines and grades shown on the Drawings or as modified by the QC Officer in the field. Backfilling of the anchor trenches shall not be allowed until the liner has been through several expansion/contraction cycles. The Lining Contractor shall be responsible for securing the lining system in the anchor trench with an adequate number of sandbags or other approved method by the QC Officer until the anchor trench can be backfilled. Rounded edges shall be provided in the anchor trenches where the geomembrane enters into the anchor trench to provide subgrade support and to avoid sharp bends in the geomembrane. The geomembrane shall be seamed completely to the ends of the panels to minimize the potential of tearing along the seams.

- Prior to installation, the Lining Contractor shall provide the QC Officer with a panel layout indicating the general panel configuration intended. Panels shall be oriented perpendicular to the line of the slope crest (i.e. down and not across the slope).

- The method and equipment used to deploy the liner shall not damage the material to be installed, the already installed materials or the subgrade in any way. Geomembrane shall be unrolled using methods that will not damage, stretch, or crimp the geomembrane and protect the underlying subsurface from damage. Personnel walking on the liner shall not engage in activities or wear any types of shoes that could damage the liner. Vehicular traffic such as cars, truck, ATV's, etc. directly on the liner will not be permitted. Equipment shall not damage the geomembrane by handling, trafficking, leaking of any hydrocarbons or any other means. The geomembrane shall not be utilized as a work or storage area. If needed, a protective cover may be spread out as a work or storage area on the liner. Smoking is strictly prohibited when on the liner.

- The bottom layer of the liner shall consist of a geomembrane of High Density Polyethylene (HDPE) with a typical thickness of 60 mils. The geomembrane manufacturer shall be listed by the National Sanitation Foundation as having met Standard 54 requirements for flexible liners. Resin used to manufacture the geomembrane shall be formulated to be resistant to chemical and ultraviolet degradation. The geomembrane material shall be free of any plasticizers or other leachable additives. Material properties for the geomembranes are presented in Table 3.

- Double wedge fusion welding (hot shoe) will be the primary means of welding. Seaming methods other than the method specified above will require prior approval by the QC Officer. The acceptance or rejection shall be based on data submitted by the Lining Contractor and shall include recommendations from the manufacturer, case history and laboratory testing. Double wedge fusion welding shall be performed in accordance with these Specifications and the manufacturer's recommendations. The two sheets of geomembrane to be joined together, shall be properly positioned so that a minimum overlap of 4 inches and a maximum of 6 inches exist. "Fishmouths" or wrinkles at seam overlaps shall be cut to achieve a flat overlap. The cut "fishmouths" or wrinkles shall be either extrusion welded if the cut is less than 3 inches in length or patched with a cap if the area cut is longer than 3 inches. If a sudden change in temperature should occur, readjustment of the panel to the acceptable overlap limits must be accomplished. The exact width of overlap is dependent on the width of the wedge element being used. All cutting and preparation of odd shaped sections or small fitted areas must be completed at least 50 feet ahead of the seaming operation in order to allow the seaming operation to proceed with as few interruptions as possible. Overlapped sheets ready for seaming must be completely free of moisture and dirt in the area of the seam. No seaming shall be allowed during rain or snow unless proper precautions are made to allow seaming on dry materials within an enclosure or shelter. Ambient temperatures shall between 32° F (0° C) and rising up to 104° F (40° C) when measured two feet above the surface of the liner. Seaming will not be allowed on frozen or saturated subgrade without taking proper corrective actions approved by the QC Officer.

- Extrusion welding will be used only for repairs and detail work such as around pipes and sumps. All extrusion fillet seams shall be in accordance with the Specifications and the manufacturer's recommendations. Prior to extrusion welding, all surfaces shall be clean and dry. A hot air device or hot air wedge (Lyster) shall be used to "tack" the two sheets together. This tacking procedure is not intended to be the primary seam but, simply creates a light bond between the two sheets, securing their position. Grind marks should not be deeper than approximately 5 percent of the geomembrane thickness. The main purpose for grinding is the removal of oxide layers and dirt from the liner surfaces and to roughen the interface for the extrudate. Grinding marks shall not extend beyond 1/4 inch of either side of the extrudate after its placement. Any grinding marks appearing more than 1/4 inch beyond the extrudate will require repair by placement of a cap over the entire seam or patch where the excessive grinding occurred. Seaming must take place no more than 10 minutes after grinding to ensure the surface oxide layers do not reappear to the area prepared for the extrudate. The welding rod shall be made from the same resin and free from dirt, dust, moisture and tangles at all times. The extrusion welder's barrel shall be purged of heat-degraded extrudate for approximately 30 seconds before beginning to seam. This must be done every time the extruder is restarted after two or more minutes of inactivity. The purged extrudate shall be disposed of properly, not on the surface of placed liner or on the subgrade, where it could damage the liner in any way. The bottom portion of the welding die must stay in contact with the sheet surface and conform to the various seam angles and configurations. The placed extrudate should be approximately twice the specified sheet thickness, measured from the top of the bottom sheet to the top or "crown" of the extrudate. Excessive squeeze-out is acceptable, only if it is equal on both sides and does interfere with subsequent vacuum box testing. However, if the extrudate can be pulled off of the seam by the squeeze-out, the weld is considered unacceptable. If the seaming process is interrupted during mid-seaming, the extrudate should trail of gradually and not in a large mass of solidified extrudate. Where such welds are abandoned long enough to cool, a new patch strip shall be placed over the entire existing patch. No extrusion welds will be permitted over the top of another extrusion weld or side-by-side of another weld. The only cases that extrudate will be allowed over the top of another weld is for “T” or “Y” shaped seams after the existing weld has been ground. In the event an extrusion weld cannot be tested with a vacuum box, provisions must be provided for the seam to be spark tested according to the spark tester manufacturer’s procedures.

TABLE 3 - Material Properties for HDPE Geomembrane

Property	Test Method	Minimum Requirement
Thickness (mils minimum ± 10%)	ASTM D1593, Paragraph 8.1.3	54
Specific Gravity (g/cc minimum)	ASTM D792, Method A	0.94
Melt Index (g/10 minutes max.)	ASTM D1238	≤ 0.50
Carbon Black Content (%)	ASTM D1603	2 - 3
Carbon Black Dispersion	ASTM D3015	A1,A2,B1
Minimum Tensile Strength (each direction) 1. Tensile strength yield (lb/in. width) 2. Tensile strength break (lb/in. width) 3. Elongation at yield (%) 4. Elongation at break (2” G.L.) % (2.5” G.L.) % 5. Modulus of elasticity (psi)	ASTM D638 (Mod. Per NSF Std. 54)	 140 240 13 750 560 80,000
Tear Strength (lb.)	ASTM D1004	45
Puncture Resistance	FTMS 101 - 2065 ASTM D4833	80 120
Low Temperature Brittleness	ASTM D746	< -112° F
Environmental Stress Crack Resistance (hrs)	ASTM D1693 (Condition B)	2,000
Dimensional Stability (%)	ASTM D1204	± 2

7.5.1 Quality Control Procedures and Frequencies

Quality Control of the geomembrane liner placement shall be furnished by the Lining Contractor. PRL shall monitor and maintain that liner deployment is in accordance with the Specifications through its Quality Assurance Program. A list of the tests and procedures required during this phase of construction and the testing frequencies are presented below.

Procedure	Procedure No.
Field Inspection	QC-PR-1
HDPE Liner Seam Integrity	QC-PR-10

- The Lining Contractor shall qualify each seaming apparatus (double wedge fusion and/or extrusion welder) and operator at the start of each day or shift of seaming, and at least once every 4 hours thereafter. A representative seam fabricated from the same sheet material and using the same seaming procedure to be utilized for production welding shall be submitted to the QC Officer or his representative. The
start-up seam shall be a minimum of 12 inches wide by 10 feet in length with the seam being centered lengthwise within the strip. Five specimens shall be obtained from each end of the strip. A tensiometer will be utilized to test five of the specimens for shear and five specimens for peel. Shear and peel tests shall result in Film Tearing Bond (FTB) as defined by NSF Standard 54, which is a failure in ductile mode of one of the bonded sheets by tearing prior to complete separation in the bonded area. Should any seam fail to meet the Specifications, the seaming device and/or seamer shall not be accepted and will not be used for any seaming until the deficiencies are corrected and two successful start-up seams have been accepted. The Lining Contractor's quality control officer/technician shall initial each test seam submitted, indicating the start-up seam has been inspected and tested for peel and shear. Every submitted test seam will marked with the time, date, operator's initials, welding machine number and welding temperature and speed. Minimum values for shear and peel tests are presented in Table 4.

Table 4 - Field Seam Requirements

Property	Test Method	Minimum Requirement
Shear Strength (lb/in. width)	ASTM D4437 [(1)]	131
Peel Strength (lb/in. width)	ASTM D4437 [(1)]	86 [(2)]
Dead Load 1. Room Temperature 73° F 50% Bonded seam load 2. Elevated Temperature 158° F 25% Bonded seam load	Annex A NSF 54	 Pass Pass
Resistance to Soil Burial 1. Peel Adhesion 2. Bonded seam strength (% change maximum in original value)	ASTM D3038 [(1)]	 FTB [(2)] -10

[(1)] As modified in Annex A, NSF 54
[(2)] Minimum recorded stress required in conjunction with Film Tear Bond (FTB) for acceptance

- Daily visual inspection of the seaming and testing process shall be performed by the QC Officer or his representative. All testing procedures shall be periodically monitored to ensure proper procedures are adhered to. If the QC Officer or his designee witnesses a vacuum test or air pressure test, they will initial, date and check that the information that was written in reference to the test results is correct.

- All seams created by the double wedge fusion weld shall be checked by the Air Pressure Testing method in the following manner:

  1. Seal one end of the seam to be tested.
  2. Insert a needle or other approved device to supply pressure through one end of the sealed channel end created by the double wedge fusion weld.
  3. Apply pressure to the device to ensure unobstructed passage of air through the channel.
  4. Seal off the opposite end of the channel.
  5. Insert a pressure between 25 and 30 psi, and allow 2 minutes for the injected air to come to an equilibrium in the channel. The channel shall sustain pressure for 5 minutes.
  6. At the end with the pressure gauge, write down the date, time test started, time test ended, air pressure reading at the beginning of the test and air pressure reading after the minimum 5 minute time period, whether the test failed or passed and the initials of the inspector.
  7. If the pressure loss exceeds 2 psi, or if the pressure never stabilizes, the defective area must be located and repaired with a cap.
  8. If the test passes after 5 minutes, the seal shall be removed from the opposite end of the pressure gauge. The air channel should deflate immediately indicating the entire length of the seam was tested.
  9. All repair welds and welds to seal the air insert holes will be tested by the vacuum box as described below.

- All extrusion welds shall be tested with a vacuum box. The vacuum box assembly shall consist of a rigid housing with a transparent viewing window on the top, a soft rubber gasket fixed to the bottom, valve assembly and a vacuum gauge. The testing procedure shall be as follows:

  1. Wet a strip of the extrusion weld approximately 12 inches wide by the length box with a soapy solution.
  2. Place the box over the wetted surface and compress.
  3. Create a vacuum of 3 to 5 psi.
  4. Make sure the seal between the box and the geomembrane is tight.
  5. Examine the geomembrane for about 15 seconds looking for animated bubbles or bubbles that increase in size while under pressure.
  6. If no animated bubbles appear close the vacuum valve and open the bleed valve, move the box over the next adjoining weld to be tested with a minimum of 3 inches of overlap and repeat the process.
  7. After completing the test on the extrusion welds, the inspector shall write on the liner the date, time, whether the test passed or failed and initials.

- If an extrusion weld can not be tested by the vacuum box method, the seams shall be spark tested according to the spark tester manufacturer's specifications and procedures.

- Destructive seam testing shall be minimized to help preserve the integrity of the liner. The Lining Contractor shall provide the QC Officer or his representative with a destructive test sample for approximately every 500 feet of production. As far as practical, these samples shall be cut above the proposed high water level of the pond or on the flat surface of the pond bottom. All samples will be a minimum of 12 inches wide by 36 inches long with the seam centered lengthwise. The sample will then be divided into three equal pieces, one to be tested by the Lining Contractor and two to be given to the QC Officer or his designee. The Contractor shall test ten, 1 inch wide specimens, five for shear strength and five for peel strength in accordance with Table 4. Seam failure is defined as failure of any one of these specimens by shear or peel. For peel adhesion, the minimum strength value must be obtained in combination with Film Tear Bond (FTB) for acceptance. For shear strength, the geomembrane specimens must exhibit at least 50 percent elongation prior to failure. The location, seam number, seaming apparatus number, operator, date and time of each cut-out shall be recorded on the each segment of the 36 inch specimen. All holes resulting from the destructive testing shall be patched as soon as possible and tested.

7.6 Performance Standards for Installation of Geonet System

The following QC/QA program shall be implemented during installation of the geonet system. The minimum standards are as follows:

- Only after the bottom (secondary) liner has been deployed, seamed, tested and approved by the QC Officer or his representative, shall deployment of the geonet commence. The Lining Contractor shall present all test results, as-built drawings and repair logs of the secondary liner for approval.

- The geonet shall be NSC, POLY-NET 2000 or an approved equal. The geonet shall conform with the minimum values and tolerances as listed in Table 5.

