Preliminary Remedial Design

Basis of Design Report

Lower Burke Canyon Repository

Bunker Hill Mining and Metallurgical Complex Superfund Site, Operable Unit 3

February 2013

Prepared for

Successor Coeur d'Alene Custodial and Work Trust

CDM Smith

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Lower Burke Canyon Repository

Executive Summary

Introduction

This preliminary (30%) design report has been prepared for the Lower Burke Canyon Repository (LBCR). The LBCR site encompasses approximately 30-acres of the existing Star Tailings Impoundment (STI) Facility located east-northeast of the community of Woodland Park in Shoshone County; in the Canyon Creek Basin within the Upper Basin of the Coeur d'Alene River in northern Idaho (Upper Basin) (see Figure ES-1). The LBCR is bounded by Highway 4 (a.k.a. Burke Road) to the west, Grays Bridge Road to the south, and Canyon Creek to the north and east. Canyon Creek is a tributary to the South Fork of the Coeur d'Alene River (SFCDR), which it intersects approximately 1.5 miles downstream from the repository site near the town of Wallace, Idaho.

The STI facility was constructed and operated by the Hecla Mining Company (Hecla) and filled with tailings from the Star Mine and Mill beginning in 1965. The proposed LBCR will be constructed on top of four inactive ponds (Ponds No. 1 through No. 4) located north of Grays Bridge Road and east of Highway 4 (see Figure ES-2).

The LBCR is designed to securely contain mine waste generated during remediation activities within the Canyon Creek watershed. Current estimates indicate that approximately 1.8 million bank cubic yards (bcy) of waste materials exist in the Canyon Creek Basin (TerraGraphics Environmental Engineering, Inc. (TerraGraphics) 2011b). The proposed LBCR will be developed to contain approximately 816,000 bcy of waste materials from the Canyon Creek Basin. The LBCR will also be utilized to consolidate waste from several other programs including the Basin Property Remediation Program (BPRP), the Institutional Controls Program (ICP), the paved road program, and the remedy protection program.

Repository Siting and Property Ownership

The Idaho Department of Environmental Quality (IDEQ)-led repository siting process has been ongoing since 2007. The Citizens Criteria Repository Site Ranking Summary (CH2M Hill 2010) identifies eight (8) sites, including the STI site, as meeting the initial siting criteria of not being actively used by its owners and having a capacity of at least 500,000 bcy. Additional criteria were developed through a public input process, as documented in the Site Ranking Summary. Based on the results of the site ranking, additional public input, and other factors important to the agencies, the IDEQ and EPA proposed the STI and Osburn Tailings Impoundments for further use as repository sites. The two locations were presented in an Open House held in Wallace, Idaho on March 25, 2010. The public was encouraged to ask questions and provide written comment on the proposed repository locations. The comment period ran from March 25 to April 25, 2010. The results of the siting process described above, public review comments, and commitments are available on the Basin Environmental Improvement Project Commission (BEIPC) website: www.basincommission.com. Based upon the siting process results, IDEQ and EPA determined that design of the LBCR should proceed. As a result of the repository siting process and at the direction of IDEQ, TerraGraphics began development of the LBCR preliminary RD in 2011 prior to transfer of the design to the Coeur d'Alene Trust.

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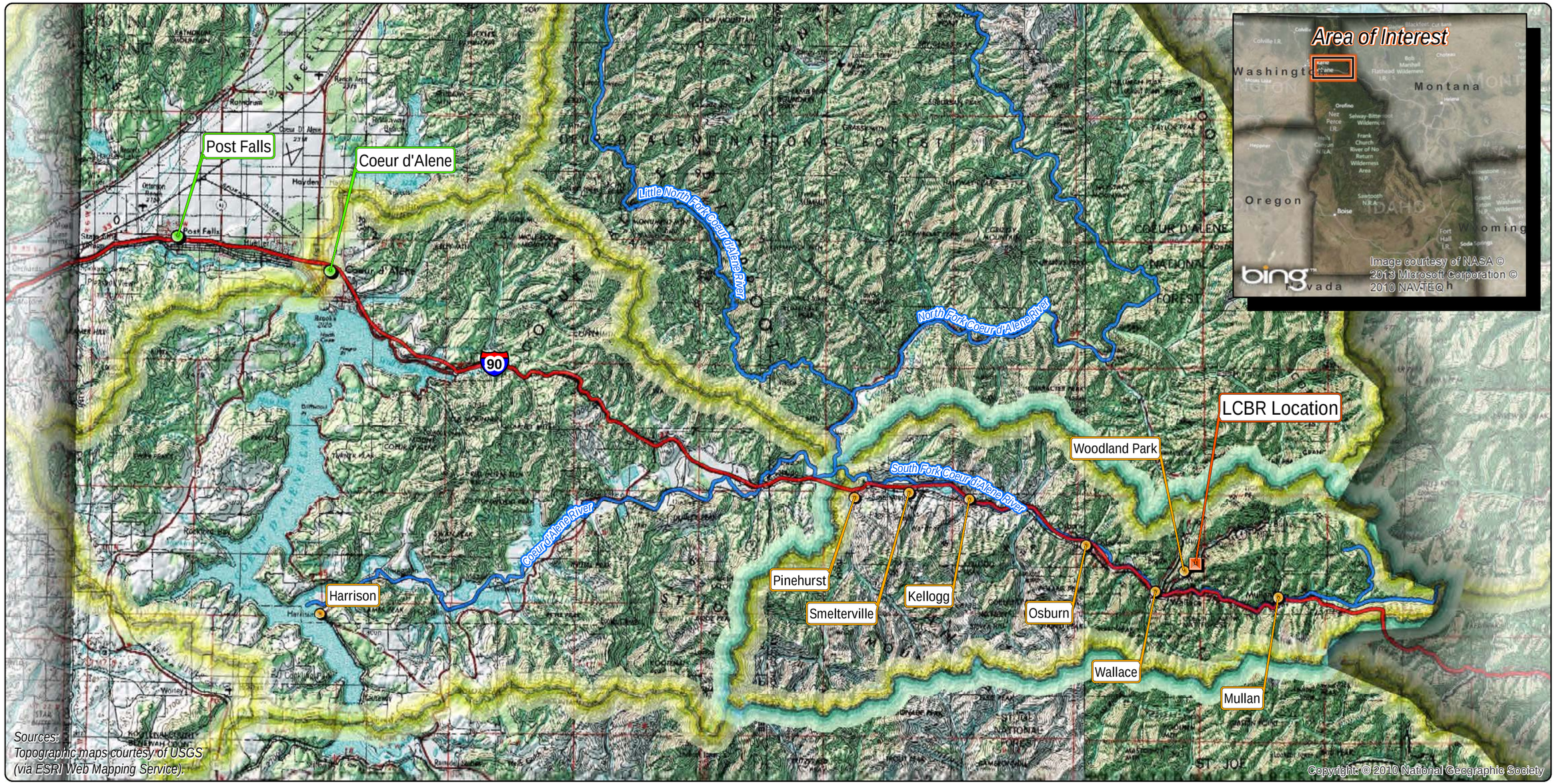

Figure ES-1
Site Location

Lower Burke Canyon Repository
Shoshone County, Idaho

- LBCR Site Location
- City
- Town
- Interstate
- Site Watershed
- Watershed Boundary
- River

0 5 10 15
Miles

N W E S

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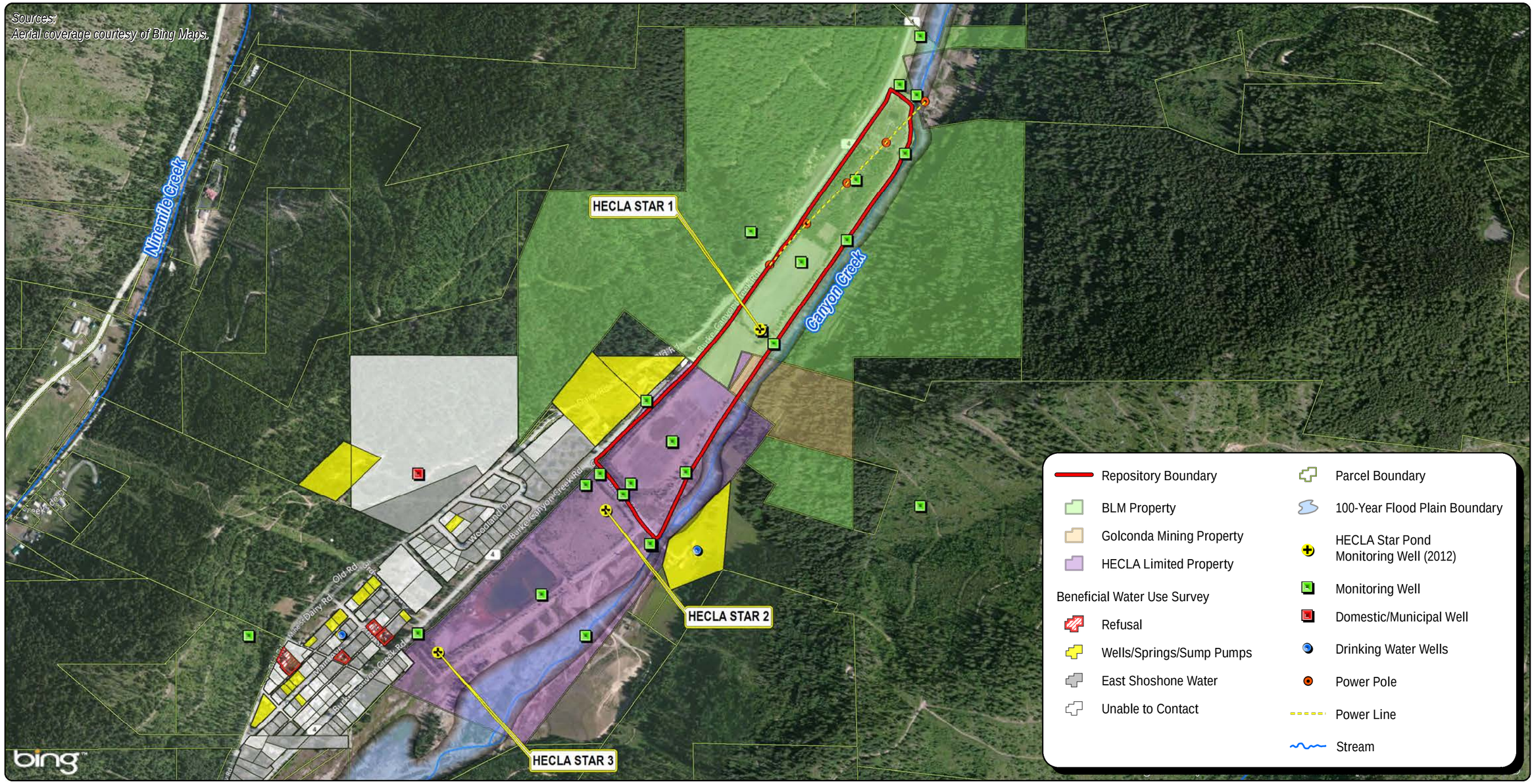

Figure ES-2
LBCR Site Details Map
Coeur d'Alene Trust

0 1,000 2,000 3,000
Feet

N W E S

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Lower Burke Canyon Repository
Shoshone County, Idaho

The LBCR footprint encompasses four parcels with three different property owners. Currently, Hecla owns two parcels, one parcel is managed by the Bureau of Land Management (BLM), and one parcel is owned by the Golconda Mining Company (see Figure ES-2). The EPA is working with the BLM and Hecla to transfer ownership of the parcels to the EPA. The finalized property boundary will be determined after the acquisition process is complete.

Phased Consolidation and Development Approach

The annual anticipated waste volumes and lifespan of the LBCR are uncertain at this time. As discussed in Section 1, EPA is currently developing a plan for the timing of the RA in the Canyon Creek Basin. The preliminary design assumes 12 Phases of consolidation; however, more specific annual waste consolidation plans will be developed as the operation of the LBCR continues and as the RA schedule is determined.

Initia Construction and Phase 1 Consolidation: Phase 1 will include initial construction of access roads, the decontamination and personnel facilities, and installation of utilities to support LBCR operations. Phase 1 consolidation will allow for the placement of approximately 80,000 bcy of waste materials during the first year the LBCR is operational, which at this time is tentatively the spring of 2015. It is anticipated that Phase 1 will include consolidation of waste materials from the Hecla-Star Complex (BUR 128) and other adjacent sites (Hidden Treasure Mine [BUR097], Hercules No. 5 [BUR098] and Tiger-Poorman Mine [BUR129]). Please note that the "BUR" designations are mine waste source identifications (IDs) and names that were initially used by the BLM during previous remedial investigation activities and are also utilized in the Interim ROD Amendment (EPA 2012a) and FFS (EPA 2012b). In addition, the LBCR will receive waste materials from the BPRP, ICP, Paved Roads, and Remedy Protection programs starting in 2015. During the intermediate design, the Phase 1 consolidation approach and construction plans will be refined as necessary.

Full-Scale Development: The full-scale consolidation plan will allow for the placement of approximately 816,000 bcy of mine waste from the various sites within Canyon Creek during the LBCR's lifespan. The current estimated schedule for mine waste consolidation to the LBCR spans from 2015 through 2025 or later (a minimum 10-year period); however, the timeline for Canyon Creek RA execution is subject to change based on funding, work execution progress, and adaptive management implementation. As a result, the consolidation plan will be updated annually to manage the anticipated waste volumes identified for disposal in the LBCR. The preliminary full-scale development plan provided on the design drawings indicates that there will be approximately 12 phases of consolidation during the LBCR's life span. Each phase will allow for the consolidation of approximately 80,000 bcy of waste material per year. The current approach provides flexibility for changes in the timeline and accommodates varying RA and consolidation tempos. Subsequent phases of the LBCR design will attempt to determine the full-scale consolidation approach and plans as the Canyon Creek RA schedule and plans are finalized.

Design Approach

The 2002 ROD (EPA 2002) and the Interim ROD Amendment (EPA 2012a) have identified the requirements and criteria for designing repositories such as the LBCR. The requirements include remedial action objectives (RAOs), such as protection of human health and the environment, cleanup levels, and other requirements including applicable or relevant and appropriate requirements (ARARs). The LBCR design also incorporates requirements provided in the Implementation Framework and Statement of Work for Remedial Design, Remedial Action, and Long-Term Operation,

Maintenance, and Monitoring (Statement of Work) between EPA and the Successor Coeur d'Alene Custodial and Work Trust (Coeur d'Alene Trust) (EPA 2011). The Interim ROD Amendment (EPA 2012a) specifies that contaminated soil and sediment will be removed from residential and select non-residential areas to protect Silver Valley residents from exposure to metals. The contaminated soils will be placed in secure repositories designed, operated, and maintained for that purpose.

The LBCR is designed to accept waste materials generated from cleanup of Canyon Creek mine sites and other programs identified in the introduction. The approximate LBCR waste capacity of 816,000 bcy is greater than 500,000 bcy as required in the The IDEQ-led repository siting criteria and it is located outside of the Federal Emergency Management Agency (FEMA) delineated floodway. Phased construction and operation of the LBCR will provide flexibility to accommodate changes in cleanup schedules and the waste consolidation approach as it continues to be developed by EPA.

Groundwater and Surface Water Protection: The LBCR design incorporates a low permeability cover that will prevent precipitation from coming in contact with or moving through the waste materials, which could result in contaminated stormwater that could reach Canyon Creek or leach into the groundwater. Additionally, the consolidated mine waste will be separated from groundwater and Canyon Creek by approximately 10 to 20 feet, due to the location of the LBCR on top of the existing STI. These features are intended to support the design in achieving RAOs, cleanup levels, and ARARs.

The selected remedy identified in the Interim ROD Amendment (EPA 2012b) includes surface water and groundwater remedial components to address metals loading from the STI, the Silver Valley Natural Resource Trustee (SVNRT) repository, and other contaminant sources within the Woodland Park area. The remedy includes installing French drains downstream of the STI and adjacent to the SVNRT repository to capture and collect contaminated groundwater and surface water within Canyon Creek and convey the water via pipeline to the central treatment plan (CTP) located in Kellogg, Idaho. Groundwater remedial components associated with the STI and surrounding Woodland Park area will be addressed in separate remedial designs and are not part of the LBCR design.

Air Quality Protection: Dust control will be required during construction of the LBCR to protect the air quality in the vicinity of the LBCR and the community of Woodland Park. Dust suppression techniques such as applications of water or chemical dust suppressants or surfactants (e.g., magnesium chloride) will be used in conjunction with operational restrictions (i.e., suspending hauling and placement operations) as necessary.

Historical, Archaeological, and Cultural Resource Protection: A cultural resource survey was conducted in 2011 and concluded that no cultural resources exist near the LBCR site (Sappington et al., 2011). The Coeur d'Alene Trust will continue to work with EPA to determine subsequent requirements that may need to be incorporated into the LBCR RD to ensure that the substantive requirements of the National Historic Preservation Act (36 CFR 800) (NHPA) are met. EPA is currently developing a basin-wide approach for coordinating historic, archaeological, and cultural resource issues with the Idaho State Historical Preservation Office (SHPO).

Wetlands Protection: A field investigation was conducted on October 28, 2009 (TerraGraphics 2009c), at the LBCR site to identify if wetlands were present within the LBCR footprint. The investigation concluded that there are no wetlands at the proposed LBCR site, thus wetlands encroachment will not be an issue in the design of the LBCR. However, the design may be revised to minimize wetland impacts if they are encountered.

Threatened and Endangered Species Protection: A review of the U.S. Fish and Wildlife Service (USFWS) databases for threatened and endangered species that could exist or be encountered near the LBCR. The results of the review indicated six species of concern listed by the USFWS in Shoshone County (USFWS 2012) (see in Table 1).

The Coeur d'Alene Trust will continue to work with EPA and USFWS to identify home ranges and migratory corridors near the LBCR. The LBCR is designed to reduce the potential for these sensitive species to be impacted by or exposed to high levels of metals in soils, surface water, and groundwater by utilizing design components such as the cover system to create physical barriers that will prevent wildlife exposure to contaminants.

Protection of Flood Plains: As discussed previously, the proposed LBCR site is located on top of the STI and outside of the FEMA's 100-year floodplain (see Figure 2-1). However, any work done to stabilize or cover the existing STI embankments along Canyon Creek would likely encroach on the 100-year floodplain. In accordance with Executive Order 11988, projects in a regulatory floodplain must undergo an encroachment review to determine their effect on flood flows and ensure that they do not increase flood heights above the allowable level. Projects involving filling or grading, such as activities that may be conducted to stabilize or cover the existing STI embankments along Canyon Creek, must be reviewed to determine whether they will obstruct flood flows and cause an increase in flood heights upstream or adjacent to the project site.

Visual Impacts: The LBCR will create a three-tiered, sloped soil mound on top of the existing STI facility. The LBCR surface will be revegetated with native grasses and shallow rooted shrubs to blend into the surrounding landscape; however, it will be visible to surrounding residents and visitors to the Canyon Creek basin. Visual simulations have been prepared to portray the visual impacts created by the LBCR in the Canyon Creek basin. The visual simulations were prepared from five view points around the LBCR that include the community of Woodland Park for reference. The visual simulations are provided at the back of this document.