Table 5 - Material Properties for Geonet

Property	Test Method	Qualifier	Value
Resin Density (g/cm^3)	ASTM D1505	minimum	0.94
Resin Melt Index (g/10 min.)	ASTM D1238	maximum	1.0
Carbon Black Content (%)	ASTM D1603	minimum	2.0
Thickness (inches)	ASTM D1777	minimum	.160
Mass per Unit Area (lbs/ft^2)	ASTM D3776	minimum	.117
Transmissivity @ 2000 psf (m^2/sec)	ASTM D4716	minimum	1 X 10^{-3}
Tensile Strength (lbs/in)	ASTM D1682	minimum	30
Standard Width X Length (feet)	----	----	7.54 X 300

- The geonet drainage material shall be manufactured by extruding two sets of polyethylene strands to form a dimensional structure allowing planar flow. All geonet materials shall be manufactured of new first quality products. The QC Officer or his designee shall ensure that delivery is made in the original wrappings showing the name of the manufacturer, product identification, lot number and roll dimensions.

- During deployment of the geonet, the Contractor shall at all times keep the geonet clean and free from debris prior to and during installation. Storage of the geonet shall be in accordance with the manufacturer's recommendations and in a location that will keep the material from damage. Installed geonet that is permitted to become filled with accumulations of debris or blowing dirt and sand shall be removed, cleaned and reinstalled following cleanup of the geomembrane secondary liner's surface.

- The geonet rolls shall be overlapped at least 4 inches and secured together by plastic ties no more than 5 feet apart. Plastic ties shall be white or any other bright color for ease of inspection. Metallic ties such as wire will not be permitted.

7.7 Performance Standards for Installation of Geotextile Materials

The following QC/QA program shall be implemented during installation of any geotextile materials to be placed. The minimum standards are as follows:

- Geotextile fabric shall be non-woven fabric with a minimum fabric weight of 8 oz/yd^2 like AMOCO 4508 or approved equal. Material properties of the non-woven geotextile shall conform to the minimum values and tolerances presented in Table 6.

Table 6 - Material Properties for Non-woven Geotextile

Property	Test Method	Minimum Values	Typical Physical Properties
Unit Weight (oz/yd^2)	ASTM D3776	8.0	----
Grab Tensile (lbs)	ASTM D4632	200	270-275
Grab Elongation (%)	ASTM D4632	50	65
Mullen Burst (psi)	ASTM D3786	450	575
Puncture (lbs.)	ASTM D4833	130	170
Trapezoid Tear (lbs)	ASTM D4533	80	120-140
Apparent Open Size (US Sieve No.)	ASTM D4751	100	100-200
Permittivity (gal/min/ft^2)	ASTM D4491	80	100
Permeability (cm/sec)	ASTM D4491	.2	.27
Thickness (mils)	ASTM D1777	90	115
U.V. Resistance (%^{2})	ASTM D4355	70	---

- Delivery of geotextile fabric shall be made in original wrappings showing the name of the manufacturer and product weight. Storage of the geotextile material must be in accordance with the manufacturer's recommendations and in a location that will keep the fabric clean and protected from damage.

- The geotextile fabric shall be placed in the Leak Detection system in accordance with the Specifications and Drawings. During installation, the fabric will be rejected if it has any defects, rips, holes, flaws, deterioration or damage incurred during manufacture, transportation and/or storage.

- The area on which the fabric is placed shall be smooth and free of projections or depressions that may cause the puncturing or stretching of the fabric. Care shall be taken to remove all sharp rocks, stones and any other sharp objects. Geotextile fabric shall be placed without stretching and shall lie smoothly in contact with the prepared surface. The adjacent ends of the fabric shall be placed with seams overlapped four to six inches. The geotextile fabric seam on top shall be overlapped a minimum of 24 inches.

7.8 Quality Control Reports

Test reports, resin batch test results, material properties and manufacturer's quality control as required by these Specifications shall be submitted by the Lining Contractor to the QC Officer for review prior to installation of any of the synthetic lining system.

7.8.1 Field Installation Reports

The Contractor shall submit to the QC Officer daily reports documenting the following:

- Changes in layout and Drawings (panel placement).

- Production data, indicating materials placed and seams welded along with batch and roll numbers.

- Non-destructive test results.

- Destructive test results.

- Areas of deficiency and corrective actions taken.

7.8.2 As-built Drawings

Upon completion of the project, the Contractor shall provide a reproducible original of the "as-built" drawings illustrating panel location, seam location, seam numbers, repair locations and the locations of destructive test samples with corresponding test sample numbers.

8.0 Repair Procedure

Any portion of the geomembrane exhibiting a flaw or failing destructive or non-destructive quality control test must be repaired. The repair of any of these faults shall be in accordance with these Specifications and the manufacturer's recommendations. All repair procedures, materials and techniques shall be approved in advance of the specific repair by the QC Officer.

9.0 Warranty

The Lining Contractor shall guarantee the synthetic lining system and geomembrane to be free of defects for a period of 20 years after installation. These warranties shall be provided to the Owner upon completion of the project.

10.0 Acceptance

Acceptance of the lining system will be accepted by PRL when:

1. The installation has been completed in accordance with the Plans and Specifications and to the satisfaction of the QC Officer and Design Engineer.
2. All quality control documentation has been submitted.
3. As- built drawings have been completed and submitted to the QC Officer.
4. Warranties have been received by PRL.

QUALITY CONTROL PROCEDURE

FOR

FIELD INSPECTIONS
QC-PR-1

BY
PLATEAU RESOURCES, LTD.

877 N. 8th W.
Riverton, WY 82501

Revision No.	Issue Date	Approved By:

INDEX

1.0 METHODOLGY

1.1 Scope

The procedure for field inspections is to be used to monitor construction activities during construction by visual observation and measurement and to record and compare these observations and measurements with the Specifications.

1.2 Procedure

The field inspection activities set forth in the Quality Plan shall be documented for earthwork, construction materials, surveys and sampling. Observations shall be recorded on Form PR-1 or an approved alternate. Items to be documented include, but are not limited to, locations, dimensions, quantities, slopes or grades of excavation and placement. Areas to receive compacted fill shall be observed and the condition of the surfaces prior to fill placement shall be noted. During placement, lift thickness, lift uniformity, compactive effort and other construction details shall be monitored in accordance with the appropriate Specification. Construction materials, surveys, and sampling shall also be observed and documented to verify compliance with the applicable Specifications.

1.3 Frequency of Observations

Observations of fill placement shall be conducted on-going during any phase of the construction process according to the Specifications.

1.4 References

1. *Annual Book of ASTM Standards,* Volumes 04.08 and 04.09

2. *Earth Manual - A Water Resources Technical Publication (Third Edition)*, Part 2, 1990, U.S. Department of Interior

2.0 REPORTING

2.1 Forms

The following form or approved equivalent shall be used to record observations of all construction activities.

- PR-1 Construction Activities Report

2.2 Records

The original of the construction activities report shall be maintained in a Project File. Copies shall be available upon request.

PR-1 CONSTRUCTION ACTIVITIES REPORT

Project No.:____

Technician: ____

Date: ____

Approved By: ____

Daily Report No.:________________ Sheet________of__________

Weather Conditions and Temperature: ____

Equipment: ____

Construction Activities and Observations: ____

QUALITY CONTROL PROCEDURE

FOR

SAMPLING of SOILS and AGGREGATES
QC-PR-2

BY
PLATEAU RESOURCES, LTD.

877 N. 8th W.
Riverton, WY 82501

Revision No.	Issue Date	Approved By:

INDEX

1.0 METHODOLGY

1.1 Scope

Determine a procedure to provide standard sampling procedures for obtaining samples of soils, aggregates and/or soil-aggregate mixtures from stockpiles, truck loads, borrow areas and at the construction site. This procedure shall include a visual-manual method for describing and identifying the different sample types.

1.2 Procedure

All soil, aggregate, soil-aggregate sampling shall be done in accordance with standardized procedures as described in the latest version of ASTM D75. Description and identification of soils using visual-manual methods shall be done in accordance with standard procedure described in the most recent version of ASTM D2488.

1.3 References

1. *Annual Book of ASTM Standards,* Volume 04.03 and Volume 04.08

2.0 REPORTING

2.1 Forms

The following form or approved equivalent shall be used for all sampling activities associated with this procedure.

- PR-2 Soil Sampling Log

2.2 Records

The original of the sampling reports shall be maintained in the Project File. Copies shall be available upon request.

PR-2 SOIL SAMPLING LOG

Sample No. ______________________________ **Report No.** ______________________________

Date ____________________________________ **Sheet** _______ **of** ______________

Sampled By _______________________________ **Reviewed By** ____________________________

QC Officer

Location (Stockpile, Test Pit, Fill, Borrow Area, Truck, etc.) ____________________________________

____

____

____

Depth of Sample ____

Sample Type (Large bulk, Undisturbed, Grab, Composite, etc.) ______________________________

____

____

____

Visual Classification (Color, Grain size, Texture, etc.) __________________________________

____

____

____

Intended Use (Fill material, Clay Liner, etc.) ____

____

____

____

Testing Program (Standard Density, Atterberg, etc.) ______________________________________

____

____

____

Note - A copy of this form must be attached with all laboratory tests performed on the sample.

QUALITY CONTROL PROCEDURE

FOR

PARTICLE SIZE ANALYSIS
QC-PR-3

BY
PLATEAU RESOURCES, LTD.

877 N. 8th W.
Riverton, WY 82501

Revision No.	Issue Date	Approved By:

INDEX

1.0 METHODOLGY

1.1 Scope

These procedures are to be used to quantitatively determine the distribution of particle sizes of soils, aggregates and soil-aggregate mixtures. The distribution of particle sizes larger than a No. 200 sieve are determined by screening and particle sizes smaller than a No. 200 sieve are to be determined by hydrometer analysis.

1.2 Procedure

Preparation of soil samples to be analyzed for particle size shall be in accordance with the most current version of ASTM D421. For particle sizes greater than the No. 200 sieve procedures from the most current version of ASTM D422 shall be adhered to. The latest version of ASTM D1140 shall be used to analyze for particle sizes smaller than the No. 200 sieve.

1.3 References

1. *Annual Book of ASTM Standards*, Volume 04.08

2.0 REPORTING

2.1 Forms

The following forms or approved equivalents shall be used for all sampling activities associated with this procedure.

- PR-3 Gradation Analysis Worksheet
- PR-4 Gradation Analysis with Hydrometer Worksheet
- PR-5 Gradation Test Results
- PR-11 Summary of Laboratory Test Results

2.2 Records

The original of the sampling reports shall be maintained in the Project File. Copies shall be available upon request.

PR-3 GRADATION ANALYSIS WORKSHEET

Technician________________________________ Project No. ____________________________

Approved By ______________________________ Date ________________________________

Sample No.		Sample No.		Sample No.		Sample No.		Sample No.	
Description		Description		Description		Description		Description	
Run by		Run by		Run by		Run by		Run by	

Dish No.		Dish No.		Dish No.		Dish No.		Dish No.	
Dry Soil & Dish		Dry Soil & Dish		Dry Soil & Dish		Dry Soil & Dish		Dry Soil & Dish	
+200 Soil & Dish		+200 Soil & Dish		+200 Soil & Dish		+200 Soil & Dish		+200 Soil & Dish	
Dish Weight		Dish Weight		Dish Weight		Dish Weight		Dish Weight	
Dry Soil Weight		Dry Soil Weight		Dry Soil Weight		Dry Soil Weight		Dry Soil Weight	

Sieve Size		Cum. Wt. Ret.	% Pass		Sieve Size		Cum. Wt. Ret.	% Pass		Sieve Size		Cum. Wt. Ret.	% Pass		Sieve Size		Cum. Wt. Ret.	% Pass		Sieve Size		Cum. Wt. Ret.	% Pass
5					5					5					5					5			
3					3					3					3					3			
1 1/2					1 1/2					1 1/2					1 1/2					1 1/2			
3/4					3/4					3/4					3/4					3/4			
3/8					3/8					3/8					3/8					3/8			
#4					#4					#4					#4					#4			
#8					#8					#8					#8					#8			
#16					#16					#16					#16					#16			
#30					#30					#30					#30					#30			
#50					#50					#50					#50					#50			
#100					#100					#100					#100					#100			
#200					#200					#200					#200					#200			
Pan					Pan					Pan					Pan					Pan			

% Gravel		% Gravel		% Gravel		% Gravel		% Gravel	
% Sand		% Sand		% Sand		% Sand		% Sand	
% Silt & Clay		% Silt & Clay		% Silt & Clay		% Silt & Clay		% Silt & Clay	
Remarks:		Remarks:		Remarks:		Remarks:		Remarks:	

PR-4 GRADATION ANALYSIS with HYDROMETER WORKSHEET

Technician ________________________________ Project No. ______________________
Approved By _______________________________ Date ____________________________
Sample No. _______________ Visual Description ____

Ran by_______________________________ **Sample Preparation** Sieve Time ____________________

Sieve Size		3"	1 1/2"	3/4"	3/8"	No. 4	Sample Weights		
Sample No and Pan No.								Wet	Dry
Weight of Pan							Total Sample	___________	___________
Dry Weight Retained									
Dry Weight Passing		XXX	XXX	XXX	XXX	XXX	Retained on No.4	___________	___________
%of Total Passing									
					w % =	_____	Passing No. 4	___________	___________

Ran By _______________________________ **Sieve & Hydrometer Analysis** Sieve Time ______________

Sieve No.	Weight Retained	Weight Passing	% of Total Passing	Factor = $\frac{w\%}{w}$ = ___________ = __________					
8 (10)		XXXXXX		MOISTURE DETERMINATION					
16		XXXXXX		Dish No.	+4 Material	-4 Material	Hygro. Moisture	Hydro. Sample	
30 (40)		XXXXXX		Wt. Wet Soil & Dish					
50		XXXXXX		Wt. Dry Soil & Dish					
100		XXXXXX		Wt. Dish					
200				Wt. of Dry Soil					
PAN			XXXXXX	Wt. of Water		_____ = w			
Total			XXXXXX	% Moisture					

Ran By _______________________________ **Hydrometer Analysis** Sieve Time ______________

Cylinder No. ______________ Specific Gravity ________________ Dispersing Agent _____________________

Dish No. ________________ Date ________________ Amount _______________ml Date Calibrated ____________

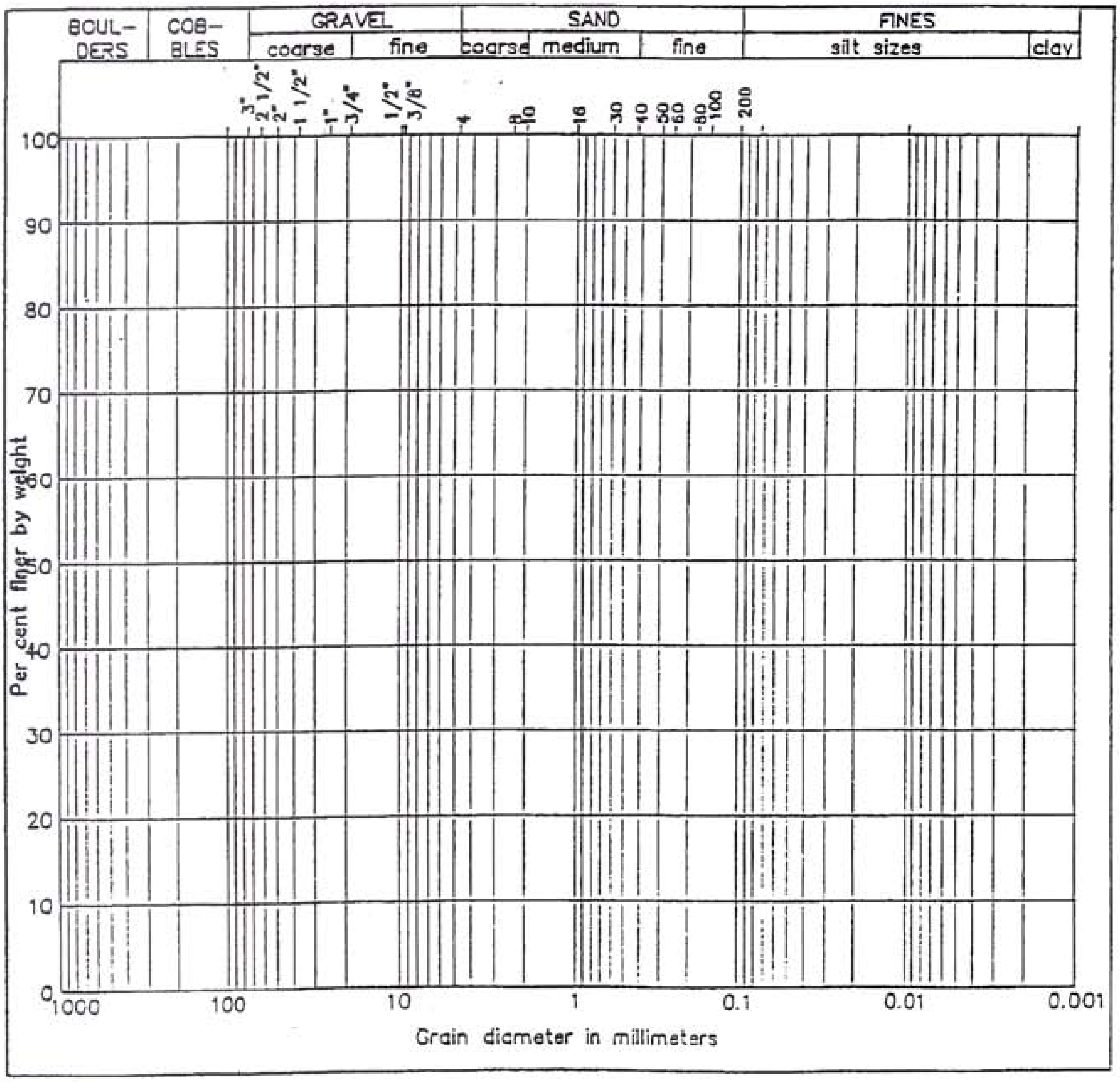
Clock Time	Test Time	Temp. °C	Hyd. Read	Hyd.* Corr.	Corr. Read		% of Total Passing	Particle Diameter	
	Start Mix	XXXXX	XXXXX	XXXXX	XXXXX		XXXXX	XXXXX	
	Stop Mix	XXXXX	XXXXX	XXXXX	XXXXX		XXXXX	XXXXX	
	0.5 Min.								
	1.0 Min.								
	4.0 Min.								
	19 Min.								
	60 Min.								

PR-5 GRADATION TEST RESULTS

Technician ______________________ Project No. ______________________

Sample Id. ______________________ Date Screened ______________________

Approved By ______________________ Date ______________________



Remarks ____

____

____

PR-11 SUMMARY of LABORATORY TEST RESULTS

Technician ______________________________ Project No. ______________

Approved By ______________________________ Date ______________

Material Tested ____

Sample Number	Moisture Content %	Dry Density pcf	**Gradation**		% Passing No. 200 Sieve	**Atterberg Limits**		Soil Type	Comments
			Gravel %	Sand %		Liquid Limit	Plasticity Index		

QUALITY CONTROL PROCEDURE

FOR

LABORATORY MOISTURE CONTENT of SOILS
QC-PR-4

BY
PLATEAU RESOURCES, LTD.

877 N. 8th W.
Riverton, WY 82501

Revision No.	Issue Date	Approved By:

INDEX

1.0 METHODOLGY

1.1 Scope

These procedures are to be used to determine the laboratory moisture content in soils, aggregates and soil-aggregate mixtures.

1.2 Procedure

The moisture contents shall be in accordance with the procedures described in the most recent version of ASTM D2216. ASTM D4643 may be utilized after a correlation factor has been established between the two methods.

1.3 References

1. *Annual Book of ASTM Standards,* Volume 04.08

2.0 REPORTING

2.1 Forms

The following forms or approved equivalents shall be used for all sampling activities associated with this procedure.

- PR-6 Moisture and Density Worksheet
- PR-11 Summary of Laboratory Test Results

2.2 Records

The original of the sampling reports shall be maintained in the Project File. Copies shall be available upon request.

PR-6 MOISTURE CONTENT WORKSHEET

Technician ______________________________ Project No. ____________

Approved By ______________________________ Date ____________

ASTM D2216 ☐	ASTM D4643 ☐
Sample No.	
Dish No.	
Wt. of Dish & Wet Soil	
Wt. of Dish & Dry Soil	
Wt. of Dish	
Wt. of Water	
Wt. of Dry Soil	
% Moisture	

ASTM D2216 ☐	ASTM D4643 ☐
Sample No.	
Dish No.	
Wt. of Dish & Wet Soil	
Wt. of Dish & Dry Soil	
Wt. of Dish	
Wt. of Water	
Wt. of Dry Soil	
% Moisture	

ASTM D2216 ☐	ASTM D4643 ☐
Sample No.	
Dish No.	
Wt. of Dish & Wet Soil	
Wt. of Dish & Dry Soil	
Wt. of Dish	
Wt. of Water	
Wt. of Dry Soil	
% Moisture	

ASTM D2216 ☐	ASTM D4643 ☐
Sample No.	
Dish No.	
Wt. of Dish & Wet Soil	
Wt. of Dish & Dry Soil	
Wt. of Dish	
Wt. of Water	
Wt. of Dry Soil	
% Moisture	

ASTM D2216 ☐	ASTM D4643 ☐
Sample No.	
Dish No.	
Wt. of Dish & Wet Soil	
Wt. of Dish & Dry Soil	
Wt. of Dish	
Wt. of Water	
Wt. of Dry Soil	
% Moisture	

ASTM D2216 ☐	ASTM D4643 ☐
Sample No.	
Dish No.	
Wt. of Dish & Wet Soil	
Wt. of Dish & Dry Soil	
Wt. of Dish	
Wt. of Water	
Wt. of Dry Soil	
% Moisture	

Remarks ____

PR-11 SUMMARY of LABORATORY TEST RESULTS

Technician ____________________ Project No. ____________________

Approved By ____________________ Date ____________________

Material Tested ____________________

Sample Number	Moisture Content %	Dry Density pcf	**Gradation**		% Passing No. 200 Sieve	**Atterberg Limits**		Soil Type	Comments
			Gravel %	Sand %		Liquid Limit	Plasticity Index		

QUALITY CONTROL PROCEDURE

FOR

ATTERBERG TESTS
QC-PR-5

BY
PLATEAU RESOURCES, LTD.

877 N. 8th W.
Riverton, WY 82501

Revision No.	Issue Date	Approved By:

INDEX

1.0 METHODOLGY

1.1 Scope

These procedures are to be used to determine liquid limit, plastic limit and the plasticity index of fine-grained soils.

1.2 Procedure

The tests shall be performed in accordance with the procedure described in the most current version of ASTM D4318.

1.3 References

1. *Annual Book of ASTM Standards*, Volume 04.08

2.0 REPORTING

2.1 Forms

The following forms or approved equivalents shall be used for all sampling activities associated with this procedure.

- PR-7 Atterberg Limits Worksheet
- PR-11 Summary of Laboratory Test Results

2.2 Records

The original of the sampling reports shall be maintained in the Project File. Copies shall be available upon request.

PR-7 ATTERBERG LIMITS WORKSHEET

Technician ______________________ Project No. ____________

Approved By ______________________ Date ____________

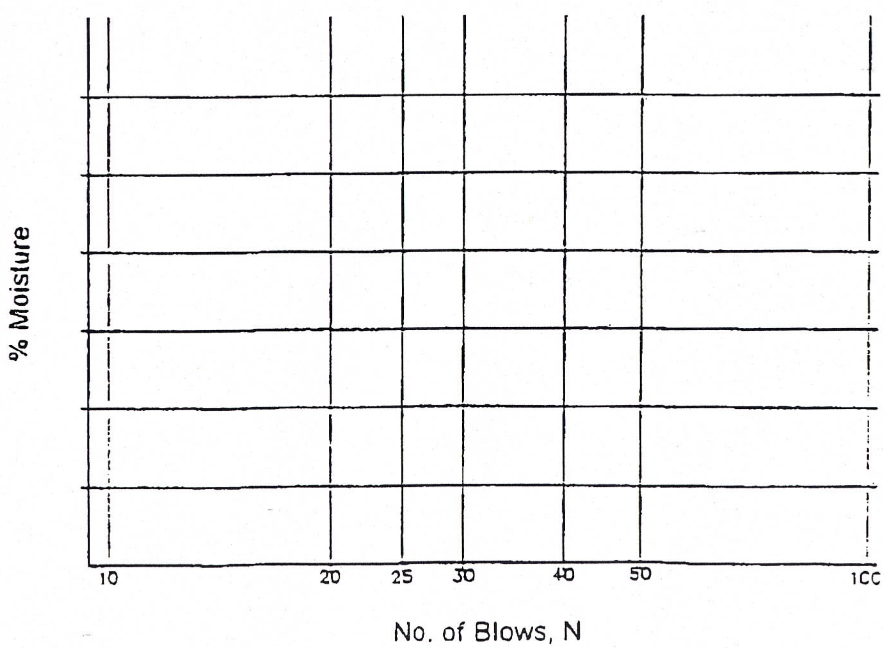
Material Sampled ______________________

Plastic Limit

Test Number	1	2	3	4	5	6
Dish No.						
Wt. of Dish & Wet Soil (g)						
Wt. of Dish & Dry Soil (g)						
Wt. of Dish (g)						
Wt. of Dry Soil (g)						
Wt. of Water (g)						
% Moisture						

Liquid Limit

Test Number	1	2	3	4	5	6
Dish No.						
No. of Blows						
Wt. of Dish & Wet Soil (g)						
Wt. of Dish & Dry Soil (g)						
Wt. of Dish (g)						
Wt. of Dry Soil (g)						
Wt. of Water (g)						
% Moisture						



Liquid Limit Factors from Water Content & No. of Drops Causing Closure

N No of Drops	k Liquid limit factor
20	0.974
21	0.979
22	0.985
23	0.990
24	0.995
25	1.000
26	1.005
27	1.009
28	1.014
29	1.018
30	1.022

Results	
LL	
PL	
PI	

C:\Projects\2005-50\mgmt plan\Form PR-7.pdf
December 2005

PR-11 SUMMARY of LABORATORY TEST RESULTS

Technician ______________________________ Project No. ______________

Approved By ______________________________ Date ______________

Material Tested ____

Sample Number	Moisture Content %	Dry Density pcf	**Gradation**		% Passing No. 200 Sieve	**Atterberg Limits**		Soil Type	Comments
			Gravel %	Sand %		Liquid Limit	Plasticity Index		

QUALITY CONTROL PROCEDURE

FOR

SOIL CLASSIFICATION for ENGINEERING PURPOSES
QC-PR-6

BY
PLATEAU RESOURCES, LTD.

877 N. 8th W.
Riverton, WY 82501

Revision No.	Issue Date	Approved By:

INDEX

1.0 METHODOLGY

1.1 Scope

The procedure is to determine the classification of soils for engineering purposes in accordance with the Unified Soils Classification System based on particle size and Atterberg Limits (liquid limit and plasticity index) of the soil.

1.2 Procedure

Classification of soils shall be performed in accordance with the most current version of ASTM D2487. Quality Control Procedures QC-PR-3 and QC-PR-5 shall be used to determine the classification parameters necessary to classify the materials according to the Unified Soil Classification System.

1.3 References

1. *Annual Book of ASTM Standards,* Volume 04.08

2.0 REPORTING

2.1 Forms

The soils classification shall be recorded on Form PR-11, Summary of Laboratory Test Results or approved equivalent.