Design Components

The LBCR footprint is approximately rectangular in shape, 3,700 feet by 300 feet, covering nearly 30 acres on top of the existing STI. Preliminary estimates from ongoing 2012 design work indicate a waste consolidation capacity of approximately 816,000 bcy.

Geotechnical Design: To achieve general slope stability of the LBCR, the consolidated mine waste and cover grading plans were developed using a maximum slope of 3 feet horizontal to 1 foot vertical (3H:1V). Preliminary stability analysis resulted in Factors of Safety (FS) which exceed the target FS of 1.5, 1.1, and 1.3 for static, seismic, and rapid drawdown conditions; respectively. However, the stability of the cover design has not yet been analyzed. The stability of the existing STI was also evaluated and is capable of providing a stable foundation for the LBCR. Waste materials will be placed in lifts (no thicker than two times the largest diameter rock) and be machine compacted (i.e., padded drum roller or grid roller) to improve the stability of the facility. Due to the compressible nature of tailings and the relative incompressibility of the perimeter dam materials in the existing STI, long-term differential settlement of the LBCR will be addressed to prevent damage to the cover system or interruptions in surface water flow.

Drainage Control: Stormwater drainage and erosion controls will be designed to convey and retain the peak discharge from a 25-year, 24-hour storm event and the 100-year snowmelt event (rain-on-

Table 1

Federal Listed Species with Potential to Occur in Shoshone County, Idaho			
Species	**Status**	**Habitat Requirements**	**Likelihood of Occurrence**
Fish			
Bull Trout (*Salvelinus confluentus*)	FT, CH	Cold headwater lakes and streams and rivers that drain high mountainous areas. Critical habitat occurs in the Coeur d'Alene River Basin in Shoshone County.	Not present; no suitable habitat.
Mammals			
Canada lynx (*Lynx canadensis*)	FT	Montane coniferous forests. Highly dependent on the snowshoe hare (*Lepus americanus*) for food, which prefer diverse, early successional forests with dense stands of conifers and shrubby understories.	Low potential to occur in suitable habitat.
Wolverine *(Gulo gulo)*	FC	Found in a wide variety of high elevation habitats. Needs water source. Uses caves, logs, burrows for cover and den area. Hunts in more open areas. Can travel long distances.	Low potential to occur in suitable habitat.
Plants			
Water howellia (*Howellia aquatilis*)	FT	Restricted to small pothole ponds or orphaned river oxbows that are generally less than 3 feet deep, but occasionally up to 6 feet deep. Ponds are typically in a matrix of dense forest vegetation, and are nearly always surrounded by broadleaf deciduous trees. Bottoms of wetlands contain clay and organic sediments. Habitats are filled by snowmelt run-off and spring rains, and then dry out to varying degrees by the end of the growing season.	Not present; no suitable habitat.
Whitebark pine (*Pinus albicaulis*)	FC	Occur only at high elevation forests from 3,600 - 9,500 feet.	Potential to occur in suitable habitat.
Spaulding's catchfly (*Silene spaldingii)*	FT	Open grasslands with a minor shrub component and occasionally with scattered conifers. Found most commonly in the Idaho fescue/snowberry association at elevations of 1900-3050 feet.	Not present; no suitable habitat.

Source: USFWS Federal Listed Species by County, Idaho Fish and Wildlife Office, revised September 6, 2012.

Federal Protection
FT – Federal Threatened (listed)
FC – Federal Candidate
CH – Designated Critical Habitat (Federal) occurs in the County

snow condition) during operation of the LBCR. After the LBCR is filled and closed, drainage controls will be designed for peak discharges from the 100-year, 1-hour storm event and the 100-year snowmelt event (100-year rain-on-snow condition). Stormwater channels will direct runoff to a stormwater infiltration pond located adjacent to the southeast corner of the existing STI. However, temporary stormwater infiltration ponds may be constructed within the flat working area of the LBCR if necessary. To prevent erosion of the drainage controls, they will be vegetated with native grasses; however, riprap will be installed where shear stresses and velocities are highest.

Erosion and Dust Control: Silt fences or similar Best Management Practices (BMPs) will be constructed around the perimeter of the LBCR to provide initial, temporary erosion control. Additional erosion control measures such as perimeter diversion dikes, hydroseeding or spray-on type soil stabilizers, and covering with polyethylene sheeting may also be used during the operational lifecycle of the LBCR as necessary.

The repository contractor will visually monitor for dust generated by vehicles onsite. To maintain compliance with state air quality regulations and prevent dust, water trucks will be onsite at all times. If dust is observed, the contractor will take immediate steps to control it. Water trucks will make multiple passes during the day to keep driving surfaces wetted. If necessary, applications of chemical dust suppressants or surfactants (e.g., magnesium chloride) will be used. In the event of excessive dust conditions, hauling and placement operations will be suspended.

LBCR Facilities: The LBCR will include facilities similar to other basin repositories to support LBCR operations including: decontamination facilities near the entrance/exit where vehicles can be washed down prior to leaving the site, a personnel building and parking area, and a separate ICP disposal area to allow users to safely and easily dispose of contaminated soil. Mine waste from mine sites located within Canyon Creek will be hauled in highway-rated trucks to the LBCR via Idaho State Highway 4 (Burke Road). To minimize impacts to the community of Woodland Park and improve safety, trucks supporting mine site cleanup will enter the LBCR near the north end. Mine waste from the BPRP, ICP, paved road program, and remedy protection programs will also be hauled via Idaho State Highway 4 (Burke Road) to temporary access locations along the LBCR. Access roads and disposal locations within the LBCR will accommodate a standard 15-ton dual axel dump truck and standard full-size pickups. Access gates and perimeter fencing will be installed around the LBCR to prevent inadvertent entry into the repository and reduce recreation or other casual traffic through the area. The ICP area will include its own access gate and perimeter fencing. The LBCR facilities will be developed in the initial construction period scheduled for 2014.

Cover Design: The proposed LBCR cover system consists of 2 feet of cover soil (2-inch minus amended growth media) underlain by a 60-mil textured polyethylene geomembrane liner. The geomembrane will be placed on roller-compacted material with a maximum particle size of 0.5 inches. Infiltrating surface water will be drained from the cover system by a geocomposite drainage layer placed on the surface of the geomembrane. The preliminary volume of cover soil required for the LBCR, placed at two feet thick, is estimated to be approximately 85,000 cy. Cover soil will be imported from an offsite borrow source to the LBCR due to high metals concentrations in the existing site soils. At this time, local borrow areas near the LBCR are being evaluated by the Coeur d' Alene Trust.

Operations and Maintenance (O&M): Plans will be developed as part of the pre-final (90 percent) design for the repository owner and contractor. O&M plans will include an annually updated waste placement plan. The waste placement plan will formulate the phased construction approach and estimate annual waste placement/production volumes at the LBCR. A Stormwater Pollution

Prevention Plan (SWPPP) and Construction Monitoring Plan (CMP) will also be developed. The SWPPP will guide stormwater management practices and controls and the CMP will address the collection and analyses of environmental monitoring samples at the LBCR site.

Preliminary Schedule

As discussed previously, the LBCR design incorporates a phased approach to construction. The initial phase includes construction of the portion of the LBCR needed to manage mine waste generated from the Hecla-Star Complex. The Coeur d'Alene Trust has developed a preliminary project schedule for the design and construction of the first phase of the LBCR, which includes the following general milestones for the project:

- January 11, 2013: Submit the preliminary (30%) design to the EPA
- May 2013: Submit the intermediate (60%) design activities to the EPA
- September 2013: Submit the pre-final (90%) design to the EPA
- Mid September 2013: Initiate final (100%) design activities
- November 2013: Conduct contractor site walk of the LBCR area
- January 2014: Submit the final (100%) design to the EPA
- Spring 2014: Coeur d'Alene Trust to award LBCR construction contract
- Summer/Fall 2014: Complete initial phase of LBCR construction
- Summer/Fall 2015: Initial consolidation of waste to LBCR.

Although this preliminary design provides information on the long-term LBCR design, such as the LBCR configuration to manage long-term waste capacity and borrow material requirements, the long-term LBCR design and construction schedule is currently under development by the EPA.

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VISUAL SIMULATION 1
NORTH VIEW
FEBRUARY 2013

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VISUAL SIMULATION 2
NORTHEAST VIEW
FEBRUARY 2013

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VISUAL SIMULATION 3
PLAN VIEW
FEBRUARY 2013

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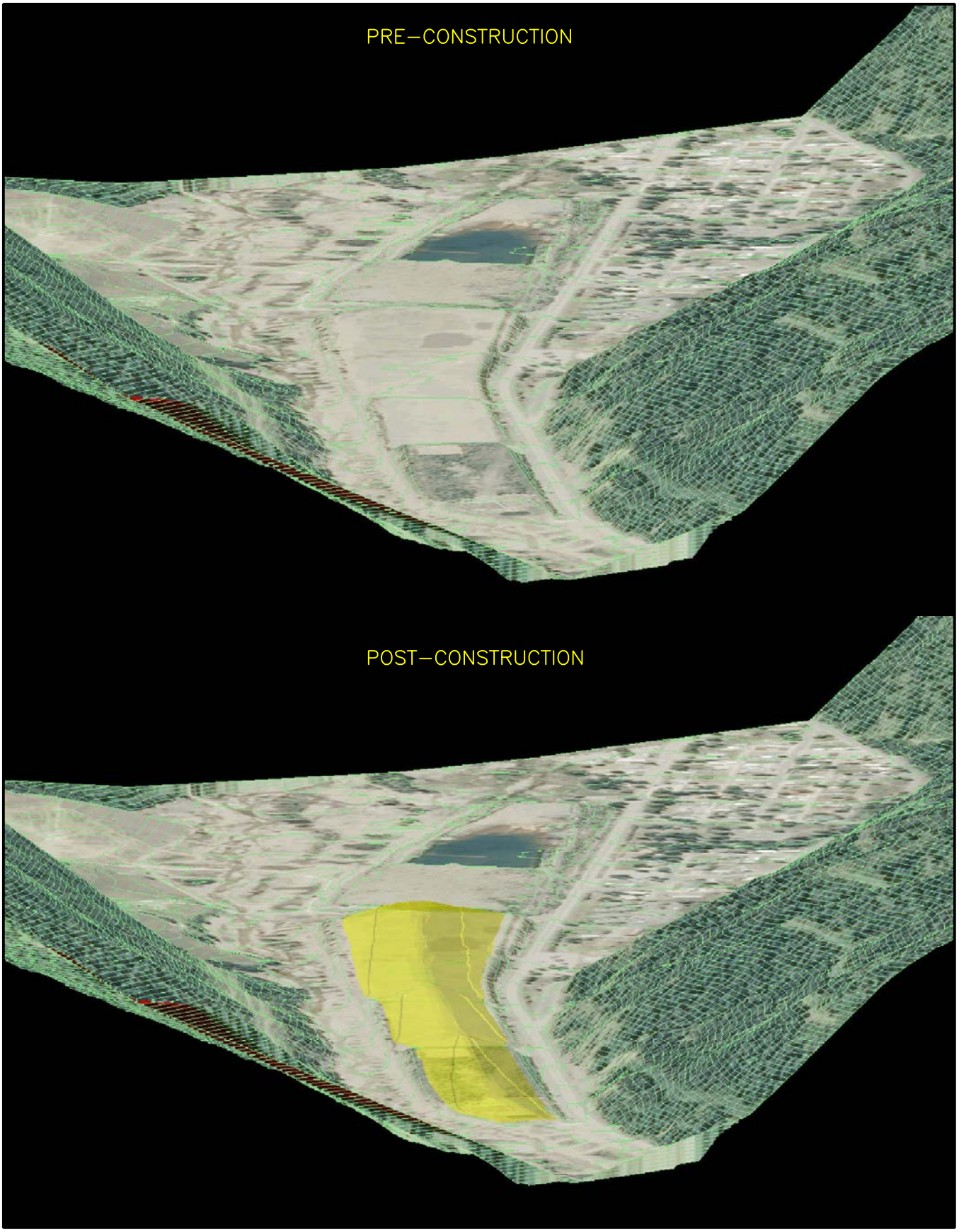
VISUAL SIMULATION 4
WEST VIEW
FEBRUARY 2013



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VISUAL SIMULATION 5
SOUTHWEST VIEW
FEBRUARY 2013

Acronyms

AASHTO	American Association of State Highway and Transportation Officials
ARAR	applicable or relevant and appropriate requirements
ARD	acid rock drainage
ASTM	American Society for Testing and Materials
AWQC	Ambient Water Quality Criteria
bcy	bank cubic yards
BDR	basis of design report
BEIPC	Basin Environmental Improvement Project Commission
BFE	Base Flood evaluation
bgs	below ground surface
BHSS	Bunker Hill Mining and Metallurgical Complex Superfund Site
BLM	U.S. Bureau of Land Management
BMPs	Best Management Practices
BPRP	Basin Property Remediation Program
CAD	Computer aided Design
CDM Smith	CDM Smith, Inc.
CEO	Chief Executive Officer
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
CESQG	conditionally exempt small quantity generators
CFR	Code of Federal Regulations
cfs	cubic feet per second
CLOMR	Conditional Letter of Map Revision
COCs	contaminants of concern
Coeur d'Alene Trust	Successor Coeur d'Alene Custodial and Work Trust
CQA	Construction quality assurance
CQAP	construction quality assurance plan
CTP	central treatment plant
CWA	Clean Water Act
D&M	Dames and Moore
EMFR	East Mission Flats Repository
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
F	Fahrenheit
FEMA	Federal Emergency Management Agency
FFS	Focused Feasibility Study
FIRM	Flood Insurance Rate Map
FML	flexible membrane liner
FS	factors of safety
ft/d	feet per day
g	gravity
H	horizontal
HDPE	high density polyethylene

Hecla	Hecla Mining Company
Hecla-Star Complex	Hecla-Star Mine and Mill Complex
ICP	Institutional Controls Program
IDAPA	Idaho Administrative Procedures Act
IDEQ	Idaho Department of Environmental Quality
IDs	identifications
IDWR	Idaho Department of Water Resources
in/hr	inches per hour
km	kilometer
lb/day	pound per day
LBCR	Lower Burke Canyon Repository
LLDPE	linear low density polyethylene
LOMR	Letter of Map Revision
MBTA	Migratory Bird Treaty Act
MCLs	Maximum Contaminant Levels
MFA	Maul Foster & Alongi, Inc.
mg/kg	milligrams per kilogram
mm	millimeter
NAS	National Academy of Sciences
NFIP	National Flood Insurance Program
NMSW	non municipal solid waste
NOAA	National Oceanic and Atmospheric Administration
NPL	National Priorities List
NRCS	Natural Resource Conservation Service
O&M	operations and maintenance
OU	Operable Unit
ppm	parts per million
QA/QC	quality assurance/quality control
QAPP	Quality Assurance Project Plan
RA	Remedial Action
RAO	remedial action objectives
RCRA	Resource Conservation and Recovery Act
RD	remedial design
ROD	Record of Decision
ROW	Right-of-way
SAP	Sampling and Analysis Plan
SFCDR	South Fork of the Coeur d'Alene River
SHPO	State Historic Preservation Office
Statement of Work	Implementation Framework and Statement of Work for Remedial Design, Remedial Action, and Long-Term Operation, Maintenance, and Monitoring
STI	Star Tailings Impoundment
SVNRT	Silver Valley Natural Resource Trustee Repository
SWPPP	Stormwater Pollution Prevention Plan
TCD	Typical Conceptual Design
TerraGraphics	TerraGraphics Environmental Engineering, Inc.
USACE	U.S. Army Corps of Engineers

USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
V	Vertical
WBZ	Water bearing zone
WRCC	Western Regional Climate Center

Section 1

Introduction

CDM Smith, Inc. (CDM Smith) has prepared this preliminary (30%) basis of design report (BDR) for the Lower Burke Canyon Repository (LBCR) remedial design (RD) for the Successor Coeur d'Alene Custodial and Work Trust (Coeur d'Alene Trust). The RD for the LBCR is being conducted as part of the environmental-cleanup-related actions in the Upper Basin of the Coeur d'Alene River in northern Idaho (Upper Basin), which is part of Operable Unit (OU) 3 of the Bunker Hill Mining and Metallurgical Complex Superfund Site (BHSS).

CDM Smith conducted the LBCR RD in accordance with the 2002 Record of Decision (ROD) (U.S. Environmental Protection Agency [EPA] 2002) and the selected remedy identified in the Interim ROD Amendment (EPA 2012a). This BDR also incorporates the RD requirements provided in the Implementation Framework and Statement of Work for RD, Remedial Action (RA), and Long-Term Operation, Maintenance, and Monitoring (Statement of Work) between EPA and the Coeur d'Alene Trust (EPA 2011). Consistent with the Statement of Work, the design was developed in accordance with EPA's Superfund RD and RA Guidance (EPA 1995a).

Implementation of the Selected Remedy requires construction of repositories such as the proposed LBCR for disposal of metals-contaminated soils, tailings, sediments, waste rock, debris, and treatment residuals. The LBCR sits atop an inactive portion of the historical tailings impoundment facility known as the Star Tailings Impoundment (STI) located near the community of Woodland Park, Idaho within the Canyon Creek basin. The STI facility was constructed and operated by the Hecla Mining Company (Hecla) and filled with tailings from the Star Mine and Mill beginning in 1965. The proposed LBCR will be constructed on top of four inactive ponds (Pond No. 1 through No. 4) located north of Grays Bridge Road and east of Highway 4 (also known as Burke Road); an area of approximately 30 acres.

The LBCR design addresses mine waste located within the Canyon Creek watershed, estimated to be approximately 1.8 million bank cubic yards (bcy) (TerraGraphics Environmental Engineering, Inc. (TerraGraphics), 2011b). The proposed LBCR will be developed to contain approximately 816,000 bcy of waste material; it is assumed that the majority of the waste capacity of the LBCR will be allocated for disposal of mine wastes from the Canyon Creek watershed. In addition, the LBCR will be utilized to consolidate waste from several other programs including the Basin Property Remediation Program (BPRP), the Institutional Controls Program (ICP), the paved road program, and the remedy protection program. Figure 1-1 provides an overview of the LBCR and Woodland Park, Idaho site vicinity.

As discussed in the Draft Implementation Plan (EPA 2012c, Section 3.3.1), preliminary Upper Basin remedy implementation schedules indicate that the LBCR design should be completed in 2013 and that the repository should be functional and ready for consolidation of waste by 2015. Initial anticipated wastes include BPRP, ICP wastes, and mine wastes from RA at the Helca Star Mine and Mill Compex (Hecla-Star Complex) (BUR 128) and potentially other adjacent sites (Hidden Treasure Mine [BUR097], Hercules No. 5 [BUR098] and Tiger-Poorman Mine [BUR129]). Please note that the "BUR" designations are mine waste source identifications (IDs) and names that were initially used by the BLM during previous remedial investigation activities and are also utilized in the Interim ROD Amendment (EPA 2012a) and Focus Feasibility Study (FFS) (EPA 2012b). Other sites that could

contribute waste to the LBCR at a later date include the Oom Paul No. 1 and No. 2; Burke Mine; West Mammoth Mine; Ajax No. 2 and No. 3; Hercules Mine; Tamarack No. 7 (1200 level); Standard Mammoth Mine; Gem Mine and Millsite; Frisco Mine and Millsite; and various impacted riparian areas of Canyon Creek (see EPA 2012b, Table 6-8). Appendix A provides additional information regarding the locations of the contaminant source areas and an overview of RAs within the Canyon Creek Basin; see the FFS Figure 7-3, (EPA 2012b). EPA is currently developing a plan for the timing of the RAs at these sites. Given the uncertainty in the mine waste consolidation timing, this BDR presents a phased LBCR consolidation and development approach as follows:

Initial Construction Phase (2014): The preliminary LBCR design provides for initial construction activities including development of the initial consolidation footprint; access road construction; and infrastructure development including access control gates and fencing, decontamination facility(s), and stormwater control features. This portion of the LBCR design will be finalized in 2013. Initial LBCR construction is scheduled for the 2014 construction season (approximately June through October).