2.2 Records

The original of the sampling reports shall be maintained in the Project File. Copies shall be available upon request.

PR-11 SUMMARY of LABORATORY TEST RESULTS

Technician ______________________________ Project No. ______________

Approved By ______________________________ Date ______________

Material Tested ______________________________

Sample Number	Moisture Content %	Dry Density pcf	**Gradation**		% Passing No. 200 Sieve	**Atterberg Limits**		Soil Type	Comments
			Gravel %	Sand %		Liquid Limit	Plasticity Index		

QUALITY CONTROL PROCEDURE

FOR

LABORATORY COMPACTION CHARACTERISTICS of SOIL
QC-PR-7

BY
PLATEAU RESOURCES, LTD.

877 N. 8th W.
Riverton, WY 82501

Revision No.	Issue Date	Approved By:

INDEX

1.0 METHODOLGY

1.1 Scope

The procedure is to be used to determine the relationship between water content and dry unit weight of soils. (compaction curve).

1.2 Procedure

The procedure for performing this test shall be in accordance with the most current version of ASTM D698. Correction for unit weight and water content of soils containing oversize particles shall be determined in accordance with the current version of ASTM D4718.

1.2.1 One-point Proctors will be obtained and used as tool to determine whether the proctor being used for calculation of field compaction is representative of the material(s) being tested. If the dry density of the one-point is within ± 3 percent of the Proctor value being used, this provides adequate confirmation of the field compaction. If the dry density is greater than ± 3 percent of the proctor value, recalculation of the field compaction test will be required using a new Proctor value as established in Section 1.2. One-point Proctors will be performed in accordance with ASTM D698 also.

1.3 References

1. *Annual Book of ASTM Standards,* Volume 04.08

2.0 REPORTING

2.1 Forms

The following forms or approved equivalent shall be used to record test results of laboratory compaction tests:

- PR-8 Laboratory Compaction Test Worksheet
- PR-9 Rock and Moisture Correction Calculation Worksheet
- PR-10 Moisture Density Relationship
- PR-11 Summary of Laboratory Test Results

2.2 Records

The original sampling reports shall be maintained in the Project File. Copies shall be available upon request.

PR-8 LABORATORY COMPACTION TEST WORKSHEET

Technician ________________________________ Project No. __________________
Approved by ________________________________ Date ______________________
Material Sampled ____

GRADATION for COMPACTION METHOD SELECTION

Sieve Size	3/4"	3/8"	#4	-#4	Total
Weight Retained					
% Retained					
Cumulative % Retained					

Sample No. ____

Sample Description ____

ASTM D698 ☐ Method: A B C Other__________

TEST DATA

Point Number	1	2	3	4	5	6	7
Amt. Of Water Added, Vol.							
Wt. of Mold and Wet Soil							
Wt. of Mold							
Wt. of Wet Soil							
Wet Density, pcf							

Dish Number							
Weight of Dish & Wet Soil							
Weight of Dish & Dry Soil							
Weight of Dish							
Weight of Water							
Weight of Dry Soil							

Moisture Content, %							
Dry Density, pcf							

Remarks ____

____

PR-9 ROCK and MOISTURE CORRECTION CALCULATIONS

Technician ______________________________ Project No. ________________

Approved By ____________________________ Date ____________________

Sample No. __________ Material ____________________________________

Field Unit Dry Weight ________________________________
Field Moisture Content ________________________________
Total Wet Weight of Correction Sample ________________________________
Wet Weight of Oversized Fraction ________________________________
Wet Weight of Finer Fraction ________________________________
Specific Gravity of Oversized Material ________________________________
SSD Moisture Content of Oversized Material ________________________________
Laboratory Max. Dry Density (Finer Fraction) ________________________________
Optimum Moisture Content (Finer Fraction) ________________________________

% Wet Oversize Fraction ________________________________
% Wet Finer Fraction ________________________________
% Dry Oversize Fraction ________________________________
% Dry Finer Fraction ________________________________
Corrected Moisture Content (Finer Fraction) ________________________________
Corrected Dry Unit Weight (Finer Fraction) ________________________________
Corrected % Compaction ________________________________
Deviation from Optimum Moisture Content ________________________________

Remarks ____

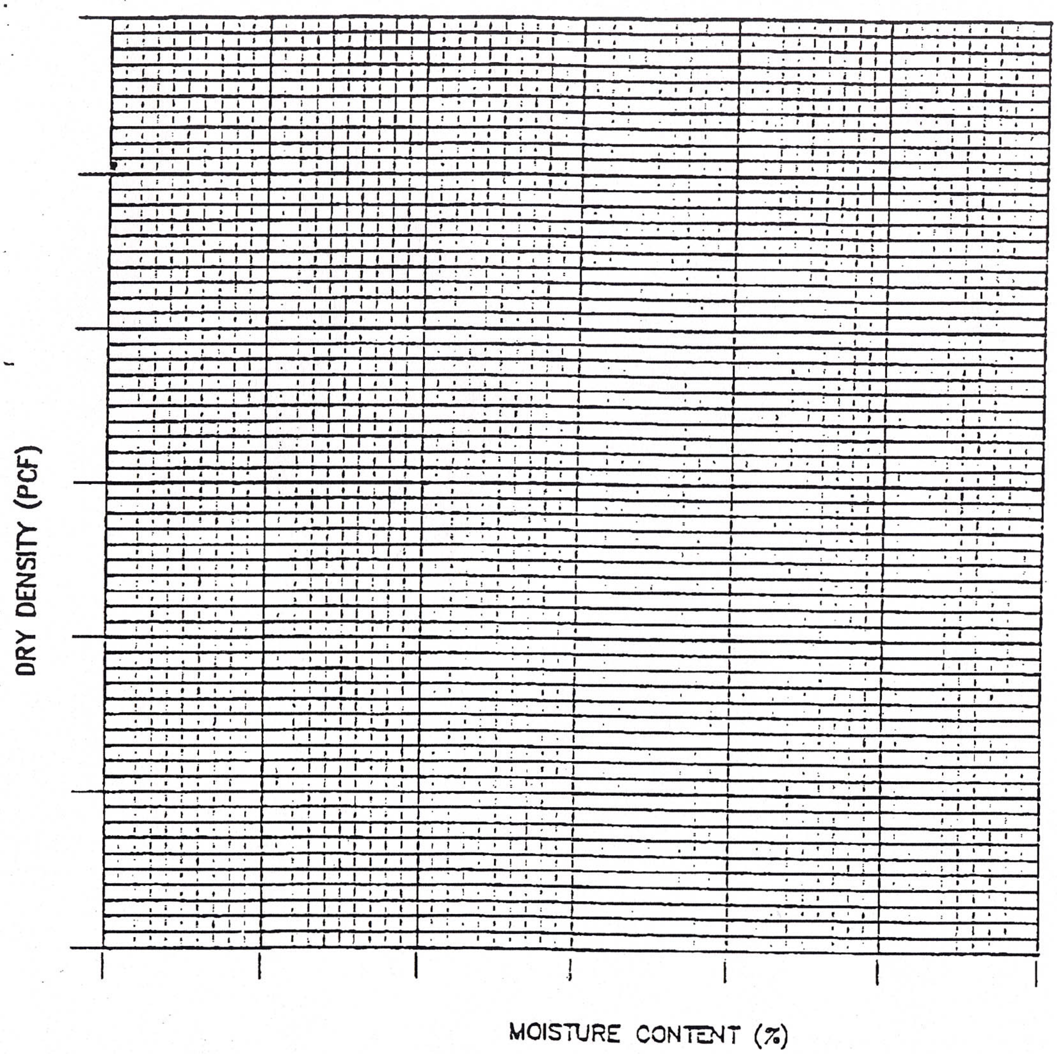
PR-10 MOISTURE DENSITY RELATIONSHIP

Technician ______________________________ Project No. ________________

Approved By ______________________________ Date ____________________

Sample No. __________ Material ______________________________________

Method _____________ % Oversized __________ Specific Gravity _________



Maximum Dry Density ________ pcf Opt. Moisture Content ________ %

Corrected Max. Density * _______ pcf Corrected Opt. Moisture Content * _______ %

Liquid Limit _______________ Plasticity Index _________________

Gravel __________ % Sand __________ % Silt & Clay __________ %

* Corrected Density and Moisture by ASTM D4718

PR-11 SUMMARY of LABORATORY TEST RESULTS

Technician ______________________________ Project No. ______________

Approved By ______________________________ Date ______________

Material Tested ______________________________

Sample Number	Moisture Content %	Dry Density pcf	Gradation Gravel %	Gradation Sand %	% Passing No. 200 Sieve	Atterberg Limits Liquid Limit	Atterberg Limits Plasticity Index	Soil Type	Comments

QUALITY CONTROL PROCEDURE

FOR

IN-PLACE DENSITY TESTS
QC-PR-8

BY
PLATEAU RESOURCES, LTD.

877 N. 8th W.
Riverton, WY 82501

Revision No.	Issue Date	Approved By:

<u>INDEX</u>

1.0 METHODOLGY

1.1 Scope

The test procedures are to be used to determine the density of in-place soils, aggregates or a combination of these materials.

1.2 Procedure

Tests shall be conducted in accordance with the most recent version of the Standard ASTM test procedures referenced below. Compaction shall be based on the percent of field maximum dry density versus the laboratory maximum dry density as established in Procedure QC-PR-7 for the correlative material type. All compaction tests shall be performed for each material type and at frequencies in accordance with the Specifications.

1.2.1 Nuclear Gauge Method

- ASTM D2922; Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow depth).
- ASTM D3017; Water Content of Soil and Rock in Place by Nuclear Methods (Shallow depth).

1.2.2 Sand Cone Method

- ASTM D1556; Density and Unit Weight of Soil in Place by the Sand-Cone Method.
- ASTM D2216; Laboratory Determination of Water (Moisture) Content of Soil and Rock.
- ASTM D4643; Determination of Water (Moisture) Content of Soil by the Microwave Oven Method.

1.3 References

1. *Annual Book of ASTM Standards,* Volume 04.08

2.0 REPORTING

2.1 Forms

The following forms or approved equivalent shall be used to record test data and results.

- PR-12 Nuclear Density Test Data
- PR-13 Field Density Tests (Sand Cone)

2.2 Records

The original sampling reports shall be maintained in the Project File. Copies shall be available upon request.

PR-12 NUCLEAR DENSITY TEST DATA

Technician ______________________________ Project No. __________________________ Date ________________

Approved By __________________________________ Material ____

Standard Count - Density _____________________________ Moisture _____________________________

Test No.	1	2	3	4	5	6	7	8	9	10
Station										
Offset										
Elevation										
Mode & Depth										
Moisture Count										
Density Count										
Wet Density										
Dry Density										
% Compaction										
Moisture										
% Moisture										
Standard Density (max.)										
Optimum Moisture										
Moisture Correction										
Moisture Variation ± from Optimum										
Specified Degree of Compaction										

Remarks ____

____

PR-13 FIELD DENSITY TESTS (SAND CONE)

Technician ____ Project No. ____________

Approved By ______________________________________ Date _________________

Material ____

Ground Surface Calibration

Weight of Jar (   ) Full of Sand ______________________________

Weight of Jar (   ) After Surface Calibration ______________________________

Weight of Sand Used, *Gs* ______________________________

Soil Density

Weight of Soil + Can (   ) ______________________________

Weight of Can (   ) ______________________________

Weight of Soil, *W* ______________________________

Weight of Jar (   ) before use, *WJ1* ______________________________

Weight of Jar (   ) after use, *WJ2* ______________________________

Weight of Sand Used, (*WJ1 - WJ2) = SU* ______________________________

Weight of Sand in Cone, *Gs* ______________________________

Weight of Sand in Hole, (*SU - Gs*) = *SW* ______________________________

Density of Standard Sand, *Gamma (pcf)* ______________________________

Volume of Hole, (*SW / Gamma*) = *Vh* ______________________________

Wet Density, (*W / Vh*) = G_{wet} ______________________________

Dry Density, (G_{wet} / (1+ *%W*)) = G_{dry} ______________________________

Moisture Content

Weight of Wet Soil + Pan (   ) ______________________________

Weight of Dry Soil + Pan (   ) ______________________________

Weight of Pan (   ) ______________________________

Weight of Water, *Ww* ______________________________

Weight of Dry Soil, *Wd* ______________________________

Water Content, (*Ww / Wd*) = *%W* ______________________________

QUALITY CONTROL PROCEDURE

FOR

COMPACTED SOIL LAYER THICKNESS
QC-PR-9

BY
PLATEAU RESOURCES, LTD.

877 N. 8th W.
Riverton, WY 82501

Revision No.	Issue Date	Approved By:

<u>INDEX</u>

1.0 METHODOLGY

1.1 Scope

The procedure is to be used to determine the thickness of compacted soil layers during dam construction and clay placement.

1.2 Procedure

Continuous monitoring and surveying of placed materials using standard survey methods during construction shall be the preliminary means of verifying that lifts are being placed in accordance with the Specifications. The thickness of compacted soil layers will be checked at random locations by either drilling or excavation pits to verify survey data. After the layer of clay or fill has been placed and compacted, a hole will be drilled or a pit excavated. Lift thickness shall be measured by taping the distance from a straight-edge placed across the top of the hole or pit to the bottom of the cavity. All measurements shall be made to the nearest 100th of a foot. Prior to placing the straight-edge across the top, all loose surface soils shall be removed to expose a firm base.

1.3 References

1. *Surveying Theory and Practice,* Sixth Edition, 1981, Davis, Foote, Anderson and Mikhail

2.0 REPORTING

2.1 Forms

Field data notebooks containing raw survey data shall be maintained in the Project Files. Direct measurement data shall by systematically recorded and incorporated in the construction verification program using PR-1 or an approved equivalent.