Phase 1 LBCR Consolidation (assumed 2015): The preliminary LBCR design provides for placement of 80,000 bcy of mine waste during the first phase, which allows for consolidation of mine waste from the Hecla-Star Complex, as well as waste from the BPRP, the ICP, the paved road program, and the remedy protection program. The design of the Phase 1 waste placement will be finalized in 2013 so that the Coeur d'Alene Trust can bid the work in 2014 and waste placement can begin in 2015.

Full-Scale LBCR Development: This BDR presents a preliminary design for the full-scale LBCR development that addresses consolidation of mine waste from the various sites within Canyon Creek. The preliminary full-scale development design allows for approximately 816,000 bcy to be consolidated in the LBCR with the selected configuration. The current estimated schedule for mine waste consolidation to the LBCR spans from 2015 through 2025 or later (a minimum 10-year period); however, the timeline for Canyon Creek RA execution is subject to change based on funding, work execution progress, and adaptive management implementation (CH2M Hill 2010a). Given the uncertainty in the timing of mine waste generation and consolidation, the preliminary design provides a full-scale phasing plan with an assumed waste generation rate of 80,000 bcy per phase. However, the full-scale development plan is flexible and can easily be modified as directed by EPA and the Coeur d'Alene Trust to accommodate the actual sequence and timing for consolidation of Canyon Creek mine waste and wastes from other Upper Basin programs. While the full-scale LBCR development design will be included in the intermediate, pre-final, and final designs to be completed in 2013, it will be presented as a separate plan set that will not have adequate details for bidding or construction. The purpose of the full scale LBCR development design will be to confirm that the configuration provides adequate capacity and stability, and that it will satisfy other RA objectives (RAO) such as isolation of waste from surface water and groundwater.

1.1 Purpose and Objectives

The BDR presents the basis of the preliminary RD for the LBCR. This document provides the technical approach and assumptions for the RD at the LBCR and incorporates the RAOs and requirements presented in the ROD and Interim ROD Amendment (EPA 2002; 2012a) as design criteria. The purpose of the overall surface contamination RA within the BHSS is to reduce exposure to toxic metals

from incidental ingestion and/or inhalation of surface tailings/waste rock and other mine wastes, and to control and/or reduce run-on and runoff from soil/tailings/mine dumps and repositories.

1.2 BHSS Background

The BHSS was placed on the National Priorities List (NPL) in 1983 and has been assigned Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) Identification Number IDD048340921. The BHSS includes mining-contaminated areas of the Coeur d'Alene River corridor, adjacent floodplains, downstream water bodies, tributaries, and fill areas, as well as the 21-square-mile Bunker Hill "Box" that is located in the area surrounding historical smelting operations.

EPA has designated three OUs at the BHSS: the populated areas of the Box (OU1), the non-populated areas of the Box (OU2), and mining related contamination in the broader Coeur d'Alene Basin exclusive of the Box (OU3). The Canyon Creek watershed, including the proposed LBCR location, is within OU3. For OU3, EPA issued a ROD (also referred to as "the Interim ROD for OU3" and "the Interim ROD") (EPA 2002). Subsequently, EPA updated the cleanup plan for the Upper Basin using improved knowledge of conditions, including numerous surface water/ground water studies, enhanced transport and probabilistic models, and treatability studies, and in response to a National Academy of Sciences (NAS) review of the ROD for OU3 (NAS 2005). In 2012, EPA issued the FFS (EPA 2012b) and the Interim ROD Amendment for the Upper Basin (EPA 2012a). The 2012 Interim ROD Amendment (EPA 2012a) modified existing, and identified additional RAs for the Upper Basin, building on the Selected Remedies identified in the 2002 Interim ROD.

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Section 2

LBCR Background

This section presents site background information for the LBCR including the history, the selected remedy and repository siting process, the initial conceptual approach, pre-design investigation activities, property ownership and acquisition, and coordination with other projects.

2.1 LBCR History

The Upper Basin encompasses a vast (300 square mile) geographic area with known sources of metals loading from legacy mine wastes dispersed throughout the area. Accordingly, the BHSS is generally described by grouping known sources of contamination by watershed (i.e., Canyon Creek, Ninemile Creek, Big Creek, Moon Creek, and Pine Creek). The LBCR will be constructed on top of the inactive portion of the STI, Ponds No. 1 through No. 4, in the Canyon Creek watershed. Canyon Creek flows south to its confluence with the SFCDR at Wallace, Idaho and drains an area of approximately 22 square miles. The Canyon Creek watershed extends nearly 14 miles from its confluence with SFCDR to its headwater at Upper Glidden Lake. As described in the Interim ROD Amendment (EPA 2012a, Table 5-1), the Canyon Creek watershed contains approximately 127 known sources of legacy mine waste which are sources of metals loading to surface water, groundwater, and soils/sediments due to 19th and 20th century mine waste disposal activities. These activities resulted in direct discharge of high concentrations of heavy metals throughout the Canyon Creek watershed from particulate and leachable metals contamination. This contamination resulted from historic direct discharge of tailings and waste rock and continued transport of heavy metals and contaminated waters from mine adits, mining and mill-related waste dumps, and impacted floodplains; as well as the use of mine wastes as fill for residential and commercial development (EPA 2001a).

The proposed LBCR site (STI Ponds No. 1 through No. 4) is a known source of contamination to the Canyon Creek watershed and is identified as part of the WAL009 source area in the RI report (EPA 2001a). The RI report also identified Canyon Creek Segment 5 impacted floodplain, which lies adjacent to the STI, as a source of contamination (EPA 2001a). In addition, seeps that discharge greater than one pound of zinc per day are known to persist from STI Pond No. 6 and the Silver Valley Natural Resource Trustee Repository (SVNRT), which are located south of Grays Bridge Road and the proposed LBCR site (EPA 2001a).

The historical and current land use at the proposed LBCR site includes mine waste management and is not considered readily developable for commercial or residential use. Therefore, the LBCR site will continue to be used as it has been, after the repository is constructed and throughout operations. The LBCR site will be fenced off indefinitely to control access to the facility.

2.2 Selected Remedy and Repository Siting

As discussed below, the selected remedy and conceptual design approach for repositories within the Upper Basin, such as the LBCR, are provided in the Interim ROD Amendment and FFS (EPA 2012a and 2012b, respectively). The Idaho Department of Environmental Quality (IDEQ)-led LBCR repository siting process is also discussed.

2.2.1 Interim ROD Amendment and FFS

The selected remedy for the Upper Basin, as presented in the Interim ROD Amendment (EPA 2012a), requires construction of repositories for disposal of metals-contaminated soils, tailings, sediments, waste rock, debris, and treatment residuals. Although the Interim ROD Amendment identifies the anticipated waste volume from each of the OU3 mine sites, such as the mine sites located within the Canyon Creek watershed, the document does not specifically identify the repository location(s) for consolidation of the waste. Instead, the selected remedy indicates that the repositories will be located following a four-step siting and design process as led by the IDEQ. In addition, the Interim ROD Amendment emphasizes that one of the focus areas for the initial phase of implementation is the continuation of the regional repository siting process.

Regarding the conceptual design approach to be used for repositories, the Interim ROD Amendment incorporates the typical conceptual design (TCD) approach developed as part of the Final FFS (EPA 2012b). The use of TCDs was used to help develop remedial alternatives, including estimated costs, for feasibility-level evaluations. It should be noted that the TCD approach was not intended to limit the technologies and process options ultimately selected during RD; instead the TCD-based approach was employed because the size and complexity of the Upper Basin remedy makes it impractical to develop site-specific conceptual designs covering the many, diverse sources of contamination. As described in the FFS, the contaminant source control TCD for repositories is identified as TCD C08a (see Figure C-8 in Appendix A (EPA 2012b)); Section 5.1 of the FFS indicates that the need for bottom liners and leachate collection at a repository will be determined during RD based on site-specific conditions. The FFS also indicates that repositories will be covered with a low-permeability cap.

The selected remedy for the STI site (i.e., WAL009) identifies groundwater treatment to address contamination due to the existing STI and the SVNRT Repository. The remedy includes installing French drains to cut-off and collect contaminated groundwater before it enters Canyon Creek. The collected groundwater will be transmitted via pipeline to the central treatment plant (CTP) (EPA 2012b). This remedy is identified as Ecological Alternative 3+, Option C remedy in the Interim ROD Amendment (EPA 2012b) and will be addressed separate from the LBCR design. The LBCR design does not address groundwater remedial components associated with the STI and surrounding area.

2.2.2 Repository Siting

The IDEQ-led repository siting process has been ongoing since 2007. The Citizens Criteria Repository Site Ranking Summary (CH2M Hill 2010b) identifies eight (8) sites, including the STI site, as meeting the initial siting criteria of not being actively used by its owners and having a capacity of at least 500,000 bcy. Additional criteria were developed through a public input process, as documented in the Site Ranking Summary. Based on the results of the site ranking, additional public input, and other factors important to the agencies, the IDEQ and EPA proposed the STI and Osburn Tailings Impoundments for further use as repository sites. The two locations were presented in an Open House held in Wallace, Idaho on March 25, 2010. The public was encouraged to ask questions and provide written comment on the proposed repository locations. The comment period ran from March 25 to April 25, 2010. The results of the siting process described above, public review comments, and commitments are available on the Basin Environmental Improvement Project Commission (BEIPC) website: www.basincommission.com. Based upon the siting process results, IDEQ and EPA determined that design of the LBCR should proceed.

2.3 Initial Conceptual Approach

As a result of the repository siting process and at the direction of IDEQ, TerraGraphics began development of the LBCR preliminary RD in 2011 prior to transfer of the design to the Coeur d'Alene Trust. The TerraGraphics LBCR initial conceptual design approach (TerraGraphics 2012a) was reviewed as part of the development of this preliminary design. Relevant site characteristic descriptions, data collection activities, and design concepts from TerraGraphics are documented below.

2.3.1 Existing Site Characteristics

The following sections provide additional, detailed information about the LBCR site and the surrounding area, which was used for the RD.

Climate - Historical temperature and precipitation data have been collected from 1941 to present by a National Weather Service Cooperative Observer Program weather station No. 109498 maintained in Woodland Park (Western Regional Climate Center (WRCC) 2012). The mean annual high temperature for Woodland Park ranges from of 33.3 degrees Fahrenheit (°F) in January to 80.4°F in July. Mean annual low temperatures range from 19.2°F in January to 48.0 °F in July.

The mean annual precipitation observed at Woodland Park is approximately 37 inches per year. The months of November, December, and January are historically the wettest (over 4.7 inches per month). July and August are typically the driest months, with an average of about 1.2 inches per month. Precipitation in December and January typically falls as snow, and the valley floor sees an average of 83.2 inches of snow per year (WRCC 2012). The snow level increases significantly at higher elevations above the canyon floor. Additional climate information for the Canyon Creek watershed is located in the RI Report (EPA 2001a).

Geology - The STI was constructed upon 17 to 42 feet of alluvium deposited by Canyon Creek that increased in thickness from upgradient to downgradient (i.e., north to south) (Maul Foster & Alongi, Inc. (MFA) 2012b). Due to historic mine waste disposal practices, tailings have been found mixed into the upper layers of the alluvium (EPA 2001a). This alluvium sits on top of a bedrock layer consisting of sedimentary rocks assigned to the Precambrian Belt Supergroup, which are the dominant rocks in the Canyon Creek watershed. Two formations within the Precambrian-age Belt Supergroup that predominate are the Prichard and, to a lesser degree, the Burke Formation of the Ravalli Group. The Prichard consists of argillite, quartz-rich argillite, and quartzite, and the Burke Formation consists of impure to less pure quartzite.

The LBCR site is located near the western terminus of the Lewis and Clark line, a prominent zone of strikeslip, dip-slip, and oblique-slip faults that extends approximately 400 kilometers (km) (250 miles) across western Montana and northern Idaho. The Lewis and Clark line generally consists of a series of southeast-northwest trending strike-slip (left/right-lateral) faults, and evidence suggests that offsets of up to 28 km (17.4 miles) have occurred along these faults (Wallace et al., 1990). In addition, a series of north-south trending faults associated with this lateral movement are mapped in the area. In general, these faults are mapped as normal (up-down) faults (Gott and Cathrall, 1979).

The U.S. Geological Survey (USGS) maintains a database of active faults within the U.S. For the purposes of the database, active faults are defined as faults and associated folds that are believed to be sources of earthquakes greater than Magnitude 6 during the Quaternary Period (the past 1,600,000 years). A search of this database revealed that the nearest active fault to the LBCR site is the

Thompson Valley Fault, approximately 46 miles to the east-northeast (USGS 2008b). Although there are no known active faults in the immediate vicinity of the LBCR site, historical records indicate that an earthquake between Magnitudes 5.0 and 5.4 occurred in the Wallace area in 1957 (Idaho Geological Survey 2012).

The Osburn Fault traverses the area in a general east-west trend, and passes within about one-half mile to the south of the LBCR site. An unnamed secondary fault parallel to and associated with the Osburn Fault passes near the southern boundary of the site, and may lie beneath the repository (Gott and Cathrall, 1979). The Osburn Fault is mapped as a strike-slip fault, while the unnamed fault is mapped as a normal fault. There is evidence to suggest that the most recent movement on the Osburn Fault occurred between 81 and 100 million years ago (Wallace et. al., 1990). In addition, since these faults do not appear in the USGS database, it can be assumed that no significant movement has occurred on these faults in the last 1.6 million years.

Surface Water Hydrology - Canyon Creek is characterized by a high stream gradient within a deeply incised, V-shaped canyon in its upper reaches. In the vicinity of Woodland Park, the gradient decreases and Canyon Creek opens into a U-shaped canyon. The Canyon Creek watershed has a drainage area of approximately 22 square miles with an elevation change in the watershed of approximately 4,000 feet (EPA 2001a). A USGS stream gage station, USGS 12413125, is located at the bottom of Canyon Creek, 65 feet upstream from the mouth at the SFCDR (USGS 2012). The maximum observed discharge for the creek (October 1998 to September 2003, February 2006 to current year, and miscellaneous measurements 1972-73, 2005-06) is 734 cubic feet per second (cfs) and a minimum daily flow of 6.0 cfs (USGS 2012).

The Canyon Creek channel slope adjacent to the LBCR site is approximately at 1.5 to 3 percent (EPA 2001a). The proposed LBCR site is located on top of the STI and outside of the Federal Emergency Management Agency (FEMA) flood zone "AE" as shown in Figure 2-1; flood zone information presented on the figure is incorporated from the Flood Insurance Rate Map (FIRM) for Shoshone County, Idaho and Incorporated Areas (FEMA 2008). FEMA flood zone "AE" designates areas with a 1 percent annual chance of flooding (i.e., 100-year floodplain). The toe of the existing STI embankment is adjacent to the FEMA 100-year floodplain for most of the reach along Ponds No.1 through No.4. The LBCR, located on top of the STI, will provide vertical separation between the footprint of waste placed in the LBCR and FEMA's 100-year floodplain; however, if work is required to stabilize or cover the existing STI embankments along Canyon Creek, those activities would likely encroach on the 100-year floodplain.

The RI Report (EPA 2001a) and the *Canyon Creek Hydrologic Study* (CH2M Hill 2007) have identified gaining reaches (i.e., groundwater is discharging to surface water) and losing reaches (i.e., surface water drains into the aquifer) of Canyon Creek (see Figure 3-5 in Appendix A) (EPA 2012b). In the vicinity of the LBCR site, modeling by CH2M Hill showed that the creek is a losing reach southeast of the LBCR downstream to approximately Grays Bridge Road and gaining next to and down gradient (south and west) of the STI Pond No. 6 and near the northern end near Pond 4 (CH2M Hill 2007).

Hydrogeology - Within the vicinity of Woodland Park and the LBCR, groundwater generally flows parallel to Canyon Creek (EPA 2012b) through the alluvial aquifer. Appendix A provides additional information regarding the hydrogeology surrounding the LBCR site – see FFS Figures 3-5 and 3-6 (EPA 2012b). In this area of the basin, unconsolidated alluvial sediments with some waste rock and mine tailings lie on top of fractured bedrock. The alluvium is up to 50 feet thick in this area because the valley widens out. The sediments comprise a multi-aquifer system consisting of clayey gravel to

gravely clay. Although depth to water for wells screened in the upper portions (5 to 15 below ground surface [bgs]) could be quite different from wells screened in the lower portions (25 to 30 feet bgs), the aquifer is considered a single water-bearing unit with significant horizontal to vertical anisotropy (EPA 2012b). Saturated thickness under the existing STI is estimated to range from 20 to 40 feet. In addition, depth to water is shallow, ranging from about 8 feet bgs to 18 feet bgs, in the area of the STI based on quarterly monitoring data (TerraGraphics 2011b). As estimated in 2007 by CH2M Hill, hydraulic conductivity ranges from less than 5 feet per day (ft/d) to about 60 ft/d with greater conductivity occurring toward the longitudinal center of the valley (CH2M Hill 2007).

Based on the Log of Boring No. 10-STI-MW-1, which is through the STI sediments and screened below the repository, the sediments consist of silt with some gravel from land surface to about 6.5 feet bgs, gravel to 13 feet bgs, and silt and clay to 29 feet bgs. The saturated hydraulic conductivity of the material is determined to be 0.04 to 0.60 ft/d based on constant-head and falling-head methods (CH2M Hill 2007). Based on quarterly sampling at STI well 10-STI-MW-01, the STI repository sediments are not saturated (TerraGraphics 2011b).

Contaminant Loading - Multiple sources of contaminant loading to groundwater and Canyon Creek have been identified in the Woodland Park area of the watershed; including the existing STI and the SVNRT Repository. The highest increases in metals concentrations occur in surface water downgradient of Grays Bridge Road to the mouth of Canyon Creek. Groundwater in monitoring wells on the east side of Canyon Creek and downstream of the SVNRT repository contains dissolved cadmium and zinc at higher concentrations than those observed in shallow groundwater immediately below the creek bed (CH2M Hill 2007). Hillside seepage and groundwater underflow at the SVNRT repository ranges from approximately 20 to 49 pounds per day (lbs/day) of zinc loading to Canyon Creek (CH2M Hill, 2007).

The net gain in dissolved cadmium load from groundwater to Canyon Creek as it passes under the existing STI is estimated to be 0.65 pounds per day (lb/day). The net gain in dissolved zinc load from groundwater to Canyon Creek as it passes under the STI is estimated to be 100 lb/day (CH2M Hill, 2007). Dissolved metal concentrations and load estimates from the 2007 *Canyon Creek Hydrologic Study* were lower than those observed during the 1999 *Canyon Creek Hydrologic Study*. In the lowest segment of Canyon Creek, near the STI, dissolved cadmium load was lower by 0.25 lb/day or 28 percent, and dissolved zinc load lower by 35 lb/day or 26 percent (CH2M Hill 2007). This reduction may be attributed to a lower discharge in 2006, when the fieldwork for the study was conducted, and inferred lower groundwater levels. In addition, the SVNRT RAs (1997 to 1998) performed throughout the Canyon Creek watershed consisted of removal, consolidation, and capping of metal-rich tailings and mine wastes, which might have resulted in a decrease in the amount of leachable metals available to impact surface water and groundwater near the LBCR site. Natural attenuation processes might also result in a long-term, slow decline in dissolved metals concentrations in the surface water and groundwater (CH2M Hill, 2007).

Table 6 of the *Canyon Creek Hydrologic Study* (CH2M Hill 2007, p. 26) further summarizes the contaminant loading (zinc is the primary contaminant of concern) from the STI to Canyon Creek and indicates that the majority of the total zinc loading from the tailings impoundment (32 lbs/day total-maximum) is associated with tailings mixed with alluvium in groundwater beneath the STI (24 lbs/day-maximum). Only a small portion of the zinc loading from the STI (2.3 lbs/day-maximum) is associated with percolation through the impoundment (i.e., the major pathway regarding our interest of the use of a liner during LBCR operations). Accordingly, given this conceptual model of the STI, additional interim mine waste placement (prior to construction of the final low-permeability cover)

will result in minimal, continued contaminant (zinc) loading to Canyon Creek due to percolation through the LBCR and existing STI. In addition, stormwater controls and BMPs will be designed and implemented to minimize potential contaminate loading from stormwater runoff during LBCR construction and operation or from the existing embankments.

The LBCR waste consolidation operations are not anticipated to affect metals loading and may be considered an interim action followed by other actions (i.e., installation of final cover, installation of French Drains) that will be conducted to achieve remedial goals as identified in the ROD Amendment.

Domestic Water Use - The East Shoshone County Water District, which has incorporated the Woodland Park Water Association, provides drinking water to residents of Woodland Park. However, even though ground and surface water quality within the vicinity of Woodland Park has been highly impacted by the release of heavy metals, the 2001 RI states, "surface water in creeks and groundwater in shallow unconfined alluvial aquifers are potential domestic water sources in the watershed" (EPA 2001a).

2.3.2 Previous Data Collection

This section provides a brief summary of the previous data collection activities completed by TerraGraphics and provided in their preliminary design (Terragraphics 2012a).

Geotechnical Investigation – Two geotechnical investigations were conducted at the STI site to gather data necessary for the LBCR design. The 2010 and 2011 investigations collected soils data from the underlying alluvium, impounded tailings, and tailings impoundment berm to assess existing geotechnical soil properties. This geotechnical data was provided to the Coeur d'Alene Trust by TerraGraphics and is included in Appendix H. This data was reviewed during the 2012 preliminary design development and additional geotechnical data needs were identified (MFA 2012a) and collected (MFA 2012b). Terragraphics did not conduct initial geotechnical assessments, including settlement and stability analyses.

Topographic Survey and AutoCAD Drawing Development – A topographic survey was conducted by TerraGraphics to locate surface features pertinent to the LBCR and site facilities design. Point-files from the topographic survey were imported into AutoCAD Civil 3D for use in the design. The TerraGraphics survey data and AutoCAD drawings were utilized with the EPA LiDAR data to develop the preliminary drawings.

Cultural Resources – A cultural resource survey was conducted on April 13, 2011 across the proposed LBCR site by Dr. R.L. Sappington and assisting staff to identify, document, and evaluate any cultural resources in the project area in accordance with 36 Code of Federal Regulations (CFR) 800. The results from the survey are documented in the *Archaeological and Historic Survey Report* for the STI site (Sappington et al., 2011). The results concluded that no cultural resources exist near the LBCR site. The survey results are maintained at the Idaho State Historic Preservation Office (SHPO), 210 Main St, Boise, ID.

Wetlands – On October 28, 2009, TerraGraphics conducted a field investigation at the STI site to identify if wetlands were present within the repository footprint (TerraGraphics 2009c). The investigation concluded that there were no wetlands at the proposed repository site, thus wetlands encroachment will not be an issue in design of a repository at the STI site. The wetlands field investigation is provided as Appendix G.

2.3.3 LBCR Conceptual Layout

As envisioned during the repository siting process, the TerraGraphics conceptual layout placed the LBCR on top of STI Ponds No. 1 through No. 4 and provided an approximate waste storage capacity of 800,000 bcy. To achieve this estimated capacity, finished slopes of 2:1 (Horizontal (H):Vertical (V)) and/or 3:1 were identified.

Constructing the LBCR on top of the STI should ensure that groundwater and surface water from Canyon Creek do not come in contact with the waste material. The LBCR will also utilize a multiple layer low permeability cover consisting of a flexible membrane liner (FML) overlain by a vegetated soil layer to prevent surface water infiltration into the waste layer. This conceptual cover system is consistent with the TCD.

TerraGraphics did not make a determination as to whether a bottom liner and leachate collection system would be included in the LBCR design. The Design Basis Report (TerraGraphics 2012a, Section 4.4.5.1), identified two general approaches (administrative and technical) that could be utilized during design to assess if a bottom liner and leachate collection system should be included as a design component to reduce potential metals loading to Canyon Creek. These approaches are discussed further in this preliminary design.

2.4 Pre-Design Investigation Activities

In 2012, additional LBCR pre-design investigation activities were completed; the scope of these activities was presented in the Proposed Scope of Work for 2012 RD Investigation – LBCR (MFA 2012a). The 2012 LBCR pre-design investigation activities occurred from August through October 2012 and a complete data summary report was developed (MFA 2012b). During the investigation activities, the following data were gathered to support the preliminary LBCR design.

2.4.1 STI Document Review

As part of scoping for additional investigation activities, historic documents regarding the STI construction were obtained and reviewed. Several of the documents (D&M 1979, D&M 1980) were provided to the Coeur d'Alene Trust from Hecla, the former operator of the inactive portion of the STI facility where the LBCR will be constructed (see Appendix C). Several additional documents were provided by EPA regarding the consolidation of mine waste on the STI during previously conducted Canyon Creek response activities in the 1990s (EPA 1995b).

The 1980 STI Report (D&M 1980) was developed to evaluate additional dike extensions to the impoundment facilities and concluded that additional tailings material should not be consolidated on Star Tailings Pond 4, located at the northern portion of the facility, because of long-term stability concerns. However, it should be noted that from a geotechnical stability perspective, the proposed consolidation of mine waste is significantly different than additional saturated tailings impoundment. As discussed in this BDR, additional geotechnical data collection and assessment were conducted to further evaluate this potential issue.

During an initial pre-design site walk at the LBCR in April 2012, the top of the STI was observed to consist of non-tailings material. Further evaluation of historic documents indicates that approximately 60,000 bcy of mine waste was consolidated on Pond 2 during the 1995-1996 Canyon Creek response action (EPA 1995, Section 5.4) (see Appendix E). Based on the 2012 investigation, it is apparent that

the 1995-1996 action placed material on Pond 2; it does not appear that additional mine waste was consolidated on Ponds 1, 3, and 4 during the previous response action.

2.4.2 Other Repository Document Review

In addition to reviewing existing data and reports pertaining to the existing STI, the Big Creek and East Mission Flats repository (EMFR) designs were also reviewed as part of the LBCR design activities (U.S. Army Corps of Engineers (USACE) 2004, (TerraGraphics 2009b). Similar to the Big Creek and East Mission Flats repositories, the LBCR will accept waste materials in a phased approach over multiple seasons. As a result, the LBCR will incorporate similar design features, components, and approaches as other basin repositories.

Maintaining consistency within the repository designs allows for more efficient and effective design processes. The LBCR will incorporate the same type of facilities that have been designed for the other basin repositories. In particular, the entrance, exit, and decontamination facilities designs used for other repositories will be utilized at the LBCR with only minor modifications. Operations and maintenance (O&M) approaches for the LBCR will also be consistent with what is used at other repositories in the Basin.

The LBCR design will take advantage of lessons learned from these earlier designs, and improvements will be incorporated into the LBCR design components and approaches where possible to improve functionality and cost effectiveness.

2.4.3 2012 Data Collection Activities and Findings

After reviewing available site data, data gaps were identified to guide 2012 data collection efforts (CDM Smith 2012) (MFA 2012a). The following is a summary of the additional data collected in 2012 to address data gaps and support the LBCR design. A complete 2012 LBCR data collection report was developed (MFA 2012b).

Geologic and Geotechnical Characterization and Results – Additional borings and test pits were completed in the LBCR area to evaluate the soil horizon characteristics and thickness and depth/elevation to the soil/bedrock interface. This information was utilized to evaluate the LBCR sub-grade for potential geotechnical stability issues, the LBCR layout, and available waste consolidation volume.

The laboratory testing results were consistent with previous information of the site soils. In general, the STI consists of perimeter dams predominantly composed of silty to clayey gravel with sand that is most likely derived from the local alluvium. Within the perimeter dam, the impoundment consists of mill tailings. The tailings generally consist of silty sand to sandy silt that were placed when they were wet and are normally to slightly under consolidated.

In addition, Pond No. 2 has been capped by a 12 to 20-foot-thick layer of sandy to silty gravel. Based on historic documentation, it appears that this material may be waste material that was consolidated in this area in the mid 1990's.

Alluvium associated with nearby Canyon Creek underlies the entire STI. The alluvium is generally very dense and consists of slightly silty to silty gravel with sand, cobbles, and boulders.

Groundwater Investigation and Results – During the 2012 pre-design investigation activities, the water bearing zone (WBZ) was evaluated further through the installation of new monitoring wells. At monitoring well MW-10S the WBZ was approximately 15 feet thick and at MW-03D it was approximately 31 feet bgs (MFA 2012b). The locations of existing and new monitoring wells used during the 2012 pre-design investigation are shown on MFA Figure 1-2 in Appendix A (MFA 2012b). The collected data was used to produce potentiometric surfaces, which are provided on MFA Figures 4-1 and 4-2 in Appendix A (MFA 2012b).

Water levels in MW-06S and MW-08S were above the bottom of the tailings ponds by 2.24 and 5.09 feet, respectively, and the water level in MW-06D was 0.61 feet below the tailings (MFA 2012b). The water levels in the remaining wells installed on the STI ranged from 7.65 to 13.32 feet below the bottom of the tailings ponds MFA 2012b).

Domestic Water Use Investigation and Results – Multiple domestic, stockwater, and irrigation water-rights records maintained by the Idaho Department of Water Resources (IDWR) indicate that potential domestic water consumption may still occur (IDWR 2012). IDWR well records also show one domestic well approximately 1.1 miles downgradient of the LBCR (IDWR 2012).

During the 2012 pre-design investigation, a beneficial water use survey was conducted for the Woodland Park area in October 2012 (MFA 2012b) within the Woodland Park area, 16 wells, 2 springs, and 3 water rights were confirmed with the following details (MFA 2012b):

- Five wells were confirmed to exist, but no additional information is known,
- Two wells were confirmed for irrigation use only,
- Two wells were confirmed to be used for drinking water,
- Seven wells were confirmed to not be used,
- Two springs were confirmed; one is used for drinking water and the other is not used,
- And three parcels have associated water rights, but no other information was available.

Agronomic Characterization and Results – Cover soil samples collected from the LBCR area were not analyzed for agronomic parameters because the soil contained lead above the cleanup level of 530 milligrams per kilogram (mg/kg).

Environmental Characterization and Results – Cover soil and embankment material (i.e., perimeter dams) samples collected from borings, test pits, and surface soil in the LBCR area during the pre-design investigation were submitted for environmental analyses. This information was utilized to evaluate if cover soil could be reused as a final cover of the finished repository and if the LBCR design would need to account for cover over the existing STI embankments.

Analyses of soil samples indicate that the STI embankment material have background metals concentrations above cleanup levels. Subsurface soil samples collected from the existing STI embankments had lead concentrations ranging from 920 to 3,920 mg/kg, which exceeds the cleanup level of 530 mg/kg. Surface soil samples collected from the existing STI embankments also had concentrations of lead exceeding the cleanup level, ranging from 2,710 to 8,540 mg/kg. These data

indicate that the LBCR design may need to address existing conditions of the embankment material (i.e., cover existing embankments with clean cover/rock material and no reuse of onsite material).

Power Pole Relocation Coordination – Avista Utilities owns and operates electrical power lines that are currently located on the STI; see Figure 2-1. Based on preliminary coordination activities, Avista Utilities is currently working on two options for accommodating the LBCR: (1) raise the existing transmission lines or (2) move the transmission line to the east, adjacent to the highway and out of the LBCR footprint. Additional details will be provided in the intermediate LBCR design.

2.5 Property Ownership and Acquisition

The LBCR footprint encompasses four parcels with three different property owners. Currently, two parcels are owned by the Hecla, one parcel is managed by the U.S. Bureau of Land Management (BLM), and one parcel is owned by the Golconda Mining Company (see Figure 2-2). The EPA is working with the BLM and Hecla to transfer ownership of the parcels to the EPA. Additional information regarding property access coordination will be provided in the intermediate LBCR design.

2.6 Coordination with Other Projects

The LBCR design will be developed to integrate with other projects in the basin including:

- STI Site Remedy
- Closure of the Big Creek Repository upon reaching its full capacity and
- Hecla-Star Complex refurbishment and re-opening, if applicable
- Abandoning the Star/Gem portal pilot treatment system

STI Site Remedy – The proposed LBCR is to be installed on top of the existing STI (WAL009) source site. The proposed remedy for the WAL009 site is to collect and treat contaminated groundwater produced from the site (EPA 2012b). The remedy selected by the EPA in the Interim ROD Amendment (EPA, 2012a) includes installation of French drains approximately one-mile downgradient of the site to cut-off and collect contaminated groundwater before it enters Canyon Creek (EPA 2012b). The collected groundwater would be transmitted via pipeline to the CTP (EPA 2012b). The selected remedy identified for the source site is shown on FFS Figure E-5, and is included in Appendix A (EPA 2012b). The LBCR design does not address groundwater remedial components associated with the STI and surrounding area.

Big Creek Repository Closure – The Big Creek Repository, which is currently used to manage contaminated soil from areas in the Upper Basin, is projected to reach its maximum capacity by 2015 (EPA 2012c). In order to provide the needed disposal capacity for waste streams that are currently being consolidated in the Big Creek Repository, the LBCR RD should be completed to allow the repository to be functional by 2015. This will reduce the potential for needing to address a disposal capacity shortage in 2015 if the Big Creek Repository reaches capacity as estimated.

Hecla-Star Complex Refurbishment and Re-Opening – EPA has received notification from Hecla that it may seek to refurbish and re-open the Hecla-Star Complex (BUR128) located in the Canyon Creek watershed, pending the outcome of viability analyses that Hecla is currently conducting (EPA 2012c). The ROD Amendment (EPA 2012a) identifies RAs for this complex. In addition, three other

mine sites requiring RA are immediately adjacent to the Hecla-Star Complex (Hidden Treasure Mine [BUR097], Hercules No. 5 [BUR098] and Tiger-Poorman Mine [BUR129]). For cost efficiency, it is anticipated that these sites will be addressed at the same time as the Hecla-Star Complex (EPA 2012c). It is anticipated that the LBCR RD will be completed so the repository is ready to accept RA mine wastes from the Hecla-Star Complex and the surrounding RA sites. Should Hecla decide to re-open the Hecla-Star Complex in the near term, the RD/RA process might be accelerated to coincide with the operations of Hecla.

In addition, Hecla has expressed interest in maintaining the adit discharge line, which currently runs along the top and west side of the existing tailings impoundments. Based on communications with Hecla, the Coeur d'Alene Trust understands that the adit discharge line will be relocated in 2013, and the line will likely be relocated between the western toe of the existing STI and the highway (Burke Road). Additional details of the adit discharge line relocation will be provided as those details are made available by Hecla.

Abandoning the Star/Gem Portal Pilot Treatment System – The Star/Gem portal pilot treatment system is located at the northern end of the existing STI, within the footprint of the LBCR. The treatment system consists of several lined ponds and piping that conveyed discharge water from the Star and Gem mine portals. The existing treatment system location is the proposed location of the main entrance, decontamination, and personnel facilities for the LBCR. Currently, it is anticipated that the system will be demolished and the components will be disposed of within the LBCR during the initial construction phase. Additional information regarding the construction of the treatment system will be obtained in 2013 to further support the LBCR design.

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Section 3

Design Approach

This section of the report presents the basis for RD including ROD requirements, design criteria, RD approach and assumptions, substantive requirements of permits, property access coordination, green remediation considerations, and cost estimate and contracting strategy.

3.1 Regulatory Requirements

The following sections present the regulatory requirements for the selected remedy presented in the Interim ROD Amendment (EPA 2012a), including the construction of repositories such as the LBCR. Construction of the LBCR will require adherence to RAOs, such as protection of human health and the environment, cleanup levels, and other requirements such as applicable or relevant and appropriate requirements (ARARs).

3.1.1 Remedial Action Objectives

RAOs are general descriptions of what a cleanup under Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) is expected to accomplish in order to achieve compliance with potential ARARs or an intended level of risk protection. The Interim ROD Amendment for the Upper Basin (EPA 2012a) identifies RAOs for protection of human health and the environment, which are presented in Table 3-1. The LBCR design approach was developed to achieve the RAOs. However, it should be noted that historic tailings located in alluvial material beneath the STI facility will continue to be a metals-loading source to groundwater. As previously discussed, the selected remedy as identified in the Interim ROD Amendment provides separate remedial components (French drain for water collection and pipeline to CTP for water treatment) to address contaminated groundwater beneath the STI facility. The LBCR design does not address those separate groundwater remedial components.

3.1.2 Cleanup levels

In conjunction with RAOs, which provide a general statement of what the cleanup will accomplish, cleanup levels are specific measurable criteria that are developed to provide protection of human health and the environment. Cleanup levels are based on federal and state standards (e.g., ARARs) and, when such standards are not available, site-specific levels are developed based on risk, toxicity, and exposure information. EPA provided the following site-specific cleanup levels in the Interim ROD Amendment (EPA 2012a):

- The cleanup level for lead in soil, sediments, and source materials in the Upper Basin for protection of human health and ecological receptors is 530 mg/kg. Lead is considered an indicator metal and is generally co-located with other contaminants of concern (COCs) when they are present. This single cleanup level for lead is a risk-based protective value that provides operational clarity and efficiency for RD and cleanup decisions. It applies only to the RAs described in the Interim ROD Amendment and does not replace cleanup levels for lead selected in previous decision documents.

- Cleanup levels for COCs in surface water for protection of human health and ecological receptors are provided in the Interim ROD Amendment (EPA 2012a, Table 8-1).
- Cleanup levels for protection of human health for COCs in groundwater used as drinking water are provided in the Interim ROD Amendment (EPA 2012a, Table 8-2).

As described in the Interim ROD Amendment (EPA 2012a, Section 8.1), although the Selected Remedy will address many significant sources of contamination in the Upper Basin, it is an interim, not a final, remedy. Consequently, achieving certain ARARs, including Ambient Water Quality Criteria (AWQC), Maximum Contaminant Levels (MCLs), and the requirements of the Migratory Bird Treaty Act (MBTA) and the Endangered Species Act (ESA), in all areas of the Upper Basin is outside the scope of the Selected Remedy. Future decision documents will determine the basis for additional cleanup actions and cleanup levels that may need to be established for the Upper Basin.