2.2 Records

The original sampling reports shall be maintained in the Project File. Copies shall be available upon request.

PR-1 CONSTRUCTION ACTIVITIES REPORT

Technician: ______________________________

Approved By: ______________________________

Project No.: ______________________________

Date: ______________________________

Daily Report No.: __________ Sheet ______ of ______

Weather Conditions and Temperature: ______________________________

Equipment: ______________________________

____

Construction Activities and Observations: ______________________________

QUALITY CONTROL PROCEDURE

FOR

HDPE LINER SEAM INTEGRITY
QC-PR-10

BY
PLATEAU RESOURCES, LTD.

877 N. 8th W.
Riverton, WY 82501

Revision No.	Issue Date	Approved By:

<u>INDEX</u>

1.0 METHODOLGY

1.1 Scope

The procedure is used to determine the integrity of field seams used in joining sheets of High Density Polyethylene (HDPE) liners by destructive and nondestructive testing.

1.2 Procedure

1. All testing shall be in accordance with the standardized procedures described in the most current version of ASTM D4437. Preparation of test samples shall be in accordance with ASTM D618.
2. Destructive testing will include peel and sheer tests as presented in the above-referenced standards. In either case, a failed test occurs when the weld fails and a passing test occurs when the fabric fails first.
3. All field seams will be continuously inspected visually.
4. All field seams shall be tested by The Vacuum Box test or Air Pressure test, dependent on the welding method.
5. Any seams or weld found to be defective by destructive, nondestructive testing or visually, shall be marked and repaired in accordance with the manufacturer's recommendations.
6. All repairs shall be tested.

1.3 Reference

Annual Book of ASTM Standards, Volumes 04.08 and 04.09

2.0 REPORTING

2.1 Forms

The following forms or approved equivalent shall be used to record test data and results.

- PR-1 Construction Activities Report
- PR-14 Panel Placement Log
- PR-15 Geomembrane Field Trial Log
- PR-16 Geomembrane Seaming Record
- PR-17 Geomembrane Seam Air Pressure Test Log
- PR-18 Repair Log
- PR-19 Geomembrane Seam Destructive Sample Log

2.2 Records

The original sampling reports shall be maintained in the Project File. Copies shall be available upon request.

PR-1 CONSTRUCTION ACTIVITIES REPORT

Technician: ______________________________

Approved By: ______________________________

Project No.: ______________________________

Date: ______________________________

Daily Report No.: ____________ Sheet ______ of ______

Weather Conditions and Temperature: ______________________________

Equipment: ______________________________

____

Construction Activities and Observations: ______________________________

PR-14 PANEL PLACEMENT LOG

Technician ______________________________ Project No. ________________

Approved By ______________________________ Date ____________________

Liner Type ________________ Primary ☐ Secondary ☐ Page ________of ________

Panel No.	Date	Time	Roll No.	Width (ft.)	Length (ft.)	Area (Sq. Ft.)

PR-15 GEOMEMBRANE FIELD TRIAL LOG

Technician ______________________________________ Project No. ____________

Approved By ______________________________________ Date _________________

Liner Type __________________ Primary ☐ Secondary ☐ Page ________of ________

Project Seam Requirements: Fusion - Peel __________ ppi Shear __________ ppi

Project Seam Requirements: Extrusion - Peel __________ ppi Shear __________ ppi

Sample	Date	Time	Amb. Temp.	Welder Id.		Wedge	Extruder	Seam Strength		Pass or Fail	Insp Id.	Remarks
				Mach.	Oper.	Temp./ Speed	Temp./ Pre-Heat	Peel ppi IN/OUT	Shear ppi			

PR-16 GEOMEMBRANE SEAMING RECORD

Technician ______________________________________ Project No. ____________

Approved By ______________________________________ Date __________________

Liner Type __________________ Primary ☐ Secondary ☐ Page ________of ________

Seam = Panel No./ Panel No.	Seaming Record							
	Length Welded	Date Time	Welder Operator	Machine No.	Temperature		Machine Speed	Nondestructive Test Pass/Fail
					Machine	Ambient		

PR-17 GEOMEMBRANE SEAM AIR PRESSURE TEST LOG

Technician ______________________________ Project No. ____________

Approved By ______________________________ Date ________________

Liner Type ________________ Primary ☐ Secondary ☐ Page ________of ________

Seam = Panel No./ Panel No.	Start Location	End Location	Pressure Test			
			Pressure	Tester Id.	Pass/Fail	Date/Time Tested

PR-18 REPAIR LOG

Technician ______________________________________ Project No. ____________

Approved By ____________________________________ Date _________________

Liner Type __________________ Primary ☐ Secondary ☐ Page ________of ________

Repair No.	Defect Code	Repair Date	Location / Panels	Approx. Time	Repair Type	Approx. Dimensions	Repair Tech.	Inspector	Vacuum Test	
									P/F	Date

PR-19 GEOMEMBRANE SEAM DESTRUCTIVE SAMPLE LOG

Technician ____ Project No. ____________

Approved By ______________________________________ Date __________________

Liner Type __________________ Primary ☐ Secondary ☐ Page ________of ________

Project Seam Requirements: Fusion - Peel __________ ppi Shear __________ ppi

Project Seam Requirements: Extrusion - Peel __________ ppi Shear __________ ppi

Sample	Seam = Panel No. / Panel No.	Date Removed	Inspector Id.	**Field** Peel, ppi IN/OUT	**Test** Shear, ppi	**Results** Pass/ Fail	Lab Test Results Pass/Fail	Remarks
Describe	Sample	Location						
Describe	Sample	Location						
Describe	Sample	Location						

APPENDIX D

MONITORING

APPENDIX D

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D.1 Table 5.5-7 Radiological Environmental Monitoring Program – Operational

Table 5.5-7					
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM - OPERATIONAL					
Type of Sample	**SAMPLE COLLECTION AND MEASUREMENT**				
	No.	**Location**	**Method and Frequency**	**Test Frequency**	**Type of Measurement**
Air stack particulates	1	Ore dump point stack	Semi-annual grab sample	Semiannually	Natural uranium Th-230, Ra-226, Pb-210 and flow rate
	1	Yellowcake Dryer and packaging stack	Isokinetic sample	Quarterly	Natural uranium, Th-230, Ra-226, and Pb-210
				Quarterly	Flow rate
Environmental particulates	3	At site boundaries & in different sectors having highest predicted concentrations	Continuous; weekly filter change or as required by dust loading	Quarterly composited	Natural uranium, Th-230, Ra-226, and Pb-210
	1	At nearest residence - Ticaboo	Continuous; weekly filter change or as required by loading	Quarterly composited	Natural uranium Th-230, Ra-226, and Pb-210
	1	Control location	Continuous; weekly filter change or as required by dust loading	Quarterly composited	Natural uranium, Th-230, Ra-226, Pb-210
Radon	5	Same as for air particulates	Continuous Track Etch	Quarterly	Rn-222
Groundwater	4, (*11)	Down-groundwater-flow gradient monitoring wells (RM-2R, RM-7, RM-14, RM-18, RM-19) (*RM-23 through RM-32)	Semiannually	Semiannually	Natural uranium, As, Cl, Se, pH
	1	Groundwater under tailings	Annually	Annually	Rate and direction of flow
	1	up-gradient control well (RM-1, RM-12)	Semiannually	Semiannually	Natural uranium, As, Cl, Se, pH
Surface water	None	N/A	N/A	N/A	N/A
Direct radiation	5	Same as for air particulate samples	TLDs	Quarterly	Gamma
Vegetation	1	Animal grazing areas	Annual grab sample in	Hold sample	Th-230, Ra-226,

Table 5.5-7					
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM - OPERATIONAL					
Type of Sample	**SAMPLE COLLECTION AND MEASUREMENT**				
	No.	**Location**	**Method and Frequency**	**Test Frequency**	**Type of Measurement**
		downwind of mill	spring growing season	for 1 yr; Analyze only if required	Pb-210
Soil	5	Same as for air particulate samples	Annual grab samples	Annually	Natural uranium Th-230, Ra-226
Instrument calibration	All instruments in use	N/A	Semiannually or at mfg's suggested intervals, whichever is sooner	Voltage plateau[1] Pulse Source	Instrument response
Instrument calibrations	Environmental air samplers	N/A	Quarterly	Quarterly	Flow rate
Surface Evaluations	N/A	Tailings Impoundment	Daily, Monthly, Quarterly, Per SOP	N/A	Examination Measurements Surveys
Meteorology	1		Continuously; wind speed & direction	N/A	N/A
Trend analyses	Routine monitoring programs	N/A	Annually	N/A	N/A
Reports	1	N/A	Semiannually effluent monitoring report	N/A	N/A
Quality assurance audit	N/A	N/A	Semiannually	N/A	N/A
Wildlife	N/A	Tailings Impoundment	Daily Visual	N/A	Record Observations
Security	N/A	Mill & Tailing Facility	Inspection	24 hr.	Visual

* = Wells to replace wells RM-7, RM-18 and RM-19 prior to construction of Cell 2.

[1]Where electrodes are accessible

D.2 Table 5.5-8 Interim Environmental Monitoring Program
(Mill not operational for 30 days or more)

Table 5.5-8					
INTERIM ENVIRONMENTAL MONITORING PROGRAM (Mill not operational for 30 days or more)					
Type of Sample	**Sample Collection and Measurement**				
	No.	**Location**	**Method and Frequency**	**Test Frequency**	**Type of Measurement**
Air particulates	1	Downwind of impoundment and ore stockpiles	20 hrs/quarter	Semiannually composited	Natural uranium and Ra-226
Radon	None	N/A	N/A	N/A	N/A
Water - Groundwater	4, (*11)	Down-groundwater-flow gradient monitoring wells (RM-2R, RM-7, RM-14, RM-18, RM-19) (*RM-23 through RM-32)	Semiannually	Semiannually	Natural uranium, As, Cl Se, pH
Water - Surface Water (Seeps)	None	N/A	N/A	N/A	N/A
Direct Radiation	None	N/A	N/A	N/A	N/A
Soil	None	N/A	N/A	N/A	N/A
Vegetation	None	N/A	N/A	N/A	N/A
Instrument calibrations	All instruments in use	N/A	Semiannually or at mfg's suggested intervals, whichever is sooner	Voltage plateau[2] Pulse Source	
Surface Evaluations	N/A	Tailings Impoundment	Monthly & Yearly Per SOP	N/A	Examination Measurement Surveys
	N/A	Ore stockpiles	Monthly	N/A	N/A
Meteorology	None		N/A	N/A	N/A
Trend analyses	Routine monitoring program	N/A	Annually	N/A	N/A
Reports	1	N/A	Semiannually effluent monitoring report	N/A	N/A
Audit	1	N/A	Annually ALARA	N/A	
Security	N/A	Mill & Tailing Facility	Inspection	Daily	Visual
* = Wells to replace wells RM-7, RM-18 and RM-19 prior to construction of Cell 2.					

[2]Where electrodes are accessible.

D.3 Table 3-1 Basic Data for the Shootaring Wells and Piezometers

TABLE 3-1. BASIC DATA FOR THE SHOOTARING WELLS AND PIEZOMETERS.