As previously discussed, the LBCR will be constructed on top of an inactive portion of the STI facility, which contains historically generated mine wastes. Any leachate generated from the LBCR because of percolation through the consolidated mine wastes will likely exceed cleanup levels; however, as discussed in Section 2.3.1, it is unlikely that consolidation of additional mine waste in the LBCR will result in increased contaminant loading to Canyon Creek during interim operations. The LBCR design incorporates components to minimize leachate generation (i.e., low permeability cover), and separate the consolidated repository mine waste from groundwater (given the location of placed mine waste on top of the STI).

3.1.3 Property Reuse Requirements

The LBCR site is located within the ICP administrative boundary and existing land use restrictions are in place including the requirement that excavation and grading projects must have an approved permit from the Panhandle Health District. The LBCR construction contractor will be a licensed ICP contractor and obtain the required ICP permit as administered by the Panhandle Health District. However, as discussed in the Interim ROD Amendment (EPA 2012a, Page 12-9), EPA will evaluate whether the existing ICP is adequate or whether additional institutional controls (i.e. land use restrictions and/or environmental covenants) are needed to ensure the long-term protectiveness of the implemented remedy. If additional institutional controls are needed, those would be recorded in Shoshone County and administrated by the ICP. Regardless of whether additional institutional controls are implemented, the RD must consider future land reuse and should include engineered elements to integrate anticipated future use of the land with the RA. The current and potential future land use at the LBCR site is primarily industrial. The site has been, and will continue to be used to store mining related waste materials. The intended primary future use of the LBCR area is industrial and/or recreational.

3.2 ARARs

CERCLA Section 121 requires that any applicable or relevant and appropriate standard be met, or a waiver justified. This subsection discusses the general status of ARARs evaluation relative to the design of the LBCR. As indicated in EPA/540/G-89/006 “CERCLA Compliance with Other Laws Manual” (EPA 1988), the technical specifications developed during detailed design must ensure attainment of ARARs.

The final ROD and the Interim ROD Amendment presents some additional summary and evaluation information regarding ARARs; however, they do not provide a detailed review of which portions of a requirement or regulation are determined by EPA to be relevant and appropriate. For instance, on Table 13-3 of the Interim ROD Amendment, the Idaho Solid Waste Management Rules and Standards (Idaho Administrative Procedures Act [IDAPA] 58.01.06) are evaluated as "relevant and appropriate" but the evaluation column does not specifically indicate which regulatory citations within IDAPA 58.01.06 are deemed to be relevant and appropriate. The Coeur d'Alene Trust will develop a detailed assessment of the ARARs presented in Tables 13-1 through 13-3 of the Interim ROD Amendment subsequent to this BDR in consultation with EPA.

ARARs presented in the Interim ROD Amendment are summarized in Appendix J to facilitate verification of project compliance and completeness as design of the LBCR progresses. A column was created in the ARAR tables to document how the design of the LBCR complies with the ARAR substantive requirements and indicate the document section that applies to the particular ARAR. The column will be populated as part of the intermediate design. This approach is intended to provide a cross-walk of the ARARs information in the table to the substantive requirements incorporated into the LBCR design basis as discussed in the BDR sections.

Applicable requirements are those substantive environmental standards that specifically address the situation at a CERCLA site. Relevant and appropriate requirements are determined by a two-step process (EPA 1992). First, to determine relevance, the requirement must address problems or situations sufficiently similar to the circumstances of the proposed response action. Second, for appropriateness, the determination must be made as to whether the requirement would also be well-suited to the conditions of the site. In some cases, only a portion of a requirement will be both relevant and appropriate. Once a requirement is deemed relevant and appropriate, it must be attained (or waived). If a requirement (that is not found to be applicable) is not both relevant and appropriate, it is not an ARAR. This procedure is further defined in Section 1.2.4 and corresponding Exhibits 1-5 and 1-7 of EPA/540/G-89/006 "CERCLA Compliance with Other Laws Manual" (EPA 1988).

Regarding evaluations of "relevant and appropriate" ARARs identified in the Interim ROD Amendment, the Coeur d'Alene Trust approach will be consistent with EPA guidance (EPA 1991) and recognizes that the determination of "relevant and appropriate" relies on professional judgment, considering environmental and technical factors at the site. For example, compared to a determination that an ARAR is applicable, there is more flexibility in the relevance and appropriateness determination: a requirement may be "relevant," in that it covers situations similar to that at the site, but may not be "appropriate" to apply for various reasons and, therefore, not well suited to the site. In some situations, only portions of a requirement or regulation may be judged relevant and appropriate; if a requirement is applicable, however, all substantive parts must be followed.

Only the substantive requirements (i.e., compliance with numerical standards, use of control/containment equipment, etc.) associated with ARARs apply to CERCLA onsite activities. According to CERCLA Section 121[e] [1], ARARs associated with administrative requirements, such as permitting, are not applicable to CERCLA onsite activities. In general, the CERCLA permitting exemption will be extended to all remedial activities conducted in the Upper Basin. The LBCR design incorporates the substantive requirements; in particular, the action-specific ARARs identified in the Interim ROD Amendment (EPA 2012a, Table 13-3).

Appendix J provides a summary of Tables 13-1, 13-2, and 13-3 of the Interim ROD Amendment (EPA 2012a), which identify the chemical-, location-, and action-specific ARARs, respectively that apply to the Upper Basin and include the following:

3.2.1 Chemical-Specific ARARs

Chemical-specific ARARs (see EPA 2012a, Table 13-1) are generally set numeric risk-based concentration limits or discharge limitations for specific chemicals within environmental media. The cleanup levels selected for the Upper Basin are chemical-specific ARARs.

3.2.2 Location-Specific ARARs

Location-specific ARARs (see EPA 2012a, Table 13-2) are requirements that relate to the geographical position or physical conditions of a site. They may limit the type of RA that can be implemented, or they may impose additional constraints on some RAs. Location-specific ARAR examples include requirements that protect historic, religious, cultural and archaeological properties and resources, and requirements that protect ecological and environmental resources. As described below, the Coeur d'Alene Trust and EPA are currently developing an approach to address location-specific ARARs including the ESA, National Historic Preservation Act, and Clean Water Act (CWA) (i.e., actions that involve in-stream work where Section 404 of the CWA applies to stream removals, bank stabilization, riparian repairs, and floodplain cleanup actions).

Protection of Historical, Archaeological, and Cultural Resources: The National Historic Preservation Act (36 CFR 800) requires that federal agencies follow a review process as outlined in Section 106. This would generally include the initiation, by EPA, of a Section 106 consultation with the Idaho State Historic Preservation Office (SHPO). As presented in Section 2.3.2, results from a 2011 cultural resource survey concluded that no cultural resources exist near the LBCR site. The Coeur d'Alene Trust will continue to work with EPA to determine subsequent requirements that may need to be incorporated into the LBCR RD to ensure that the substantive requirements of the HNPA are met. EPA and the Coeur d'Alene Trust are currently developing a basin-wide approach for coordinating historic, archaeological, and cultural resource issues with the Idaho SHPO.

Wetlands: Section 404 of the Clean Water Act regulates the discharge of dredge and fill material into waters of the United States, including wetlands and streams. LBCR construction work has the potential to place fill in wetlands or streams and although a permit is not required for this cleanup action, the project must demonstrate compliance with the substantive requirements of the regulation. A field investigation was conducted on October 28, 2009, at the STI site (see Appendix G) to identify if wetlands were present within the conceptual LBCR footprint (TerraGraphics 2009a). The investigation concluded that there were no wetlands at the proposed LBCR site, thus wetlands encroachment will not be an issue in design of the LBCR at the STI site.

Threatened and Endangered Species: Compliance with the ESA includes demonstrating that the project will not jeopardize the continued existence of any threatened or endangered species. A review of the USFWS databases was conducted for threatened and endangered species that could exist or be encountered near the LBCR. The results of the review are provided in Table 3-2 and indicated there are six species of concern listed by the USFWS in Shoshone County (U.S. Fish and Wildlife Service (USFWS) 2012). Threatened species include the Canada lynx, bull trout, Spalding's catchfly, and Water Howellia; the wolverine and Whitebark Pine are both listed as candidate species (USFWS 2012). A biological assessment (also referred to as a biological evaluation) will be prepared to support the

LBCR project. Due to contamination in the Canyon Creek corridor, bull trout are not currently present and historic project requirements related to the bull trout have been relatively streamlined. The Canada lynx may be present, and so more documentation would be needed to demonstrate why the project would not likely adversely affect the lynx. Considerations would include factors such as the current habitat condition, the recent timber harvest history, and management considerations found in the USFWS Recovery Outline for the Contiguous United States Distinct Population Segment of the Canada Lynx and documents such as the Northern Rockies Lynx Management Direction developed by the US Forest Service.

The Coeur d'Alene Trust and EPA are coordinating with the USFWS to provide mapped species corridors (lynx, bull trout, and any migratory birds). That information along with the proposed work areas will be used to develop an in-house Biological Opinion. Information from that approach will be incorporated into the LBCR design.

Migratory Birds: The LBCR will also be designed to not significantly impact migratory birds. As described above, the Coeur d'Alene Trust will continue to work with EPA and USFWS to identify home ranges and migratory corridors near the LBCR.

Protection of Flood Plains: As discussed previously, the proposed LBCR site is located on top of the STI and outside of the FEMA's 100-year floodplain (see Figure 2-1). However, any work done to stabilize or cover the existing STI embankments along Canyon Creek would likely encroach on the 100-year floodplain. In accordance with Executive Order 11988, projects in a regulatory floodplain must undergo an encroachment review to determine their effect on flood flows and ensure that they do not increase flood heights above the allowable level. Projects involving filling or grading, such as activities that may be conducted to stabilize or cover the existing STI embankments along Canyon Creek, must be reviewed to determine whether they will obstruct flood flows and cause an increase in flood heights upstream or adjacent to the project site.

The National Flood Insurance Program (NFIP) regulations (44 CFR 60) generally describe the process for encroachment review; the substantive requirements of that process would apply if the LBCR project involves work in the flood plain. The process generally requires submitting forms, referred to as "MT-2" application forms, to FEMA prior to project implementation to request a Conditional Letter of Map Revision (CLOMR). The CLOMR is a letter from FEMA commenting on whether a proposed project, if built as proposed, would meet minimum NFIP standards or proposed hydrology changes. A Letter of Map Revision (LOMR) after the project completion must also be requested; the LOMR is a letter from FEMA officially revising the current NFIP map (LOMR) to show changes to floodplains, floodways, or flood elevations. In both CLOMR and LOMR applications, information must be provided to FEMA describing the project construction work within the floodplain and evaluating if it will cause an increase in Base Flood Elevation (BFE) more than the increase permitted by the community or State. The evaluation must be completed using the same computer models (or converted versions) that were used to develop the regulatory floodplains (i.e., as presented in the FIRM). When the increase in BFE is more than the permitted increase (typically a 1-foot allowance), the following documents must be submitted to FEMA with the CLOMR/LOMR application:

- An evaluation of alternatives which would not result in a BFE increase above that permitted and a demonstration regarding why these alternatives are not feasible;

- Documentation of individual legal notice to all affected property owners within and outside of the community, explaining the impact of the proposed action on their property;
- Concurrence of the Chief Executive Officer (CEO) and any other communities affected by the proposed actions; and
- Certification that no structures are located in areas that would be impacted by the increased BFE.

Additional coordination with the Coeur d'Alene Trust and EPA will be conducted during the 60 percent design to evaluate if activities to stabilize or cover the existing STI embankments along Canyon Creek will be required as part of the LBCR. If these activities are required, additional coordination with FEMA and property owners (in the case of increase in BFE) will be required along with additional floodplain assessment and modeling. Additional information regarding the CLOMR/LOMR application process and MT-2 forms are available at FEMA's website: http://www.fema.gov/library/viewRecord.do?id=1493

3.2.3 Action-Specific ARARs

Action-specific ARARs (see EPA 2012a, Table 13-3) generally set performance, design, or other similar controls or restrictions on particular kinds of activities. Action-specific requirements do not in themselves determine the remedial alternative; rather, they indicate how, or to what level, a selected alternative must be achieved. Potential action-specific ARARs that could be pertinent to remedial activities in the Upper Basin include air emission and control requirements from release points of remediation equipment and actions, and solid (and possibly hazardous) waste identification and management requirements. Although the materials that will be placed in the LBCR are Bevill wastes that are not considered hazardous wastes, EPA has determined that Bevill wastes are solid wastes as defined in 40 CFR 261.2 (54 FR 36614, September 1, 1989) and thus are subject to Subtitle D requirements. In Idaho, solid waste requirements, including the management, processing, waste handling, and disposal of non-municipal solid waste, are promulgated in IDAPA 58.01.06, Solid Waste Management Rules and Standards, and are potentially applicable. The Interim ROD Amendment (EPA 2012, Table 13-3) presented the IDAPA 58.01.06 and indicated that "the substantive requirements that are more stringent than federal requirements are *relevant and appropriate* to RAs that include the removal, transport, consolidation, and/or disposal of contaminated mine wastes [emphasis added]." Resource Conservation and Recovery Act (RCRA) Subtitles C and D and State of Idaho solid waste and surface mining requirements that address the design and performance standards for landfills and waste disposal, which are potentially relevant and appropriate or TBC to the proposed consolidation of remediation wastes, are included in the Interim ROD Amendment (EPA 2012, Table 13-3).

The following key action-specific ARAR assumptions for the configuration of the LBCR are incorporated into this BDR. As discussed previously, the Coeur d'Alene Trust (in consultation with EPA) will address ARARs comprehensively subsequent to this preliminary design.

LBCR Liner and Leachate Collection: IDAPA 58.01.05.008 address the potential for an exemption of a bottom liner system for landfills if a demonstration can be made that an alternative design and operating practices, together with location characteristics, will prevent the migration of hazardous constituents into the groundwater or surface water. As previously discussed, repository operations will consist of the placement of mine waste (and other metals-contaminated waste) on top of the existing STI facility (inactive impounded mine tailings facility). Until the final cover is constructed, it is

expected that metals loading (zinc in particular) from the STI to groundwater will continue as a result of deep percolation through the placed mine waste. Technical and administrative considerations regarding the use of a bottom liner are discussed below. Based on these considerations, the LBCR design does not include a liner and leachate collection system as a design component.

- **Technical Considerations:** To better assess the potential interim impacts that LBCR operations could have on Canyon Creek, the Canyon Creek Hydrologic Study (Hydro Study) (CH2M Hill 2007) was reviewed. The Hydro Study evaluated metals loading from various mine waste features (e.g., contaminant source areas) to Canyon Creek groundwater and surface water. The primary mechanism of metals loading to Canyon Creek during LBCR operation is percolation through consolidated mine waste. Regarding the STI, the Hydro Study states that (CH2M Hill 2007, p. 27):

  For this [STI] analysis, the metals loading generated by this source was divided into three components: the loading generated by leakage from Pond 6 (5.9 acres), the loading generated by the deep percolation of precipitation on the remaining pond areas (55.7 acres), and the loading generated by the tailings within the alluvium under the ponds that reside beneath the water table.

  Table 6 of the Hydro Study (CH2M Hill 2007, p. 26) further summarizes the contaminant loading (zinc is primary contaminant of concern) from the STI to Canyon Creek and indicates that the majority of the total zinc loading from the STI (32 lbs/day total-maximum) is associated with tailings (within the alluvium) in groundwater from beneath the STI (24 lbs/day-maximum). Only a small portion of the zinc loading from the STI (2.3 lbs/day-maximum) is associated with percolation through the impoundment (e.g., the major pathway regarding our interest of the use of a liner during LBCR operations). Accordingly, given this conceptual model of the STI, additional interim mine waste placement (prior to construction of the final low-permeability cover) would not be expected to affect the continued metals loading (zinc in particular) from the STI to groundwater as a result of deep percolation through the placed mine waste.

- **Administrative Considerations:** As discussed in the Interim ROD Amendment, the LBCR will be utilized to consolidate mine waste (and other waste material such as ICP wastes). Following waste consolidation, a low-permeability cover system will be constructed to minimize percolation through the consolidated waste and metals loading to Canyon Creek. In addition, the Interim ROD Amendment includes several actions to address contaminated groundwater and surface water in the STI area including the completion of French drains along Canyon Creek, beginning near the STI and extending downstream to the Canyon Creek impacted floodplain. A cutoff drain will also be placed on the north side of floodplain, and a French drain will be located around the SVNRT Repository. Water collected by the French drains will be conveyed via pipeline to the CTP in Kellogg for treatment. Accordingly, the consolidation of waste material at the LBCR could be considered an interim measure within the Canyon Creek RA; the interim measure would be followed by final capping of the LBCR and installation of French Drains and other groundwater remedial activities identified in the Interim ROD Amendment. Regarding interim measures, EPA guidance (EPA 1990, p. 6) indicates the following:

  The Interim Measure Waiver: This waiver provides that the action selected need not attain an ARAR where the action "is only part of a total RA that will attain such level or standard of control when completed." See CERCLA Section 121(d)(4)(d). Therefore, the interim measure

waiver may be used to waive ARARs for interim measures, which by their temporary nature, do not attain all ARARs. However, the interim measure must be followed by, or be part of, complete measures that attain all ARARs, and it should not exacerbate site problems nor interfere with the final remedy (see the revised NCP [National Contingency Plan], 55 FR [Federal Register] 8747-8748 (March 8, 1990)).

In addition, temporary degradation of ground water may be allowable during implementation of RAs if appropriate temporary actions are taken to protect human health (EPA 1991, p. 4):

Where temporary degradation of the ground water may be required during RA, protection should be provided by restricting access or providing institutional controls, and EPA response actions should ultimately result in restoration of the ground water's beneficial uses.

As described previously and documented in the Hydro Study (CH2M Hill 2007), the historic tailings beneath the STI that the LBCR will be constructed on top of are significant contaminant sources for metals loading to Canyon Creek. The LBCR waste consolidation operations are not anticipated to significantly increase metals loading and may be considered as an interim action followed by other actions (e.g., installation of final cover, installation of French Drains) that will be conducted to achieve remedial goals as identified in the Interim ROD Amendment.

Tier II Facility: IDAPA 58.01.06 (Idaho Solid Waste Management Rules) establishes general siting, operation and closure requirements for solid waste management facilities in a tiered structure. Tier II facilities are not required to install ground water monitoring wells, leachate collection systems or liners. Facilities must be classified as a Tier II facility if the Department determines the facility is not: (1) landfilling or disposing of conditionally exempt small quantity generators (CESQG) hazardous waste; (2) landfilling or disposing of materials with a high human pathogenic potential; (3) managing solid waste in a manner or volume that will form toxic leachate or gas; or (4) managing solid waste in a manner or volume that is likely to pose a substantial risk to human health or the environment. A Tier II facility is one that meets the four above criteria and is a non municipal solid waste (NMSW) landfill that has a total disposal capacity greater than two thousand (2,000) cubic yards. Alternatively, Tier III facilities do not meet the criteria for a Tier II facility and thus are required to additionally install ground water monitoring wells, leachate collection systems and liners. The assumption for the configuration of the LBCR is that it would be classified as a Tier II facility and thus substantive requirements associated with Tier II facilities are incorporated into the LBCR design.

Interim/Temporary Cover: IDAPA 58.01.06.012 (Idaho Solid Waste Management Rules) for Tier II facilities requires the use of a 6-inch soil cover layer on exposed waste to prevent nuisance and vector conditions and placement of an interim cover layer of 12-inches of compacted soil between lifts to provide erosion control and structural stability. Given the coarse rock nature of most of the mine waste to be consolidated at the LBCR, this material does not represent a nuisance or vector condition and the material is inherently structurally stable. Accordingly, although this requirement is relevant to solid waste disposal, it is assumed to not be appropriate for the LBCR and thus interim/temporary soil cover will not be utilized during LBCR operations. However, this basis of design does incorporate best management practices (BMPs) for stormwater and erosion control during repository operations; the activities are similar to those that have been implemented during interim operations at other repositories in the Coeur d'Alene Basin such as at the East Mission Flats and Big Creek Repositories.

3.3 Design Criteria

EPA and IDEQ have determined that contaminated waste materials generated from the remediation of Canyon Creek mine and mill sites (including impacted floodplains) must be safely contained. It is anticipated that a significant volume of the wastes generated during this remediation will be disposed of in the LBCR due to the following:

- The LBCR is located closer to Canyon Creek mine and mill sites than the proposed OSBR or other existing upper Basin repositories; and
- Disposal of Canyon Creek waste materials in the LBCR will alleviate truck traffic resulting from transport of contaminated materials through the towns of Woodland Park and Wallace.

This section presents the evaluation of design criteria for the LBCR including the waste types to be disposed of in the LBCR, the required waste capacity(s) during phased construction/operation, borrow material requirements, cover design criteria, and drainage layer criteria. The components of the design and the discussion of how they will fulfill the design criteria are provided in Section 4.

3.3.1 LBCR Anticipated Waste Types

This section provides information about the anticipated waste types that have been identified for disposal at the LBCR. All wastes to be consolidated at the LBCR must meet the Basin-Wide Waste Acceptance Criteria (TerraGraphics, 2011a).

Mine wastes: Mining activity sites were identified through inventories of contaminant source areas during the development of Remedial Investigation reports for OU3 (EPA 2001a). Mine waste types that have been identified for disposal at regional repositories (EPA 2012b) include:

- Un-impounded tailings,
- Waste rock,
- Floodplain sediments/impacted alluvial materials, and
- Floodplain artificial fill/impacted alluvial materials.

It is assumed that the majority of the capacity of the LBCR will be allocated for disposal of mine wastes from the Canyon Creek watershed.

Basin Property Remediation Program: The BPRP is a remedial program provided to protect residents in the BHSS OU3. Field personnel collect soils from residential properties and unpaved roads to test for lead and arsenic. Soils with lead concentrations greater than 1,000 parts per million (ppm) or arsenic concentrations greater than 100 ppm are excavated and removed to 1 foot bgs. In cases where the contamination extends deeper than 1 foot bgs, a visual marker/ protective barrier is placed over the contaminated soils at the base of the excavated area and clean soil is placed over the barrier. The clean soil and visual marker/protective barrier are intended to protect residents from exposure to contaminated soils. It is anticipated that future waste generation from the RAs on unpaved roads will be incorporated into the BPRP.

Institutional Controls Program: The ICP is designed to ensure the integrity of clean soil and other protective barriers placed over contaminants left in place throughout the BHSS. The ICP regulations require all excavation and grading construction and certain interior remodeling projects proposed for any land or structure within the boundaries of the BHSS to have an approved permit from the Panhandle Health District. These regulations are also designed to protect human health and the environment and promote economic development.

The ICP manages the disposal of waste materials resulting from the disturbance or excavation of contaminated soils from residential, commercial development, or infrastructure redevelopment projects. The ICP also administers disposal of synthetic waste materials from construction, renovation, demolition, and land development.

Paved Roads: It is anticipated that remediation of publicly-owned paved roads within the ICP Administrative Boundary will occur as existing BHSS roads reach the end of their service life, and according to the schedule and criteria identified in the "Roads Strategy" for the BHSS. Remediation of these roads will generate significant quantities of waste from the portion of the road surface or subgrade that will be removed and disposed. Generated waste materials will require disposal capacity in a regional repository and meet the Basin-wide Waste Acceptance Criteria (TerraGraphics 2011a).

Remedy Protection: "Remedy protection" is focused on maintaining the selected remedies that have been implemented by addressing uncontrolled water flow from tributary flooding, precipitation events, and rapid snowmelt run-off that could erode protective barriers, transport contaminated materials, and/or deposit contaminated sediments. Waste generated from remedy protection projects is expected to meet the Basin-wide Waste Acceptance Criteria (TerraGraphics 2011a) and will be disposed of in a regional repository.

Excluded Wastes: Waste materials not identified in the Bunker Hill Waste Acceptance Criteria (TerraGraphics, 2011a) are not anticipated for disposal at the LBCR. Should it become necessary that current and future sludge generated from mine water and impacted groundwater treatment at the CTP requires disposal in regional repositories, design and operational parameters will need to be modified to accommodate it. For the purpose of this design, it is assumed that the LBCR will not receive any CTP sludge and therefore no separate sludge disposal facilities will be located at the LBCR. In addition, it is assumed that the LBCR will not receive any principal threat wastes, such as mining concentrates, as defined in the Interim ROD Amendment (EPA 2012a, Section 11).

3.3.2 Waste Capacity Requirements and Phased Construction & Operation

As previously discussed, the estimated timeline for Canyon Creek Basin RA implementation spans from 2015 through 2025 or later (a minimum 10-year period) with remedial activities potentially beginning near the Hecla-Star Complex and ending near the confluence with SFCDR (i.e., Standard-Mammoth Mill Site).

As identified in Section 1, the estimated waste volume generated from remediation of the mine and mill sites in the Canyon Creek drainage basin is approximately 1.8 million bcy as quantified in the technical memorandum titled "Estimated Waste Volume from Canyon Creek" (TerraGraphics 2012b). This total waste quantity estimate is still preliminary and may not account for several uncertainties, including the site-specific removal plans that are in the process of being developed and acknowledgement that the extent of contamination is not completely determined. The waste volume estimate includes quantities of upland waste rock, floodplain waste rock, floodplain sediments, and

upland tailings from 47 mine and mill sites in the Canyon Creek watershed. The 47 sites were identified on the list of Alternative 3+Canyon Creek sites to remain included in the selected remedy (EPA 2012a, Table 14-1). The TerraGraphics "Estimated Waste Volume from Canyon Creek" memorandum is included as Appendix F.

Delivery Timeline: The LBCR will be designed to accept waste from April to November and operate on a ten-hour per day shift, four days per week, consistent with other Basin repositories. At this time, it is estimated that waste will be delivered to the LBCR at a rate of approximately 80,000 bcy per year (based upon compacted annual surveyed waste volume) over an operational life cycle of at least 10 years. However, it is possible that annual delivery rate could increase with an aggressive RA schedule. When additional information becomes available regarding the waste delivery schedule for proposed remediation of Canyon Creek mine and mill sites, this estimate will be modified.

Handling Areas: The LBCR must contain designated areas for waste handling including; unloading, sorting, staging, placing, compacting, and covering facilities to demonstrate the achievement of engineering design, construction, and O&M requirements until final closure of the LBCR. To allow for handling of the various materials that could be disposed of in the LBCR, specifically ICP wastes (see Section 3.2.2), the following staging areas will be developed to unload, sort, and dry waste at any one time:

- 500 bcy of concrete or large rock debris
- 500 bcy of woody debris (to be shredded)
- 1,000 bcy of wet-waste that needs to dry before placement and compaction
- 1,000 bcy of waste staging/stockpile area

If possible, waste will be placed directly in its final position to avoid double handling. For example, if there is sufficient space on the working surface, wet waste can be placed directly and dried in place during appropriate weather periods. Engineered features and/or operations plan(s) allow for the management and disposal of wastes accepted into the LBCR.

Phase 1 Capacity Criteria: The initial phase of construction is tentatively scheduled for 2014 with the intent of beginning Phase 1 operations in 2015. The design for Phase 1 allows for consolidation of approximately 80,000 bcy of waste materials at the LBCR. It is anticipated that Phase 1 will include consolidation of waste materials from the Hecla-Star Complex (BUR 128) and other adjacent sites (Hidden Treasure Mine [BUR097], Hercules No. 5 [BUR098] and Tiger-Poorman Mine [BUR129]). In addition, the LBCR will receive approximately 10,000 bcy of waste per year from the BPRP, ICP, Paved Roads, and Remedy Protection programs starting in 2015, based on estimates of the annual waste volumes delivered to the Big Creek repository by these programs.

TerraGraphics previously estimated the waste volume from the Hecla-Star Complex and the adjacent sites identified above to be approximately 172,700 bcy (TerraGraphics 2012b, Table 1). However, these estimates are currently being updated based on pre-design investigation activities completed in 2012. At this time, it is anticipated that consolidation of waste materials from the Hecla-Star Complex will continue beyond Phase 1.

Full-Scale Capacity Criteria: The full-scale capacity criterion for the LBCR is to manage mine waste generated from Canyon Creek remedial activities, as well as, wastes from the BPRP and ICP. The estimated volume of mine waste material that can be consolidated in the LBCR is approximately 816,000 bcy. The preliminary LBCR design includes the layout of the LBCR for the full-scale capacity. At this time, it is unclear when subsequent phases of LBCR construction (i.e., post Phase 1 or 2) will need to be completed in order to accommodate additional mine waste from the Canyon Creek Basin following completion of the Hecla-Star Complex activities. The design will be altered if necessary during the intermediate design to increase capacity as much as practicable.

3.3.3 Site Access Criteria

Access points will be designed to safely allow truck traffic to enter and exit the LBCR site from Highway 4 and be designed in accordance with Shoshone County Public Works Road & Bridge Department requirements. The access intersections will be designed to meet American Association of State Highway and Transportation Officials (AASHTO) *A Policy on Geometric Design of Highways and Streets* (AASHTO 2011) requirements and any applicable county standards.

3.3.4 Design Vehicle Criteria

The design vehicle for the repository will be a standard 15-ton dual axel dump truck commonly used for commercial construction projects and as used at other Basin repositories. However, a standard dump truck and pup will also be accommodated in the design to ensure adequate sizing of the decontamination facilities, haul routes and dump locations. No off-road haul trucks are anticipated to be used at the repository. For the ICP stockpile area, the design vehicle is a standard full-size pickup; however, the area will accommodate a 50-foot turning radius per AASHTO standards, which will allow a pickup with a small trailer to use the ICP area. A standard full-size pickup is the most common vehicle used by local ICP users to dispose of small quantities of contaminated soil. The detailed calculations for the turning radius and pavement designs will be provided with the intermediate design for the selected design vehicle.

3.3.5 Cover Material Requirements

Unlike the LBCR waste capacity requirements, which address both initial and full-scale requirements, clean cover materials will primarily be developed for the full-scale final cover system. However, initial cover material development may be required if it is determined that temporary soil cover is necessary between construction seasons, or the final cover will be installed in phases similar to the approach for consolidating waste materials. The required cover material volumes will be refined during the intermediate and pre-final LBCR RD.

As part of the preliminary LBCR design, cover material volumes needed to install the LBCR permanent cover system were evaluated based on the LBCR configuration developed utilizing computer-aided design (CAD). The preliminary configuration requires approximately 85,000 bcy of clean cover soils, placed 2-feet thick, for the final cover. As mentioned above, temporary/partial cover material requirements will be evaluated during the intermediate design, if necessary.

As mentioned in Section 2.4.3, samples collected during the 2012 pre-design investigation indicated that the existing impoundment cover soil contains concentrations of metals above the lead cleanup level, which was anticipated based on the construction and use of the existing facility. As a result, cover materials cannot be generated onsite and must be imported from other sources. In addition, clean cover materials could be required to cover the existing impoundment as well as the LBCR

because of the high metals concentrations identified on the perimeter dams (i.e., embankment material). At this time, local borrow areas near the LBCR are being evaluated by the Coeur d' Alene Trust to attempt to minimize the effects (e.g., costs) of importing cover materials from outside the Canyon Creek Basin.

Quantity estimates are preliminary and will be re-evaluated and refined during the progression of the LBCR design. The LBCR design may also incorporate staging areas for stockpiling of cover materials for use at the LBCR.

3.3.6 LBCR Cover Design Criteria

Design criteria for cap and cover actions, such as those anticipated for the LBCR, typically include the assessment of stability (i.e., settlement and subsidence), stormwater management, erosion control, and cover system infiltration. The repository cover design criteria are discussed in this section.

Phased Cover Installation: Similar to the waste consolidation approach, the final cover system could be installed in phases. Phased installation of the final cover system will reduce the periods of time that waste materials will be susceptible to erosion or potentially impact stormwater runoff. The preliminary design provides for installation of the final cover system upon full-scale development of the LBCR; however, phased final cover system installation will be evaluated during the intermediate LBCR design.

Stability and Erosion Control Criteria: The repository and cover slopes are designed to meet project-specific stability design criteria. The minimum factors of safety (FS) for design are adapted from USACE criteria for earth and rock-fill dams (USACE 2003). For static, seismic, and rapid drawdown conditions, the minimum FS are 1.5, 1.1, and 1.3, respectively.

For the seismic evaluation, the design peak ground acceleration was determined from the USGS (USGS 2008a). Based on data presented by USGS, the LBCR site may experience a peak ground acceleration equal to 17 percent of the acceleration due to gravity (0.17g), with a 10 percent probability of exceedance in 250 years. In accordance with 40 CFR 258, the site is located in a seismic impact zone, since the 10% in 250 year PGA exceeds 0.1g, and the design documents must demonstrate that the LBCR will remain intact under the anticipated seismic load. In addition, the design utilizes a general slope constraint of 3H:1V for the configuration of the LBCR; however, the existing STI perimeter dams will be left at steeper slope angles, which have been considered in the stability analyses.

For long-term stability and erosion control, a key design consideration is to remove mine waste out of the Canyon Creek 100-year floodplain and to construct the LBCR out of this flood plain; the LBCR location incorporates these siting criteria. The starting elevation where additional waste will begin to be consolidated (i.e., top of the existing STI) averages approximately 20 feet above Canyon Creek and is outside the delineated 100-year floodway.

Stormwater Management Criteria: The sizing of permanent run-off control channels and other LBCR stormwater control features will be determined using the 100-year, 1-hour storm event resulting in a 100-year rain-on-snow event. Temporary stormwater control features will be designed for the combined 25-year, 24-hour storm event and the 100-year snowmelt event (rain-on-snow). The Rational Equation will then be used to calculate design discharges for the stormwater control channels. The 100-year, 1-hour rainfall intensity for use in the Rational Equation along with a 100-year snowmelt event will provide conservative design discharges for permanent structures.

Final Cover System Infiltration Criteria: The LBCR cover system will be the primary means used to limit exposure to humans by incidental ingestion and/or inhalation and to limit infiltration of precipitation and subsequent leaching of contaminants or generation of acid rock drainage (ARD) from the consolidated mine wastes. The EPA defined a typical conceptual design (TCD C08a) in the FFS (EPA 2012b) for repositories that identifies the use of a low permeability cover system that includes 6-inches of compacted soil and a FML above the consolidated mine waste, a 12-inch thick subsoil drainage layer, and a 24-inch layer of topsoil/growth material to support vegetation. Although the FFS identifies this specific cover system, overall cover performance criteria, such as a maximum infiltration rate or allowable leaching rate, are not identified. In addition, the FFS and Interim ROD Amendment allow for modifications to the TCD based on site-specific information and other considerations (i.e., adaptive management). The LBCR cover design will incorporate a FML and cover components similar to those identified in the TCD (i.e., linear low density polyethylene (LLDPE)) overlain by a drainage layer and a vegetated and/or non-vegetated soil layer.

3.4 Property Access Coordination

As previously discussed, the LBCR is located on property currently owned by Hecla, the BLM, and the Golconda Mining Company (see Figure 2-1). The EPA is working with the BLM and Hecla to transfer ownership of their parcels to the EPA. Additional information regarding property access coordination will be provided in the intermediate RD. The EPA will be responsible for providing LBCR property access to the Coeur d'Alene Trust and its contractors.

3.5 Green Remediation Considerations

The sustainability of RAs must be considered at all stages of remediation (EPA 2009). Green remediation is defined as the practice of considering all environmental effects of remedy implementation and incorporating options to maximize new environmental benefit of cleanup actions. The BMPs of green remediation help balance key elements of sustainability. These key elements—resource conservation, material intensity, and energy efficiency—are described in EPA's green remediation guidance (EPA 2008). As further guidance, EPA has developed five recommended elements for greener cleanups (EPA 2009): (1) minimize total energy use and maximize use of renewable energy; (2) minimize air pollutants and greenhouse gas emissions; (3) minimize water use and impacts to water resources; (4); reduce, reuse, and recycle material and waste; and (5) protect land and ecosystems. The FFS (EPA 2012b, Table 5-1) incorporated these five recommended elements into the LBCR TCD (TCD C08a) via sustainability actions as follows:

- **Minimize total energy use and maximize use of renewable energy:** Reduce idling of trucks and equipment and use local sources for materials/equipment.
- **Minimize air pollutants and greenhouse gas emissions:** Utilize onsite dust and noise control; use clean fuel incentives in contract for trucks and heavy equipment; and maximize use of equipment and vehicles equipped with advanced emission controls.
- **Minimize water use and impacts to water resources:** Reduce impact to water sources (the low permeability LBCR cover will reduce water infiltration and thus will serve to protect groundwater).
- **Reduce, reuse, and recycle material and waste:** Minimize waste generation and use recycled products and local materials.

- In addition, electronic document transactions will be used whenever possible for project-wide sustainability.

3.6 Implementation Schedule

As discussed previously, the LBCR design incorporates a phased approach to construction. Phase 1 includes construction of the portion of the LBCR needed to manage mine waste generated from the Hecla-Star Complex. The Coeur d'Alene Trust has developed a preliminary project schedule for the design and construction of Phase 1 of the LBCR, which includes the following general milestones for the project:

- **February 8, 2013:** Submit the preliminary (30%) design to the EPA
- **May 2013:** Submit the intermediate (60%) design to the EPA
- **September 2013:** Submit the pre-final (90%) design to the EPA
- **November 2013:** Conduct contractor site walk of the LBCR area
- **January 2014:** Submit the final (100%) design to the EPA
- **Spring 2014:** Bid and award LBCR construction contract
- **Summer/Fall 2014:** Complete initial LBCR construction
- **Summer/Fall 2015:** Begin consolidating waste at the LBCR

Although this preliminary RD provides information on the full-scale LBCR design, such as the LBCR configuration to manage the full-scale waste capacity and borrow material requirements, the full-scale LBCR design and construction schedule is currently uncertain and is not further discussed.

3.7 Cost Estimate and Contracting Strategy

The LBCR construction cost estimate for the preliminary full-scale development design will be completed using the USACE MCACES II software and will be submitted to the Coeur d'Alene Trust under a separate cover. The LBCR construction cost estimate will be prepared based on the understanding that the Coeur d'Alene Trust is the lead entity for the LBCR construction and will implement the construction activities including both the contracting/procurement and construction management.