WELL NAME	NORTH. COORD.	EAST. COORD	CASING DIAMETER (in)	TOTAL DEPTH (ft-mp)	STICKUP (ft)	MP ELEV. (ft-msl)	WATER LEVEL DEPTH (ft-mp)	WATER LEVEL ELEVATION (ft-msl)	SLOTTED CASING (ft-lsd)	SAND PACK (ft-lsd)	PUMP INTAKE (ft-mp)
						WELLS					
OW1A	57140	63730	1.0	300.0	0.2	4472.53	239.40	4233.13	200-300	-	---
OW1B	57140	63730	1.0	798.0	1.9	4474.23	449.73	4024.50	648-798	-	---
OW2	57094	63667	1.0	300.0	0.2	4470.70	228.50	4242.20	200-300	-	---
OW3	57046	63659	1.0	798.0	2.3	4470.78	452.85	4017.93	650-798	-	---
OW4	57035	63707	1.0	570.0	2.3	4472.54	230.48	4242.06	435-570	-	---
RM1	59307	61827	3.0	487.0	2.2	4449.20	176.50	4272.70	220-480	157-487	225
* RM2	57731	63040	3.0	520.0	1.6	4519.76	258.25	4261.51	260-520	250-520	---
RM2R	57924	63142	5.0	300.0	1.2	4504.86	243.40	4261.46	250-300	242-300	273
* RM3	57193	60647	6.0	540.0	1.8	4461.32	214.80	4246.52	230-540	190-540	246
* RM4	56472	61099	3.0	500.0	3.5	4395.50	155.80	4239.70	190-490	115-500	176
* RM4R	56358	61086	5.0	160.0	1.0	4368.32	128.60	4239.72	110-160	105-160	157
* RM5	56416	61286	3.0	440.0	3.6	4379.12	140.30	4238.82	150-430	130-440	172
* RM6	56348	61481	3.0	460.0	2.3	4374.57	136.50	4238.07	175-455	110-460	174
RM7	57904	61645	3.0	219.5	2.2	4395.86	140.30	4255.56	187-217	177-217	200
RM8	57204	61576	3.0	79.1	3.1	4381.77	58.10	4323.67	57-77	47-77	75
* RM9	56767	61363	3.0	82.8	1.2	4369.31	61.30	4308.01	62-82	52-82	80
* RM10	56286	61272	5.0	99.0	2.0	4343.57	95.30	4248.27	57-97	53-97	---
* RM11	56594	60769	5.0	240.0	2.0	4436.14	184.70	4251.44	140-180	5-180	220
									180-240#	-	
RM12	59477	61791	5.0	157.0	1.3	4415.95	142.90	4273.05	117-157	110-157	156
* RM13	56648	61996	5.0	270.0	2.0	4434.81	189.60	4245.21	140-180	5-180	219
									180-270#	-	
RM14	58419	61368	5.0	260.0	1.5	4450.84	191.30	4259.54	134-174	127-174	253
									174-260#	-	
* RM15	56311	61354	5.0	460.0	1.9	4343.75	107.70	4236.05	379-459	95-459	157
* RM16	56615	60772	5.0	296.0	1.2	4434.95	194.60	4240.35	246-296	240-296	225
* RM17	56636	61993	5.0	290.0	0.7	4433.58	190.00	4243.58	240-290	235-290	218
RM18	57833	61851	5.0	243.3	1.3	4421.56	163.80	4257.76	162-242	149-242	232
RM19	58077	61524	5.0	236.3	1.3	4409.50	152.30	4257.20	155-235	139-235	219
RM20	57208	61592	5.0	212.6	1.6	4380.83	129.70	4251.13	131-211	120-212	201
RM21	57843	61851	5.0	141.3	1.3	4421.64	Dry	4280.34	110-140	100-140	---
RM22	58088	61513	5.0	120.8	0.8	4410.52	Dry	4289.72	90-120	80-120	---
WW1	57144	63677	6.0	870.0	-2.8	4454.79	---	---	635-870#	-	---
WW2	56562	63086	6.0	1000.0	-3.4	4471.61	---	---	602-1000#	-	---
						TAILINGS WELLS					
T4	58456	61953	2.0	20.0	1.2	4431.20	Dry	4411.20	12.9-17.9	10-18	---
T5	58371	61891	2.0	10.0	2.5	4425.00	Dry	4415.00	2.5-7.5	0.7-8	---
T6	58133	61801	2.0	11.7	2.9	4429.00	Dry	4417.30	3.8-8.8	1-9	---
						PIEZOMETERS					
PZ1	56598	61022	1.0	87.0	1.8	4434.51	---	---	75-85	2-85	---
PZ2	56580	61327	1.0	88.0	1.7	4434.74	---	---	76-86	3-86	---
PZ3	56564	61575	1.0	88.0	1.9	4435.34	---	---	76-86	3-86	---
* PZ4	56271	61383	1.0	25.0	1.7	4347.17	Dry	4320.92	13-23	2-23	---
* PZ5	56301	61275	1.0	25.0	1.8	4344.79	Dry	4318.49	13-23	1-23	---

TABLE 3-1. BASIC DATA FOR THE SHOOTARING WELLS AND PIEZOMETERS.

WELL NAME	NORTH. COORD.	EAST. COORD	CASING DIAMETER (in)	TOTAL DEPTH (ft-mp)	STICKUP (ft)	MP ELEV. (ft-msl)	WATER LEVEL DEPTH (ft-mp)	WATER LEVEL ELEVATION (ft-msl)	SLOTTED CASING (ft-lsd)	SAND PACK (ft-lsd)	PUMP INTAKE (ft-mp)
* PZ6	56332	61167	1.0	25.0	1.6	4362.50	Dry	4336.90	13-23	2-23	---

NOTE: Wells RM1 through RM6, RM15 through RM17, OW1A and OW2 are completed in the Entrada Aquifer
Wells RM2R, RM4R, RM7 through RM14 and PZ4 through PZ6 are completed in the Upper Entrada Sandstone
Wells WW1, WW2, OW1B and OW3 are completed in the Navajo Aquifer
Well OW4 is completed in the Carmel Aquitard
Piezometers PZ1 through PZ3 are Dam Piezometers
mp = measuring point; lsd = land surface datum; msl = mean sea level
# = open hole
* = Abandoned Well
Above data compiled from physical measurements, records and site surveys.

APPENDIX E

ORE PAD LINER

APPENDIX E

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E.1 Ore Pad Study, December 11, 1998

plateau resources LIMITED

Corporate Offices:
877 North 8th West, Riverton, WY 82501

Tel: (307) 856-9271
Fax: (307) 857-3050

Shootaring Operations:
Box 2111, Ticaboo, Lake Powell, UT 84533

Tel: (801) 788-2120
Fax: (801) 788-2118

December 11, 1998

State of Utah
Department of Environmental Quality
Division of Radiation Control
168 North 1950 West
Salt Lake City, Utah 84114-4850
Attn. Mr. Rob Herbert

Re: Shootaring Canyon Uranium Mill, Ore Pad Study

Dear Rob:

As per your request, Plateau conducted a study of the surface material on the Ore Pad. This study was to determine the hydraulic conductivity of the surface material. On September 17, 1998 three samples were collected and composited into one sample for testing. The samples were collected at a depth of two to twelve inches. The composite sample was sent to Inberg-Miller Engineers for laboratory testing. On December 7 additional data was collected as to the total depth of the surface material. Five areas on the Ore Pad were tested and found to have a depth of 12 to 14 inches of clay material on a couple inch gravel base.

The sample was prepared to optimum moisture of 95 % maximum density. The 95 % density was used as it will be most representative of ore pad operating conditions. Ore pad operating conditions will include the use of heavy equipment and water for dust control. The compaction effect of these operating conditions will produce at least the 95 % maximum density used in the laboratory test.

The use of any other ore pad surface material, such as, concrete or asphalt, is not easy to maintain and Plateau will continue to use the clay prepared base for the ore pad. Attached is the November 19, 1998 laboratory report. The results are; optimum moisture of 12.5 percent, maximum density of 94.4 percent and hydraulic conductivity of 3.7 x E-6 cm/sec.

Should you have any questions please contact me at the Riverton office.

Sincerely,
Plateau Resources Limited

F. R. Craft

Enclosure
xc: File

Procedure for Collection of Soil Samples from Ore Pad

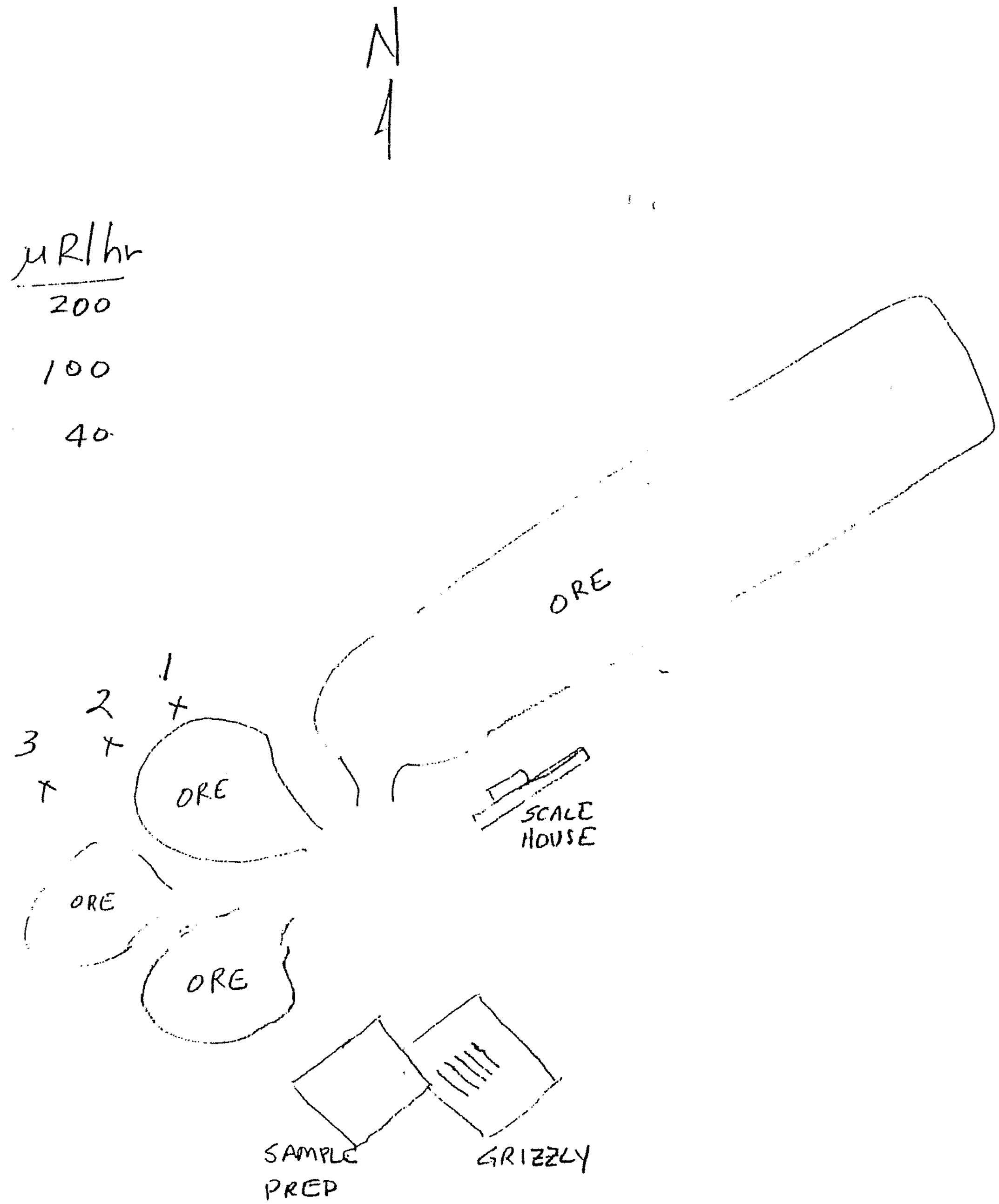
Locations:

See attached sketch.
Holes 1 and 2 were opposites water supply nozzles.

Method:

Used a round point shovel to dig down approximately two inches and then started placing soils into a five gallon plastic bucket. Continued placing soil into the bucket until a depth of approximately twelve inches was reached.
This was repeated at two additional sampling locations. The bucket at completion was three fourts full.
A gamma probe was suspended into each hole and a gamma field reading was recorded. Those results are indicated on the sketch.
The samples were taken on September 17, 1998.

Hole #	µR/hr
1	200
2	100
3	40



NOT TO SCALE

Ore Pad Sample
Locations
Sampled 9-17-98

INBERG-MILLER ENGINEERS
124 EAST MAIN STREET RIVERTON, WYOMING 82501-4397 307-856-8136

November 19, 1998 7664-RX

U.S. Energy Corp./Crested Corp.
877 N. 8th West
Riverton, WY 82501

ATTENTION: FRED CRAFT

RE: MOISTURE-DENSITY RELATIONSHIP
AND PERMEABILITIES
ORE PAD
SHOOTARING CANYON DAM SITE

Gentlemen:

This letter transmits the results of moisture-density relationships and hydraulic conductivity (permeability) testing that we performed in accordance with our November 21, 1996, Service Agreement and Proposal and Amendment No. 1 dated January 2, 1998.

Samples were collected from three locations on the northwest areas of the ore pad at the above project site. Each sample, approximately 1/6 of a cubic foot, was collected at depths between 2 and 12 inches below the ground surface. Samples were collected by U.S. Energy personnel and delivered to Inberg-Miller Engineers for testing. Two laboratory soil tests performed:

1. Moisture-Density Relationship (ASTM D698)
2. Measurement of Hydraulic Conductivity (ASTM D5084) Method B

Measurement of the hydraulic conductivity included preparing a sample with an initial diameter of 2.432 inches and length of 2.994 inches, a dry density of 108.6 pounds per cubic foot (pcf) and a moisture content of 11.9 percent. A graphic representation of the moisture-density relationship as determined by a Standard Proctor analysis is included with this letter. The results indicate an optimum moisture content of 12.5 percent and a maximum dry density of 115.0 pcf. Laboratory tests resulted in a hydraulic conductivity of 3.7×10^{-6} cm/sec. Accordingly, the sample density is 94.4 percent of the ASTM D698 maximum density.

We appreciate the opportunity to participate on this project. If you have any questions with the contents of this letter or enclosures or if we can be of additional assistance, please contact us.

Sincerely,

INBERG-MILLER ENGINEERS

Jeffrey A. Young
Civil Engineer

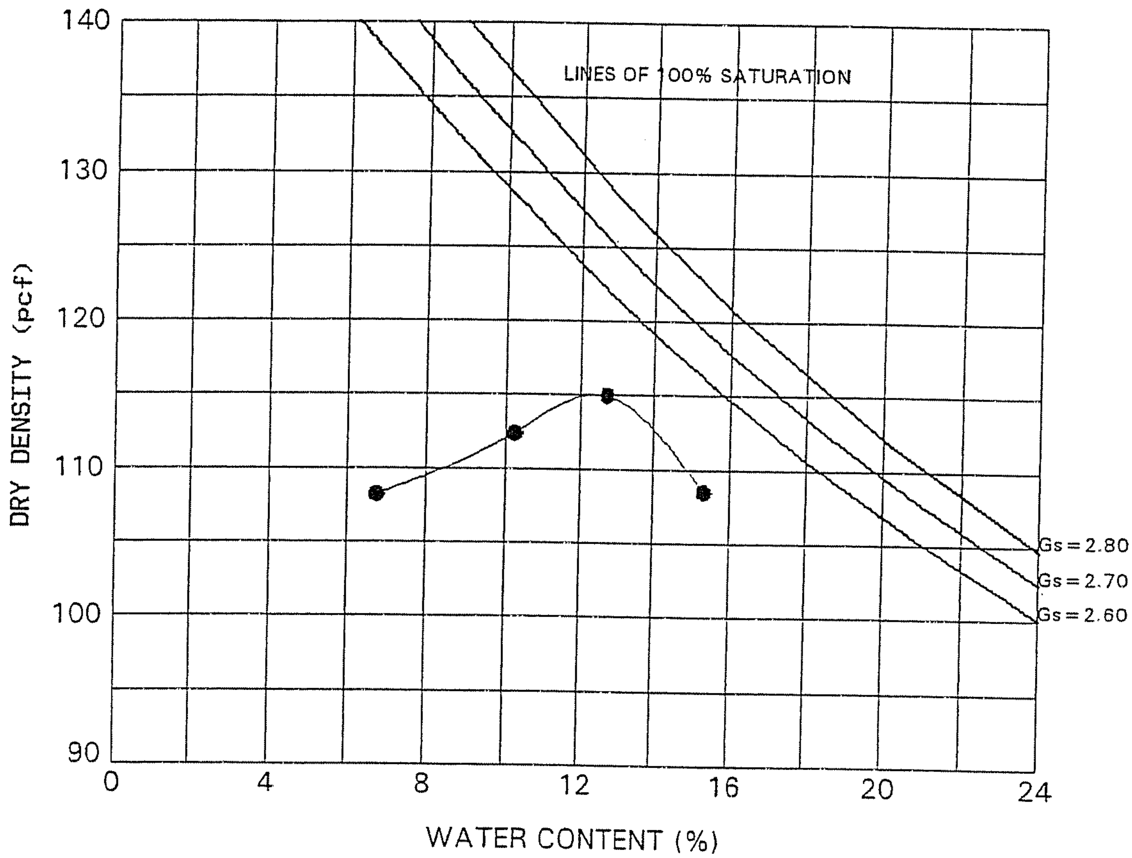
JAY:cāg:ltr\7664-rx.ltr

Enclosure as stated

MOISTURE-DENSITY ANALYSIS

PROJECT: SHOOTERING DAM
JOB NO.: 7664 RX
CLIENT: U.S. ENERGY

TEST DATE: 9-28-98
TESTED BY: JMR
TEST METHOD: STANDARD PROCTOR



SAMPLE NO.: 1
SAMPLED BY: CLNT
DEPTH: 0.00

SOIL DESCRIPTION: Red to Brown, Silty, Fine Sand
SOURCE: On Site

PASSING #200 SIEVE: ____ %
LIQUID LIMIT: ____
PLASTICITY INDEX: ____

OPTIMUM WATER CONTENT: 12.5 %
MAXIMUM DRY DENSITY: 115.0 pcf

INBERG-MILLER ENGINEERS

APPENDIX F

CLAY BORROW MATERIAL

APPENDIX F

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F.1 Permeability, Atterbert Limits, Gradation and Moisture-Density for the Alternate Clay Source

by Inberg-Miller Engineers, September 20, 2005

RIVERTON . CASPER . CHEYENNE
POWELL . GREEN RIVER

INBERG-MILLER ENGINEERS

QUALITY SOLUTIONS THROUGH TEAMWORK

September 20, 2005

10223-RM

RECEIVED
SEP 21 2005

Mr. Fred Craft
U.S. Energy Corporation
877 North 8[th] West
Riverton, WY 82501

RE: SOIL TEST RESULTS
SHOOTERING CANYON MILL PROJECT

Dear Fred:

This letter transmits the results of laboratory testing that we performed on a sample of claystone that you submitted to our Riverton, Wyoming laboratory.

Specifically, you requested that we perform classification tests consisting of Moisture-Density Relationship (Standard Proctor), Atterberg-Limits, and Particle Size Analysis on 2 sub-samples of the claystone that you submitted. Further, you requested permeability testing on 3 specimens re-molded from the claystone.

The claystone as submitted was hard, dry, and shale-like. The claystone rapidly softened when submerged in water. The tests were performed on the claystone after it was softened to a soil-like consistency.

Refer to the attached test results. Note that the progress of permeability testing was slow due to the low permeability of the remolded claystone (which had been remolded to 95 percent of the ASTM D698 maximum dry density). The permeability tests were terminated when the volume of water measured passing through the sample was determined to represent permeability on the order of 10^{-8} centimeters/second or less.

Please call if you have any questions or require further information.

Sincerely,

INBERG-MILLER ENGINEERS

Glenn M. Bobnick, P.E.
Geotechnical Engineer
Riverton Office

Enclosures as stated

124 East Main Street
Riverton, WY 82501
307-856-8136
307-856-3851 (fax)
riverton@inberg-miller.com

1120 East "C" Street
Casper, WY 82601
307-577-0806
307-472-4402 (fax)
casper@inberg-miller.com

350 Parsley Boulevard
Cheyenne, WY 82007
307-635-6827
307-635-2713 (fax)
cheyenne@inberg-miller.com

428 Alan Road
Powell, WY 82435
307-754-7170
307-754-7088 (fax)
powell@inberg-miller.com

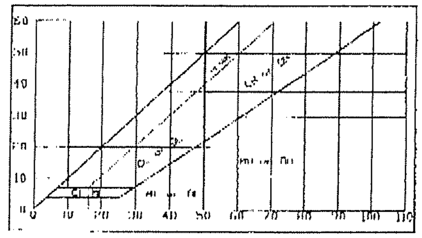
520 Wilkes Drive, Suite 13
Green River, WY 82935
307-875-4394
307-875-4395 (fax)
greenriver@inberg-miller.com

ATTERBERG LIMITS TEST

INBERG-MILLER ENGINEERS

ASTM D4318

CLIENT:	U.S. Energy
PROJECT:	Shootering Canyon Mill
JOB NO.:	10223 RM
TEST DATE:	6-3-05
TESTED BY:	DAL
SAMPLE NOS:	Sec. 16, A & C
SAMPLED BY:	Client
SOURCE:	Site Soil



SAMPLE NO. A	Plastic (Y/N)?	Y

PLASTIC LIMIT INFORMATION			LIQUID LIMIT INFORMATION			TEST RESULTS	
TRIAL NO.:	1	2	1	2	3	LIQUID LIMIT:	90
Tare (Pan) No.:	2P		3L			PLASTIC LIMIT:	29
Tare (Pan) Wt.:	13.83		23.58		-	PLASTIC INDEX:	61
Tare + Wet Soil Wt.:	17.81		45.5			USCS CLASSIFICATION:	CH
Tare + Dry Soil Wt.:	16.92		35.14			ERROR MESSAGES	
No. of Blows:			25				
PERCENT MOISTURE:	28.80%		89.62%				
AVERAGE MOISTURE:	28.80%		89.62%				

SAMPLE NO. C	Plastic (Y/N)?	Y

PLASTIC LIMIT INFORMATION			LIQUID LIMIT INFORMATION			TEST RESULTS	
TRIAL NO.:	1	2	1	2	3	LIQUID LIMIT:	90
Tare (Pan) No.:	6		6L			PLASTIC LIMIT:	28
Tare (Pan) Wt.:	14.35		23.76			PLASTIC INDEX:	62
Tare + Wet Soil Wt.:	17.51		48.1			USCS CLASSIFICATION:	CH
Tare + Dry Soil Wt.:	16.82		36.64			ERROR MESSAGES	
No. of Blows:			28				
PERCENT MOISTURE:	27.94%		90.20%				
AVERAGE MOISTURE:	27.94%		90.20%				

SAMPLE NO.	Plastic (Y/N)?	

PLASTIC LIMIT INFORMATION			LIQUID LIMIT INFORMATION			TEST RESULTS	
TRIAL NO.:	1	2	1	2	3	LIQUID LIMIT:	
Tare (Pan) No.:						PLASTIC LIMIT:	
Tare (Pan) Wt.:						PLASTIC INDEX:	
Tare + Wet Soil Wt.:						USCS CLASSIFICATION:	
Tare + Dry Soil Wt.:						ERROR MESSAGES	
No. of Blows:							
PERCENT MOISTURE:							
AVERAGE MOISTURE:							

SAMPLE NO.	Plastic (Y/N)?	

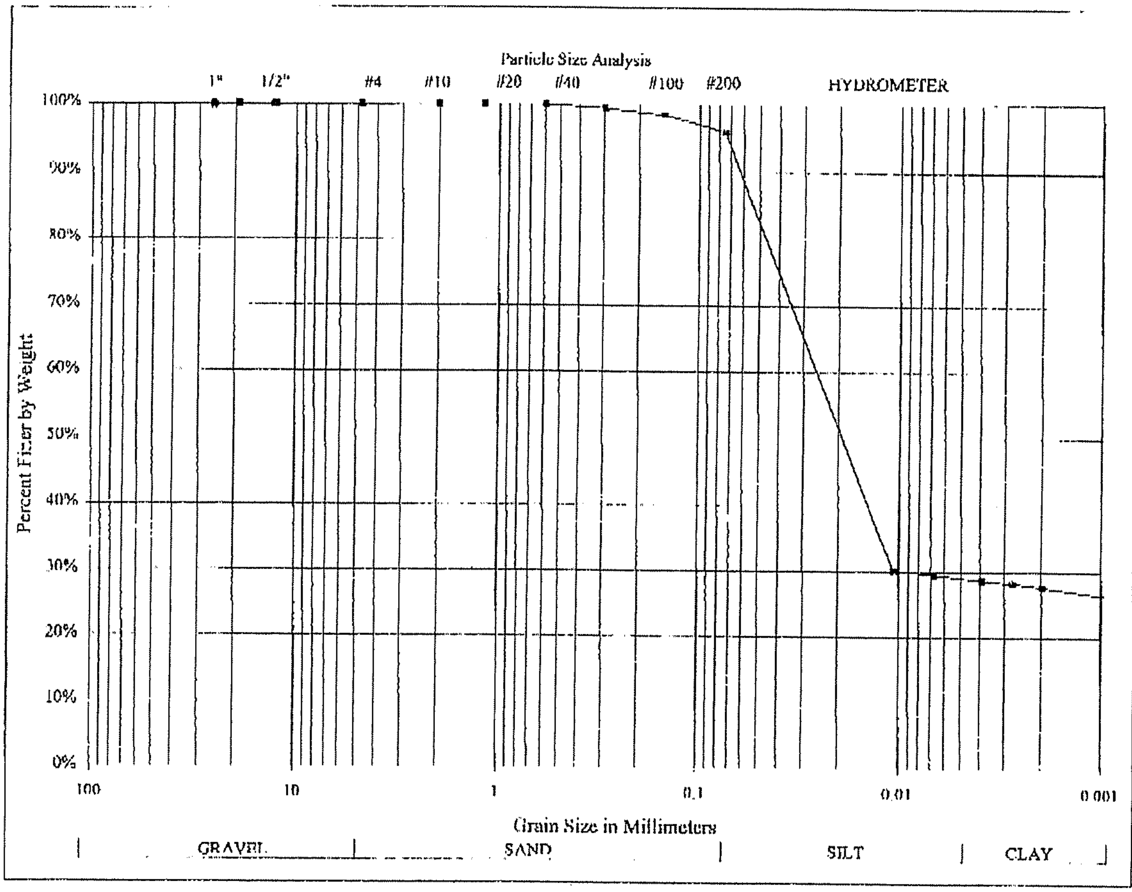
PLASTIC LIMIT INFORMATION			LIQUID LIMIT INFORMATION			TEST RESULTS	
TRIAL NO.:	1	2	1	2	3	LIQUID LIMIT:	
Tare (Pan) No.:						PLASTIC LIMIT:	
Tare (Pan) Wt.:						PLASTIC INDEX:	
Tare + Wet Soil Wt.:						USCS CLASSIFICATION:	
Tare + Dry Soil Wt.:						ERROR MESSAGES	
No. of Blows:							
PERCENT MOISTURE:							
AVERAGE MOISTURE:							

SAMPLE NO.	Plastic (Y/N)?	