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Section 4

Design Components

The LBCR RD includes the following major components:

- LBCR siting and configuration
- Existing impoundment stabilization and grading
- Site facilities design
- Phased consolidation approach
- Cover design
- O&M considerations

4.1 LBCR Configuration

The LBCR will be entirely sited within property that is owned by the EPA. The finalized property boundary will be determined after the acquisition process is complete. Preliminary LBCR capacity estimates based on the 30-percent CAD drawings indicate a waste disposal capacity of approximately 816,000 bcy, which is greater than the 500,000 bcy identified as a siting criterion in Section 2.2.2. The repository configuration shown in the preliminary design is intended to maximize waste disposal capacity while achieving the design criteria described in Section 3.2 of this report. Given that the projected waste volume generated from remedial activities of the Canyon Creek mine and mill sites will likely be greater than the estimated disposal capacity of the LBCR, additional waste storage capacity will need to be developed.

4.1.1 Geotechnical Design

Geotechnical considerations for the LBCR design include the geologic setting, slope stability, mine waste compaction and characteristics, and long-term settlement.

Geologic and Seismic Setting: The manmade fill of the STI Ponds overlies alluvium associated with the nearby Canyon Creek. Bedrock lies beneath the alluvial sediments as described in Section 2.3.1.

The USGS maintains a database of active faults within the U.S. For the purposes of the database, active faults are defined as faults and associated folds that are believed to be sources of earthquakes greater than Magnitude 6 during the Quaternary Period (the past 1,600,000 years). A search of this database revealed that the nearest active fault to the site is the Thompson Valley Fault, approximately 46 miles to the east-northeast (USGS 2008b). However, the Osburn Fault traverses the area in a general east-west trend, and passes within about one-half mile to the south of the LBCR site. An unnamed secondary fault parallel to and associated with the Osburn Fault passes near the southern boundary of the site, and may lie beneath the repository (Gott and Cathrall, 1979). The Osburn Fault is mapped as a strike-slip fault, while the unnamed fault is mapped as a normal fault. There is evidence to suggest that the most recent movement on the Osburn Fault occurred between 81 and 100 million years ago

(Wallace et al., 1990). In addition, since these faults do not appear in the USGS database, it can be assumed that no significant movement has occurred on these faults in the last 1,600,000 years. Additional information regarding the geologic setting is presented in the Geotechnical Stability Analysis – 30% Design Submittal Memorandum (Appendix D).

Slope Stability: The LBCR is designed to meet certain stability design criteria. The minimum factor of safety (FS) for design are adapted from USACE criteria for earth and rock-fill dams (USACE 2003). For static, seismic, and rapid drawdown conditions, the minimum FS are 1.5, 1.1, and 1.3, respectively.

The stability analyses were performed using a Morgenstern-Price limit-equilibrium calculation using the computer program SLOPE/W (GEO-SLOPE 2007). SLOPE/W performs a search routine to find the most critical circular slip surface. In addition, SLOPE/W provides the option of optimizing this slip surface. In the optimization routine, the critical slip surface is altered incrementally and a new FS is computed. This enables non-circular slip surfaces to be included.

To achieve general slope stability of the LBCR, the consolidated mine waste and cover grading plans were developed using a maximum design slope of 3H:1V, which was also used for stability analysis. Preliminary analysis resulted in FS which exceed the target FS provided that certain setback limits are adhered to. Details of the slope stability analysis and recommendations for construction are provided in the Geotechnical Stability Analysis – 30% Design Submittal Memorandum (Appendix D).

Waste Compaction: The material to be placed in the LBCR will be predominantly re-compacted mine waste materials from the legacy mine and mill sites within the Canyon Creek Basin. In general, waste materials will be placed in lifts (no thicker than two times the largest diameter rock) and be machine compacted (i.e., padded drum roller or grid roller).The Technical Specifications (Appendix K) will be prescriptive in nature, rather than performance-based. Placement and compaction requirements may be adjusted as more data becomes available to characterize waste materials identified for consolidation within the LBCR; however, the stability analyses included in Appendix D utilize conservative assumptions for the strength of the waste which should be readily achievable using the compaction equipment and methods described.

Waste Characteristics: As mentioned above, the LBCR is anticipated to accept primarily mine waste materials that include tailings, sediments, and waste rock. Geotechnical characterization data will be collected as waste materials are identified for transfer to the LBCR to supplement and/or verify assumptions made for the design. If large volumes of tailings or other weak materials are identified during construction, these materials should be blended with other wastes to improve the strength characteristics of the material.

Long-term Settlement: Due to the compressible nature of tailings and the relative incompressibility of the perimeter dam materials, long-term differential settlement of the LBCR must be addressed in the design to prevent damage to the cover system or interruptions in surface water flow. This will be analyzed as a part of the LBCR 60% Design.

4.1.2 Drainage Control

The LBCR site is located adjacent to Canyon Creek, as described in Section 1.2 and illustrated in Figure 2-1. Because of its proximity to Canyon Creek and the severely impacted nature of the drainage and the surrounding area, the hydrology and hydraulic characteristics in and around the site are complex.

The following sections describe the key components and methodologies that will be employed for the drainage control design.

Runoff channels and swales will be installed at the LBCR to direct runoff from the drainage area and surface of the LBCR. Stormwater infiltration ponds will also be designed to capture and retain runoff onsite to prevent potentially contaminated water and sediment from reaching Canyon Creek. Hydraulic calculation details will be provided in the intermediate design to confirm the capacities of the designed channels, swales, and detention basins. Appendix I includes a list of design calculations to be completed during the intermediate design.

As discussed in Section 2.4.3, data collection activities completed during 2012 at the LBCR site indicated that the existing cover materials contain high concentrations of metals, particularly lead. As a result, precipitation that falls within the repository boundary will be managed to minimize, to the maximum extent practicable, the release of impacted runoff and sediment. Sediment control BMPs will be installed to contain mobilized sediments onsite during storm events. Containment of stormwater will occur through the use of berms, detention basins, and other stormwater controls that will be constructed within the LBCR site. Stormwater controls will be constructed in locations that maintain effectiveness while avoiding impacts to operations.

Temporary Operational Phase Drainage Control: Operational Phase stormwater and erosion controls will be capable of conveying and retaining peak discharges from a 25-year, 24-hour storm event and the 100-year snowmelt event (rain-on-snow condition). Using the 25-year, 24-hour rain event to design temporary drainage controls is consistent with applicable requirements (see Appendix J, IDAPA 58.01.05.009 (40 CFR Part 265 Subpart N: 265.301 d(2)(ii); f - i)) and the approach used in the design of other basin repositories (e.g., Big Creek). The estimated amount of precipitation from the 25-year, 24-hour storm is 3.47 inches as interpolated from isopluvials provided in the NOAA Atlas 2 for the state of Idaho (National Oceanic and Atmospheric Administration (NOAA) 1973). The 100-year snowmelt amount (4.20 inches) was established from snow-water equivalence data collected from the Humboldt Gulch Snotel site in Idaho for the water years of 1982 to 2012 (Natural Resource Conservation Service (NRCS) 2012). The intensity for the combined 25-year, 24-hour rain event and the 100-year snowmelt is estimated to be 0.49 inches per hour (in/hr) (see Appendix I). Temporary stormwater and erosion control BMP measures will be included in the LBCR Stormwater Pollution Prevention Plan (SWPPP) that will be prepared prior to construction.

Permanent Closeout Drainage Control: As part of the intermediate design, the 100-year, 1-hour storm event and the 100-year snowmelt event (100-year rain-on-snow condition) will be used to estimate the discharges used to design permanent drainage control components. Due to the absence of measured flow data and drainage areas smaller than 200 acres, the 100-year peak discharge from the drainage area of the LBCR will be estimated using the Rational Equation and snow-water equivalence data from the Humboldt Gulch Snotel site in Idaho. The results from the Rational Equation and snow-water equivalence data will be checked against the USGS regression equation for Idaho Region 2 for the 100-year recurrence interval.

Use of the Rational Equation to estimate 100-year peak rain-on-snow discharges requires multiple input data. The 100-year, 1-hour rainfall amount (1.36 inches) was approximated from an equation from the NOAA Atlas 2 for the state of Idaho (NOAA 1973) and precipitation frequency data obtained from the NOAA Hydrometeorological Design Studies Center (NOAA 2012). The 100-year snowmelt amount (4.20 inches) was established from snow-water equivalence data collected from the Humboldt

Gulch Snotel site in Idaho for the water years of 1982 to 2012 (NRCS 2012). The runoff coefficient used to run the model will be 0.98 to simulate saturated (impermeable) conditions resulting in maximum design discharges.

This approach also involves inherent assumptions. The Rational Equation assumes that rainfall intensity is consistent throughout the storm duration, loss in snow-water equivalence is snowmelt, and peak snowmelt occurs during a 12-hour window of warmth and is evenly distributed throughout the 12-hour window. The intensity for the 100-year, 1-hour combined (rain-on-snow) storm was estimated to be 1.71 in/hr (see Appendix I).

As shown in the design drawings (Appendix B), runoff control swales will be integrated into benches on the embankments of the LBCR. A toe drain swale will also be constructed around the LBCR consolidation footprint to collect and convey runoff from the final cover below the bench swales and from the cover system drainage layer. The drainage layer will discharge into the toe drain so water that infiltrates the cover soils can be directed away from the toe of the LBCR. The swales and toe drain will direct water to outlet channels that will run down the existing STI embankments in specified locations. The outlet channels will be capable of conveying more stormwater at higher velocities than the bench swales to prevent the swales from exceeding capacity. The outlet channels will be lined with riprap to prevent erosion of the repository slopes. From the outlet channels, stormwater runoff channels along the toe of the existing STI will carry runoff to a stormwater infiltration pond located adjacent to the southeast corner of the existing STI. Locating the stormwater infiltration pond in this area will allow stormwater to infiltrate primarily through cleaner alluvial material rather than through the existing STI waste materials. The stormwater runoff channel on the east side of the existing STI will be adjacent to and likely encroach upon the FEMA delineated 100-year floodway. Swale, outlet channel, and stormwater infiltration pond details and configurations will be provided in the intermediate design.

Bench and toe drain swale lining requirements will be determined based on velocities calculated by Haestad Methods FlowMaster v5.13. Riprap sizing for the outlet channels will be completed using Bathurst Resistance Calculations. Conceptual swale locations are provided on the design drawings in Appendix B.

4.1.3 Erosion and Dust Control

Silt fences or similar BMPs will be constructed around the perimeter of the LBCR to provide initial, temporary erosion control. Additional erosion control measures such as perimeter diversion dikes, hydroseeding or spray on type soil stabilizers, and covering with polyethylene sheeting may also be used during the operational lifecycle of the LBCR.

The repository contractor will visually monitor for dust generated by vehicles onsite. To maintain compliance with state air quality regulations and prevent dust, water trucks will be onsite at all times. If dust is observed, the contractor will take immediate steps to control it. Water trucks will make multiple passes during the day to keep driving surfaces wetted. If necessary, applications of chemical dust suppressants or surfactants (e.g., magnesium chloride) will be used. In the event of excessive dust conditions, hauling and placement operations will be suspended. Decontamination wastewater and stormwater will be utilized as much as possible for dust control within the footprint of the LBCR waste placement areas during construction. These requirements will be incorporated in an operation and maintenance manual, a draft of which will be submitted as part of the pre-final (90 percent) LBCR design.

4.1.4 Phased Consolidation and Development Approach

The annual anticipated waste volumes and lifespan of the LBCR are uncertain at this time. As discussed in Section 1, EPA is currently developing a plan for the timing of the RA in the Canyon Creek Basin. The preliminary design assumes 11 phases of consolidation; however, more specific annual waste consolidation plans will be developed as the operation of the LBCR continues and as the RA schedule is determined.

Phase 1 Consolidation: Phase 1 will include initial construction of access roads, the decontamination and personnel facilities, and installation of utilities to support LBCR operations. Phase 1 consolidation will allow for the placement of approximately 80,000 bcy of waste materials during the first year the LBCR is operational, which at this time is tentatively the spring of 2015. Initial waste streams will include the mine sites and other waste materials that were identified in Section 3.2.2. Sheet C11 of the design drawings displays the conceptual Phase 1 consolidation of 80,000 bcy of waste materials at the south end of the LBCR (see Appendix B). During the intermediate design, the Phase 1 consolidation approach and construction plans will be refined as necessary.

Full-Scale Development: The full-scale development plan will allow for the placement of approximately 816,000 bcy of mine waste from the various sites within Canyon Creek during the LBCR's lifespan. The current estimated schedule for mine waste consolidation to the LBCR spans from 2015 through 2025 or later (a minimum 10-year period); however, the timeline for Canyon Creek RA execution is subject to change based on funding, work execution progress, and adaptive management implementation. As a result, the consolidation plan will be updated annually to manage the anticipated waste volumes identified for disposal in the LBCR. The preliminary full-scale development plan provided on the design drawings (see Appendix B) indicates that there will be approximately 11 phases of consolidation during the LBCR's life span. Each phase will allow for the consolidation of approximately 80,000 bcy of waste material per year. The current approach provides flexibility for changes in the timeline and accommodates varying RA and consolidation tempos. Subsequent phases of the LBCR design will attempt to determine the full-scale consolidation approach and plans as the Canyon Creek RA schedule and plans are finalized.

4.2 Existing Impoundment Re-Grading and Stabilization

Re-grading and stabilization activities will be completed as part of the initial construction (2014) to prepare the existing impoundment for construction of the LBCR and additional waste consolidation based on the Geotechnical Stability Analysis – 30% Design Submittal Memorandum (Appendix D). Portions of the existing STI contain significant erosion features that need to be prepared and stabilized prior to construction. Stabilization will be achieved through grading (i.e., reducing slope angles) or installation of riprap where grading is not feasible.

In the portions of the STI where erosion channels are prominent, the existing embankments will be re-graded to 2H:1V or flatter slopes; however, most of the existing embankments will remain steeper than 2H:1V (see design drawings in Appendix B). The proposed re-grading was evaluated to ensure that the existing starter dams will not be compromised and re-grading will not cut into tailings. This was accomplished by comparing the re-grading contours to the existing starter dam contours provided on drawings of the existing STI from Dames and Moore (D&M 1979). An 18-inch layer of clean growth media cover will then be placed on the slope and a native seed mix will be applied to re-vegetate the embankment. The gradation and other requirements for the growth media cover for the existing impoundment will be provided in the intermediate design.

If the existing impoundment is in close proximity to the Highway 4 right-of-way (ROW) or the delineated floodway such that flattening the slopes is not possible but stabilization is required, the embankments will be prepared (i.e., graded) and stabilized with large riprap along the toe and potentially smaller rock up the embankment to minimize erosion of the steep slopes. The riprap installed on the steep existing embankments will provide scour protection during high flow events along Canyon Creek and protection from rainfall and snowmelt on the slopes. Although not specifically designed for this, the riprap will also serve to buttress the toe of the slopes resulting in an increased FS for stability. If needed, the design of the riprap will be completed as a part of the intermediate design.

Because the STI embankments are located adjacent to the FEMA delineated floodway, placing riprap along the Canyon Creek side of the existing embankments will extend the embankments and encroach on the floodway in most locations (see Figure 2-1). As discussed in Section 4.1.2, stormwater runoff channels along the toe of the east side of the existing STI will be adjacent to and likely encroach upon the floodway with the existing STI embankment configuration. The intermediate design will further evaluate the need for riprap protection and potential encroachment into the floodway.

4.3 Site Facilities Design

The following sections provide design details for the various facilities and infrastructure that will be constructed for the LBCR.

4.3.1 ICP Disposal Area

In an effort to maintain public safety and allow for smooth operation of the LBCR, an ICP disposal area and entrance will be located away from the main repository entrance to maintain separation from large truck traffic and construction equipment. This will allow the ICP users to dispose of contaminated soil in a safe, easy, and efficient manner throughout the year. The ICP disposal area will be designed as a temporary facility to allow maximum flexibility in repository operations. The location and additional details are provided on the design drawings in Appendix B.

The ICP will utilize a clean gravel access area to eliminate the need for vehicle decontamination. The clean gravel and dumping areas will be separated by a moveable barrier system (i.e., jersey barriers or similar) so the dumping area can be reconfigured if necessary to maintain efficient operations. Signage will also be used to indicate dumping areas and locations where dumping is not allowed. Barriers will also be used along the perimeter of the clean gravel access, as necessary, to prevent waste materials from migrating into the clean gravel or dumping in undesignated areas. Access control for the ICP Disposal Area is discussed in Section 4.5.

4.3.2 Decontamination Facilities

Decontamination facilities will be designed for large truck traffic and construction equipment to reduce the potential for contamination being spread off-site. Facilities will be provided near the entrances/exits of the repository so that vehicle decontamination can occur before a truck exits. These facilities will be designed to operate in the same manner as at existing basin repositories and will be active during the construction season and closed during the winter months. Additional space will be allocated for a second decontamination facility to give further repository flexibility in case the waste delivery schedule is increased.

The permanent decontamination facility will be the first facility constructed to provide a designated decontamination area for the repository for use during the initial construction season and subsequent consolidation phases. Prior to leaving the LBCR, vehicles will drive onto the decontamination pad where they will be washed down to remove contaminated materials. Contaminated water and sediment will be collected in a sump adjacent to the pad. The water can be pumped out of the sump and used for dust control within the LBCR or pumped to a stormwater sedimentation basin if dust suppression is not necessary. Accumulated sediment will be routinely removed from the sump and deposited within the repository. Decontamination water will be supplied by either a dedicated well installed near the decontamination pad or by the East Shoshone County Water District. Additional details on the water supply and usage will be provided in the intermediate design.

In the event that ICP projects need to use the main repository entrance during the winter months, decontamination procedures will remain the same; however, water will likely be supplied by a tank or water truck.

4.3.3 Personnel Facilities

Personnel facilities will be located near the decontamination facilities similar to the EMF repository and will include an employee building and a parking area for employees. The employee building will have electricity so the building can be accessed on a limited basis during the winter. Employee parking will be in a designated area. Additionally, the Repository Contractor will be responsible for providing drinking water and portable toilet facilities. The location and additional details are provided on the design drawings in Appendix B.

4.3.4 Site Access

Waste will be hauled in trucks from Canyon Creek mine and mill sites to the LBCR via Idaho State Highway 4 (Burke Road). Wastes from the BPRP, ICP, and other programs will also be transported to the LBCR via Highway 4 and other existing roads. Highway 4 and other existing roads are assumed to be adequate to handle the truck traffic delivering waste to the LBCR.

The main LBCR access point will be located at the north end of the repository site to limit traffic impacts to the community of Woodland Park. However, temporary LBCR entrances will be utilized during the different consolidation phases to reduce truck traffic within the LBCR, which could potentially create significant volumes of dust during operations. The Phase 1-4 entrance will be the closest in proximity to Woodland Park, but it is still located north of the northern residences of Woodland Park. The Phase 5-8 entrance will be located near the center of the LBCR, farther north of Woodland Park than the Phase 1-4 entrance. Subsequent phases will utilize the main access point to enter and exit the LBCR. All trucks will exit the LBCR through the main access point during all phases so they pass through the decontamination facility.