PLASTIC LIMIT INFORMATION			LIQUID LIMIT INFORMATION			TEST RESULTS	
TRIAL NO.:	1	2	1	2	3	LIQUID LIMIT:	
Tare (Pan) No.:						PLASTIC LIMIT:	
Tare (Pan) Wt.:						PLASTIC INDEX:	
Tare + Wet Soil Wt.:						USCS CLASSIFICATION:	
Tare + Dry Soil Wt.:						ERROR MESSAGES	
No. of Blows:							
PERCENT MOISTURE:							
AVERAGE MOISTURE:							

SIEVE & HYDROMETER TEST ASTM D422

IME SAMPLE NO :	C	DATE RECEIVED:	5/6/1998
CLIENT:	U.S. Energy	TYPE OF SAMPLE	Bulk
CLIENT SAMPLE NO.:	Sec. 16 Site Soil		
SOIL DESCRIPTION:	Shale/Clay		

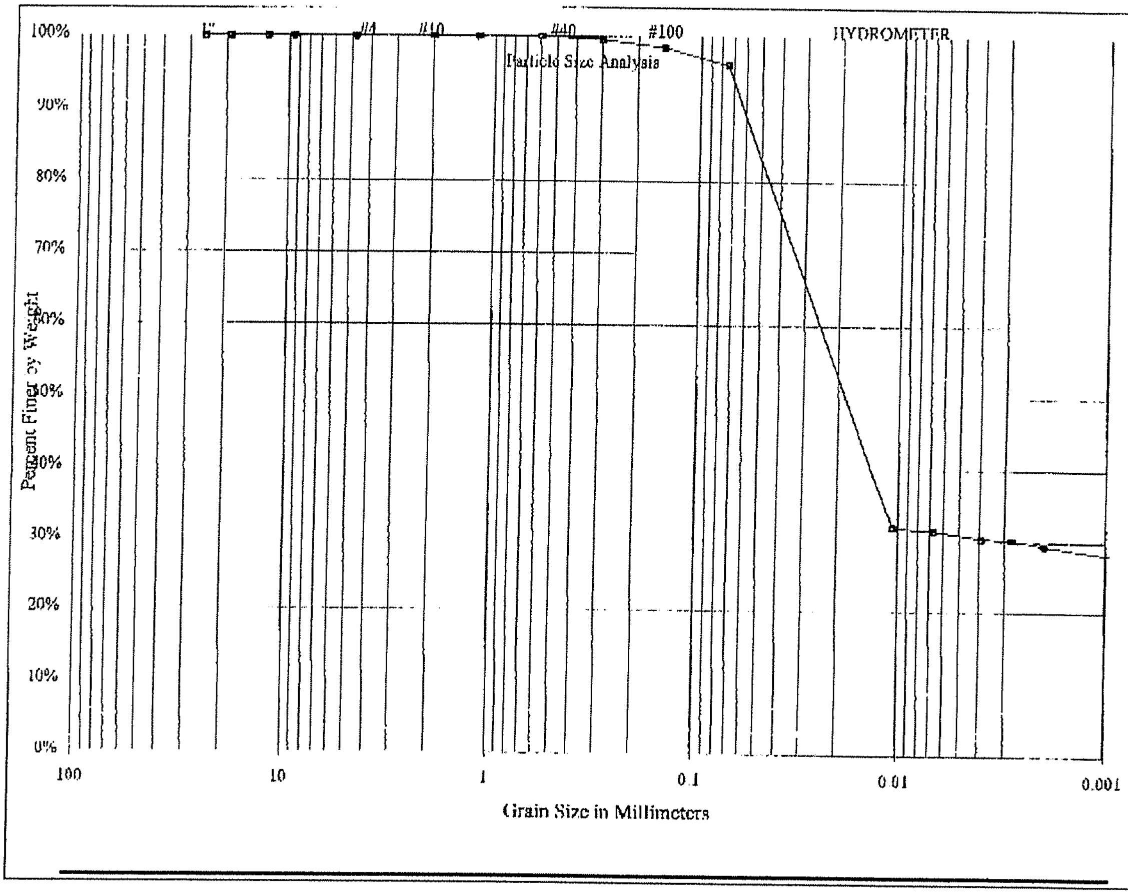


Sieve Size	PARTICLE SIZE (mm)	PERCENT FINER
1"	25.4000	100.0%
3/4"	19.1000	100.0%
1/2"	12.7000	100.0%
3/8"	9.5200	100.0%
NO. 4	4.7600	100.0%
NO.10	2.0000	100.0%
NO. 16	1.1900	100.0%
NO. 30	0.5900	100.0%
NO. 50	0.2970	99.4%
NO. 100	0.1490	98.4%
NO. 200	0.0740	95.9%
Hydrometer Range	0.0106	30.2%
	0.0067	29.5%
	0.0039	28.7%
	0.0028	28.3%
	0.0020	27.7%
	0.0010	26.4%
	0.0004	26.0%

Inberg-Miller Engineers
270 North American Road
Cheyenne, WY 82007

SIEVE & HYDROMETER TEST ASTM D422

IME SAMPLE NO.:	A	DATE RECEIVED:	5/6/1998
CLIENT:	U.S. Energy	TYPE OF SAMPLE	Bulk
CLIENT SAMPLE NO :	Sec. 16 Site Soil		
SOIL DESCRIPTION:	Shale/Clay		



Sieve Size	PARTICLE SIZE (mm)	PERCENT FINER
1"	25.4000	100.0%
3/4"	19.1000	100.0%
1/2"	12.7000	100.0%
3/8"	9.5200	100.0%
NO. 4	4.7600	100.0%
NO.10	2.0000	100.0%
NO. 16	1.1900	100.0%
NO. 30	0.5900	100.0%
NO. 50	0.2970	99.6%
NO. 100	0.1490	98.5%
NO. 200	0.0740	96.0%
Hydrometer Range	0.0105	31.8%
	0.0067	31.5%
	0.0039	30.5%
	0.0028	30.3%
	0.0020	29.4%
	0.0010	28.1%
	0.0004	27.5%

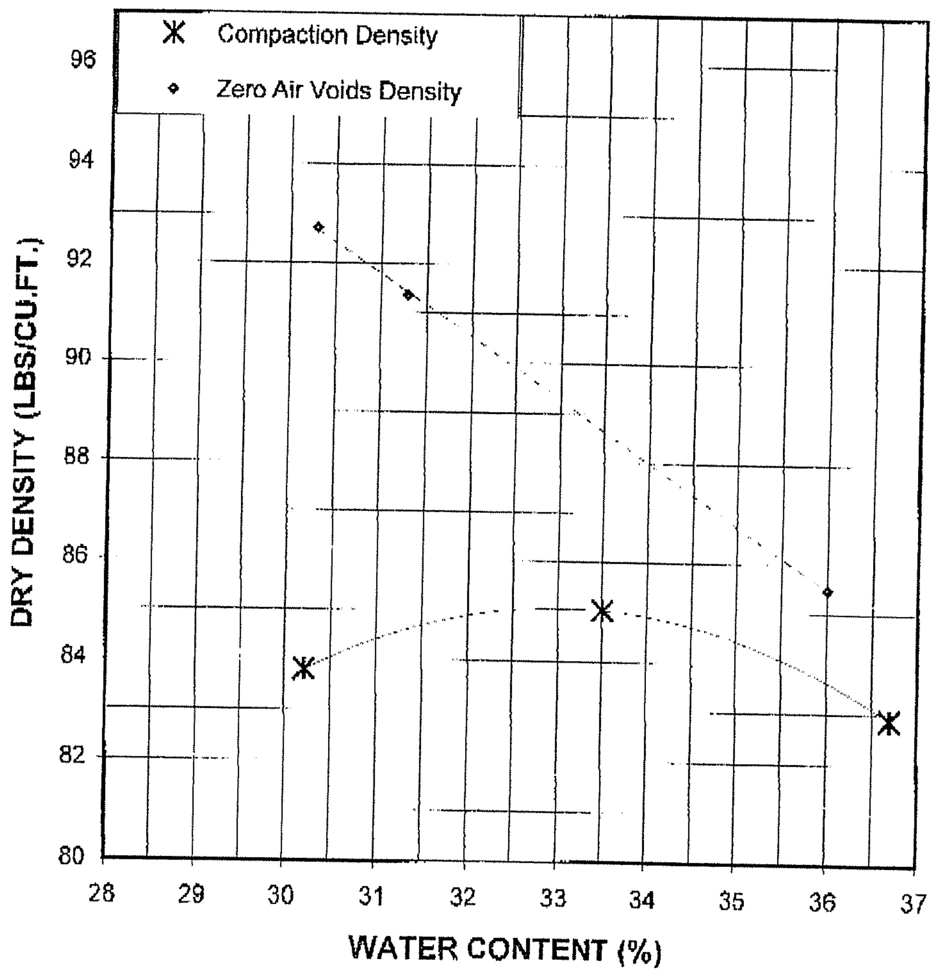
Inberg Miller Engineers
270 North American Road
Cheyenne, WY 82007

MOISTURE-DENSITY ANALYSIS

INBERG-MILLER ENGINEERS

CLIENT: U.S. Energy
PROJECT: Shootering Canyon Mill
JOB NO. 10223 RM
TEST DATE: 6-3-05
SOURCE: Site Soil
DESCRIPTION: Shale/Clay

SAMPLE NO.: Sec. 16, #C
SAMPLED BY: Client
TESTED BY : BJC
TEST METHOD: D 698-A



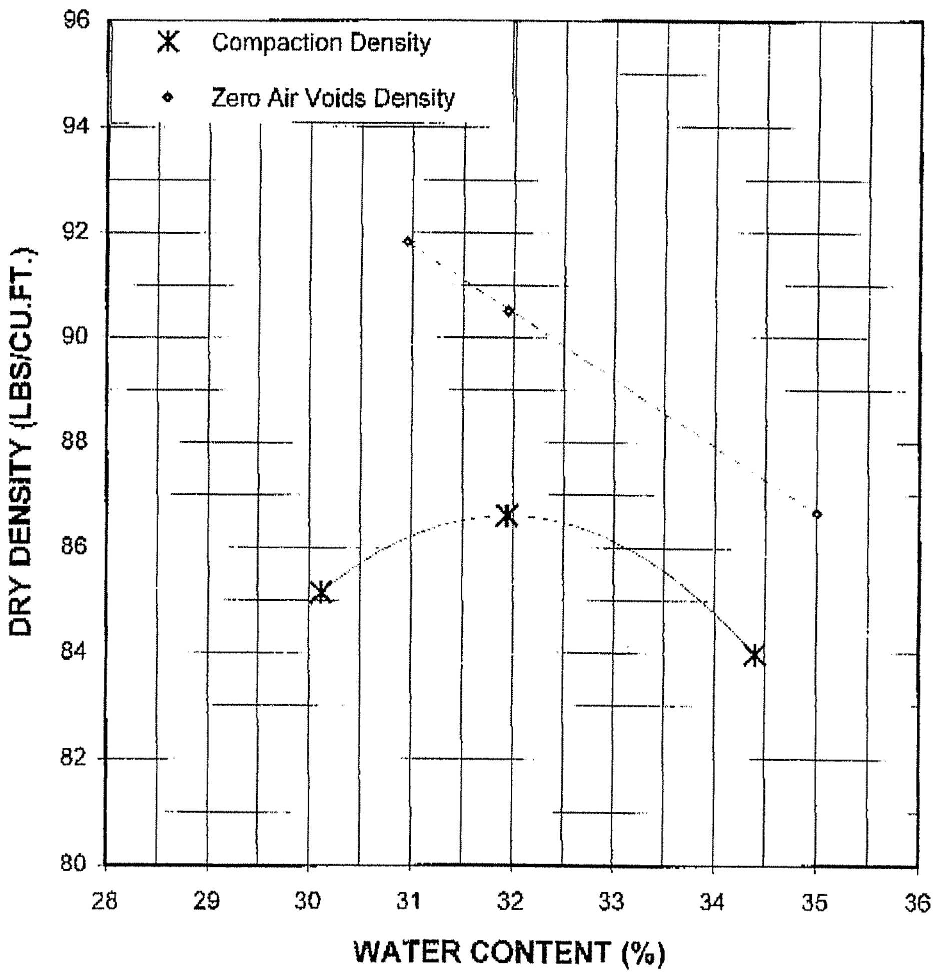
OPTIMUM WATER CONTENT (%): 31.3
MAXIMUM DRY DEN. (LBS/CU. FT): 85.7

MOISTURE-DENSITY ANALYSIS

INBERG-MILLER ENGINEERS

CLIENT: U.S. Energy
PROJECT: Shootering Canyon Mill
JOB NO. 10223 RM
TEST DATE: 6-3-05
SOURCE: Site Soil
DESCRIPTION: Shale/Clay

SAMPLE NO.: Sec. 16, #A
SAMPLED BY: Client
TESTED BY : BJC
TEST METHOD: D 698-A



OPTIMUM WATER CONTENT (%): 32.0
MAXIMUM DRY DEN. (LBS/CU. FT): 86.6

F.2 Discussion of Alternate Source Clay Properties
by Inberg-Miller Engineers, December 7, 2005

RIVERTON . CASPER . CHEYENNE
POWELL . GREEN RIVER

INBERG-MILLER ENGINEERS

December 7, 2005 10223-RM

Mr. Fred Craft
U.S. Energy
877 North 8th West
Riverton, WY 82501

RECEIVED
DEC - 8 2005

RE: SEPTEMBER 19, 2005 SOIL TESTING
SHOOTERING CANYON MILL PROJECT

Dear Fred:

This letter summarizes our observations of the claystone soil sample you submitted for laboratory testing, the results of which were reported on September 19, 2005.

As mentioned in our test report, the sample (as originally submitted) appeared shale-like, but softened rapidly upon inundation with water. Subsequently, moisture-density relationship, particle size analysis including hydrometer analysis, Atterberg Limits and permeability tests were performed. You and your consultant, Hydro Engineers, noted that the particle size analysis test indicated the fine fraction (minus 200 sieve) appeared to be substantially silt-size particles, and that the particle size analysis does not corroborate the relatively low permeability for the sample which was more representative of clay.

There are two observations that we make with regard to your note as presented above:

1. As stated, the sample was processed from hard shale-rock fragments to an apparent relatively soft soil through the addition of water. While the majority of the sample was soil when tested, the disintegration from silt to clay was likely incomplete based on visual and manual observations of variable texture.

2. Hydraulic permeability is controlled by pore size and pore volume of the soil mass through which water flows. Although a substantial portion of a certain soil may include silt through gravel-sized particles, if the soil particles are well graded and there is sufficient clay-sized particles to close the pore space of the larger soil particle fraction (soil matrix), soil pore size and pore volume may be reduced to that of the clay and render clay-like permeability test results.

Based on the above observations, it is our opinion the hydrometer analysis is not a good indicator of hydraulic permeability for the subject sample.

Please feel free to call if you have questions or require further information.

Sincerely,

INBERG-MILLER ENGINEERS

Glen M. Bobnick, P.E.
Geotechnical Engineer
Riverton Office

GMB:bjh:10223/10223 test observ. Ltr 12-07-05

124 East Main Street, Riverton, WY 82501, 307-856-8136, 307-856-3851 (fax), riverton@inberg-miller.com
1120 East "C" Street, Casper, WY 82601, 307-577-0806, 307-472-4402 (fax), casper@inberg-miller.com
270 North American Road, Cheyenne, WY 82007, 307-635-6827, 307-635-2713 (fax), cheyenne@inberg-miller.com
428 Alan Road, Powell, WY 82435, 307-754-7170, 307-754-7088 (fax), powell@inberg-miller.com
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