Temporary haul roads within the LBCR will be connected to the access points and used to place waste materials inside the repository footprint. The preliminary design drawings (Appendix B) include layouts for temporary access roads within the LBCR. The drawings also indicate that approximately 10,000 bcy of material will be needed to construct the temporary access roads and access road ramps (i.e., buttresses) (see design drawings, Appendix B). The access road ramps that will be constructed for access from STI Pond 2 to Pond 3 and from STI Pond 3 to Pond 4 require most of the fill material volume. It is anticipated that cut material from the existing embankment re-grading discussed in Section 4.2 could be used as fill to construct the ramps. Additional access roads may be developed as

needed by the contractor to maintain efficient movement of materials and equipment within the LBCR footprint. Haul roads may be modified, abandoned, realigned, or raised as needed to accommodate the placement of waste. Some haul roads may eventually be converted to permanent roads and used for surveillance or monitoring after repository closure. Haul road maintenance will be incorporated into the repository interim operation plan as discussed in Section 4.5.

The LBCR will accept waste from April to November consistent with other Basin repositories. The LBCR is assumed to be operated on a ten-hour per day shift, four days per week schedule matching current work schedules of existing repositories. Occasional monitoring and waste disposal will also be accommodated as necessary during the closed season.

4.3.5 Security and Access Control

Access control requirements for the LBCR will be based on the action-specific ARARs (see Appendix J, 40 CFR Part 258 Subpart C, Section 258.25). Access gates and perimeter fencing will be installed around the LBCR to prevent inadvertent entry into the repository and reduce recreation or other casual traffic through the area. The ICP area will include its own access gate and perimeter fencing and include key card access and video monitoring. It is assumed that key card access or video monitoring will not be required for the other parts of the LBCR.

4.3.6 Utilities

Several existing utilities cross or parallel the LBCR site; the features are shown on the preliminary drawings (see Appendix B). STI Pond No. 6 still receives discharge from the Star main adit, which is piped along the western edge of Ponds No. 1 through No. 4 (EPA 2001a). As discussed in Section 2.6, this pipeline may be relocated to the ROW of Highway 4, eliminating interference with LBCR construction and operations. Coordination with Hecla will continue as the design process progresses to address potential issues with the location of the pipeline. In addition, Gem adit piping runs to the pilot treatment system at the north end of STI Pond No. 4. This piping will be rerouted or removed when the pilot treatment system is demolished during initial LBCR construction.

Existing power transmission lines crossing Pond No. 4 of the existing STI will need to be relocated outside of the LBCR footprint to eliminate interferences during construction and waste consolidation operations. The Coeur d'Alene Trust has been in contact with Avista Utilities to coordinate relocating or raising the lines with the development of the LBCR. Based on preliminary coordination activities, Avista Utilities is currently working on two options for accommodating the LBCR: (1) raise the existing transmission lines or (2) move the transmission line to the west, adjacent to the highway and out of the LBCR footprint. Additional details will be provided in the intermediate LBCR design.

In addition to the existing utilities, new services will be installed to provide electricity from Avista Utilities and possibly communications from Frontier. The personnel, decontamination facilities, and access controls will require electrical power for operations. New utilities and additional details are identified in the design drawings included in Appendix B. As described previously, non-potable and potable water supply will be further assessed during the intermediate design.

4.4 Cover Design

The function of the cover is to minimize infiltration of precipitation water through a waste pile, minimize erosion and sustain plant growth (IDAPA 58.01.06). In addition, the cover must accommodate settlement with minimal post-closure maintenance and monitoring.

The proposed LBCR cover system consists of 2 feet of cover soil (2-inch minus amended growth media) underlain by a 60-mil textured polyethylene (LLDPE) geomembrane liner. The geomembrane will be placed on roller-compacted material with a maximum particle size of 0.5 inches (if possible, screened mine waste and/or tailings will be used to generate this bedding material). Infiltrating surface water will be drained from the cover system by a geocomposite drainage layer placed on the surface of the geomembrane.

The basis for the assumed soil cover thickness of 2-feet includes:

- Provides sufficient rooting depth for a vegetated cover
- Provides sufficient long-term erosion protection for the underlying geosynthetic liner
- Reduces cover soil import volume and cost (i.e., 3-foot thick soil cover would result in greater volume and higher costs to import).

The preliminary volume of cover soil required for the LBCR, placed at two feet thick, is estimated to be approximately 85,000 bcy based on the CAD generated configuration provided on the design drawings (see Appendix B). Cover soil will be imported from an offsite borrow source to the LBCR due to the limited extent of soil material and high metals concentrations in the existing site soils. Amendments such as organic matter and fertilizer will be added as necessary during application of the cover soil layer to support vegetation. The soil will have a course fragment component (greater than 2 millimeter (mm)) to help provide erosion control. In addition, the soil layer will be vegetated with native grasses and shallow-rooted shrubs suited for the LBCR cover soil conditions to provide erosion control, increased soil shear strength, transpiration of soil moisture, and habitat.

A 60-mil thickness was selected for the geomembrane liner to provide increased puncture resistance and tensile strength compared to a 40-mil thick liner. The liner will be textured on each side so that the interface friction angle between the liner and adjacent geocomposite drainage layer is sufficient for application on 3H:1V slopes (see Section 4.5.2 below for further discussion of friction angle requirements). The selected liner material is LLDPE, which has better interface friction and elongation properties than high density polyethylene (HDPE) (important for steep slope applications with settlement potential). LLDPE also has increased flexibility, which provides increased ease of installation and ultimately lower installation costs.

Drainage will be provided by a geocomposite layer (i.e., geogrid wrapped with geotextile) laid on top of the geomembrane. A minimum transmissivity value will be specified in the intermediate design for the drainage layer to maintain free-draining conditions for the cover soils. See Section 4.5.3 below for a detailed discussion of drainage requirements. The geocomposite drainage layer will also serve as a cushion layer above the geomembrane.

Liner cushion material (six to 12-inch layer of roller-compacted material with a maximum particle size of 1 inch) will be placed over waste material as soon as the waste has been consolidated to finished grades to provide a temporary cover the foundation for the permanent cover system in these areas. If deemed necessary, a spray-on soil stabilizer could be used as a temporary cover in areas where additional waste placement will occur. Note that use of a temporary cover may not be warranted, as the development of leachate from the consolidated mine waste is not expected to be significant given that the *Canyon Creek Hydrologic Study* (CH2M Hill 2007) indicates metals loading to Canyon Creek is

minimal from the existing STI. Within the LBCR, this material is expected to produce significantly less metals loading during interim operations given that the material will be compacted, separated from groundwater interaction and stormwater run-on, and potential erosion will be controlled via the use of BMPs.

4.4.1 Cover Puncture Protection Design

To protect the geomembrane from potential puncture, cushion layers will be integrated into the cover system. Over the majority of the LBCR surface, puncture protection below the geomembrane will be provided by the 6-12 inch layer of roller compacted 1-inch minus material topped with a non-woven geotextile fabric, if necessary. The geocomposite drainage layer wrapped with non-woven geotextile will provide puncture protection on top of the geomembrane. If access roads will be constructed on the final LBCR cover, additional puncture protection will likely be required due to added live loading situations. Additional layers of non-woven geotextile and compacted cushion material may be required on either or both sides of the geomembrane. A detailed summary of the puncture protection calculations will be provided in the intermediate design.

4.4.2 Cover Stability Design

This section describes evaluations to be performed to assess minimum interface friction properties to provide adequate cover stability against sliding. The analysis will utilize the limit equilibrium method (Koerner and Soong 2005). Stability depends primarily on the frictional properties (friction angles) between the interfaces of the cover system soil to geocomposite drainage layer, geocomposite drainage layer to geomembrane, and geomembrane to underlying geotextile or geotextile to liner cushion material (i.e., if a geotextile is used) and on the seepage buildup on top of the geomembrane.

Interface friction angle calculations will be performed using friction angle testing results for geosynthetic materials used in similar applications. The critical interface for stability within the cover system typically exists between the geomembrane and the non-woven geotextile fabric that may be installed for puncture protection on both sides of the geomembrane, if necessary. A detailed summary of the cover stability calculations will be provided in the intermediate design.

Stability and interface friction testing will be required for the selected cover system geosynthetic components to verify that they will meet the required FS for the design and will be indicated in the Technical Specifications.

Single intermediate benches will be installed into the final LBCR surface to improve the stability of the finished slopes and provide stormwater conveyance off the LBCR. Slope run lengths will be approximately 120 feet maximum above and below the benches. Benches will create v-ditch channels with 5H:1V and 3H:1V side slopes and will be five feet wide, providing a depth of one foot.

4.4.3 Cover Drainage Layer Design

The purpose of the cover drainage layer is to maintain free draining conditions and to remove infiltrating surface water and direct it to the perimeter drainage ditches. The primary goal is to prevent saturation of the cover soil that can lead to instability.

The maximum rate of water infiltration to be carried by the geocomposite can be conservatively calculated using the unit gradient method (Richardson et al 2000). This method assumes that the cover soil is saturated (i.e., worst-case condition).

The 2-foot layer of 2 inch minus growth media on the surface of the cover system will control infiltration of water through the cover soils and into the geocomposite drainage layer. When the source of the cover soils is identified, permeability tests will be performed on samples of the material and used to estimate the maximum rate of infiltration to design the geocomposite drainage layer. Permeability testing will be performed in accordance with American Society for Testing and Materials (ASTM) standard 5084 D. The drainage layer will be conservatively designed to account for root channels and increased variability (i.e. varying rates of permeability) that may occur within the growth media lift after it is installed. If a borrow source is not identified, the geocomposite drainage layer will be designed using conservative assumptions for permeability that will be verified by testing cover soil when the source is identified. The intermediate design will provide a detailed summary of the drainage layer approach and calculations.

4.4.4 Offsite Borrow Area Identification and Assessment

As described previously, cover soil will be imported from an offsite borrow source to the LBCR due to the limited extent of soil material and high metals concentrations in the existing site soils. The preliminary cover design identifies the need for approximately 85,000 cubic yards of soil material. In addition, the initial access road construction requires approximately 12,000 cubic yards of rock fill material. The identification of a local borrow area for cover soil and rock resources will be critical to the cost-effective construction of the LBCR. Further coordination regarding the identification and assessment of a local borrow area will be completed with Coeur d'Alene Trust and EPA during the intermediate design.

4.5 O&M Considerations

Construction and operations of the repository are key components that will be addressed to ensure that proper techniques and methods are used to construct the repository as designed. Key operational and construction quality assurance components and other long-term O&M activities are addressed in the following sections consistent with EPA guidance.

4.5.1 O&M Considerations and Durability

As described previously, when reviewing the design documents for the O&M portion of the remedy, permanence and durability of the design configuration, equipment, and materials should be considered, especially for remedies that will be operated for a long time. Ease and efficiency of performing O&M is also critical.

As described in this BDR, the LBCR cover configuration was developed to reduce the level of O&M required via the use of erosion control features (i.e., growth media and seeding, straw bales, and fiber rolls) and run-on/runoff control features to reduce erosion and manage stormwater. These features will require periodic O&M.

4.5.2 O&M Cost Estimate

As part of the design, an O&M cost estimate is typically developed. This estimate, which is refined as the design becomes more complete, normally includes the costs of the operating labor, materials, energy, purchased services, administrative costs, insurance, and contingency. The O&M cost estimate should be sufficiently detailed with contingencies clearly noted. The implementation schedule and specific activities for full-scale O&M are currently unclear. For example, the timing for construction of the permanent LBCR cover (cover soils and geosynthetics) is uncertain. Accordingly, full-scale O&M

costs are not provided in the preliminary (30 percent submittal) RA cost estimate. Development of an O&M cost estimate will be completed during the pre-final RD.

4.5.3 Operation and Maintenance Manual

In accordance with the Statement of Work (EPA 2011) and EPA guidance (EPA 2001a), O&M components will be identified in the draft O&M manual that will be developed during the pre-final design (90 percent submittal).

The purpose of the O&M manual is to describe inspection; sampling, monitoring and analysis; routine operation and maintenance; and reporting procedures at the LBCR to ensure the long-term effectiveness of the remedial action (RA). Periodic inspection and maintenance of LBCR features installed during the RA (i.e., repository covers, ground water monitoring, etc.) is essential for maintaining the protectiveness of these features. As described in EPA guidance (EPA 1995), the draft O&M Manual will be developed during the RD to provide the intent of the design components (e.g., stormwater run-on control channels) during operation and the anticipated inspection O&M procedures. However, the report will be provided as a draft because it should be updated and revised following completion of the RA to incorporate specific information from the RA Contractor and reflect as-built conditions of the LBCR. The Draft O&M manual will be prepared to provide the following information:

- Description of the design intent regarding facility operation;
- Description of normal operation and maintenance conditions, tasks, and schedule.
- Description of potential operating problems and anticipated remedies.
- Quality assurance tasks including description of location and rationale for monitoring points, routine monitoring tasks, required laboratory tests, and required data collection reporting requirements.
- Description of alternative procedures to prevent releases or threatened releases and potential corrective actions to be implemented in the event that cleanup or performance standards are exceeded
- Safety requirements, tasks, and procedures to be used during O&M activities
- Description of installed equipment and monitoring components
- Records and reporting mechanisms

Regarding QA and safety procedures, the O&M manual will reference Coeur d'Alene Trust programmatic documents that are currently used to support monitoring activities (MFA 2012a,b). O&M activities are typically "initiated after the remedy has achieved the remedial action objectives and remediation goals in the ROD (Record of Decision), and is determined to be operational and functional" (EPA 2001). For containment remedies such as the LBCR, O&M typically begins following final cover installation. As described previously, the schedule for final cover installation is uncertain but it will likely be constructed in phases as part of the full scale LBCR development (e.g., post 2015).

4.5.4 Coordination with Interim Operations

Given that the LBCR will be constructed in a phased approach, there will be operations of the area over several years to consolidate mine waste from various sites within Canyon Creek and other waste materials; this work is referred to as interim operations. Interim operations differ significant from long-term O&M activities that will be conducted following final cover installation.

The design specifications require that the RA Contractor prepare pre-construction submittals to provide detailed information on construction implementation. Pre-construction submittals will be reviewed and approved by the Coeur d'Alene Trust prior to construction activities. For example, the RA Contractor is required to provide an environmental protection plan (EPP) describing how pollution and erosion controls will be implemented during construction to satisfy specification requirements. Similarly, to support interim operations, the RA Contractor will be required to submit an operations plan prior to 2015 waste consolidation activities at the LBCR. It is anticipated that the LBCR operations plan will be similar in scope to operation plans currently being implemented at the East Mission Flats (EMF) repository and the Big Creek repository (BCR)(TG 2009). The LBCR operations plan will describe waste acceptance and consolidation operations, vehicle decontamination, stormwater and erosion control activities and best management practices (BMP), road maintenance, dust control, and general cleanup.

4.5.5 Other Long-Term O&M Activities

CERCLA and the National Oil and Hazardous Substances Pollution Contingency Plan require that RAs that result in any hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure be reviewed every 5-years to ensure protection of human health and the environment. The Coeur d'Alene Trust and EPA will coordinate the 5-year review process for the BHSS in accordance with EPA guidance (EPA 2001c).

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Section 5

Contract Documents

The section presents information on the preliminary drawings and specifications provided in Appendices B and L, respectively.

5.1 Intermediate Construction Drawings

The preliminary (30%) Construction Drawings for development activities at the LBCR are provided in Appendix B. As shown on Sheet G1 of the full-scale development plans, the design includes drawings for the following phases of repository construction:

- **LBCR Initial Construction and Phase 1 Consolidation (2014-2015):** Drawings for the initial construction and Phase 1 consolidation show construction of the main LBCR access point, the decontamination and personnel facilities, access roads and controls, temporary stormwater controls, and consolidation of approximately 80,000 bcy of mine waste material. It is anticipated that the waste materials will come from the Hecla Star Complex at this time. These drawings will be completed to 100 percent and are anticipated to be released for bid in the winter 2013/spring 2014.

- **LBCR Full-Scale Development (Beyond 2016):** Drawings for the full-scale construction/consolidation phases show consolidation of approximately 816,000 bcy of mine waste over 11 phases, full-scale/final access roads and controls, and full-scale/final stormwater controls. These drawings were developed for full-scale repository development and planning and will not be developed past the 60 percent completion until the RD of the next Canyon Creek Basin source site is initiated. The drawings will be revised/updated for subsequent phases of mine waste consolidation at the LBCR.

5.2 Draft Specifications

The Coeur d'Alene Trust has developed a base set of specifications for use on multiple construction projects within the Coeur d'Alene basin (programmatic approach). The base specifications are provided in Appendix K. For each project, such as the LBCR, the base specifications will be supplemented by a Statement of Work that provides information on the specific construction activities and additional specifications that may be required to complete the specific construction project. The draft Statement of Work for the LBCR initial construction phase will be included in the intermediate design. LBCR project-specific specifications will be provided as part of the pre-final design submittal, but a preliminary list of project-specific specifications includes:

- Asphalt
- Signage
- Precast Concrete Barriers, Wheel Stops, and Blocks
- Guardrails

- Fencing
- Electrical Systems
- Decontamination Well
- Availability and Use of Utility Services
- Installation of Facilities (Employee Building, Decontamination Pad)

5.3 Construction Quality Assurance & Monitoring

As part of the pre-final design submittal (90 percent design), a draft construction quality assurance plan (CQAP) and construction monitoring plan (CMP) will be developed consistent with EPA guidance (EPA 1993) and the Statement of Work (EPA 2011).

5.3.1 Construction Quality Assurance Plan

The CQAP will describe the quality assurance (QA) tests necessary to ensure that proper construction techniques and procedures are used during LBCR construction and to verify that the materials used and the installations of those materials comply with the design drawings and technical specifications (Construction Documents). The tests are used to provide quantitative criteria with which to accept the LBCR construction. Construction QA is the responsibility of the Coeur d'Alene Trust and will be implemented by the Trust's construction management team. The CQAP generally provides the following information:

- Lines of authority and responsibility for key personnel involved in the EFNM WCA construction
- Construction QA personnel qualifications
- List of inspection activities including the summary, scope, and frequency of the tests and observations used to monitor LBCR construction and verify compliance with environmental requirements and customary construction practices and safety requirements.
- List of sampling requirements construction QA activities including daily summary reports and inspection data sheets.
- Documentation requirements for reporting including inspection data sheets, problem identification and corrective measures reports, and final documentation and records storage.

This CQAP will be developed to be consistent with EPA guidance for QA procedures at waste containment facilities (EPA 1993). The CQAP does not establish construction requirements; construction requirements are established by the plans and specifications. The criteria for acceptance will be as defined in the construction documents (plans and specifications). The CQAP does not establish procedures to control or guide the operations of the manufacturer of materials or the contractor or relieve them of their contractual responsibility to set up the necessary procedures and controls within their organizations to produce the quality of work called for in the plans and specifications. This CQAP is not intended to function as or to replace the contractor's quality control program. The contractor shall develop a quality control plan defining the construction quality control (CQC) activities as required in specification Section 01451 (Contractor Quality Control). That plan is a

pre-construction submittal and will be reviewed and approved by the Coeur d'Alene Trust prior to any construction activities at the LBCR.

5.3.2 Construction Monitoring Plan

The purpose of a construction monitoring plan (CMP) is to describe construction oversight and monitoring procedures at the LBCR to ensure the long-term effectiveness of the RA. As described previously, the CQAP identifies the quality assurance (QA) tests necessary to ensure that proper construction techniques and procedures are used during LBCR construction and to verify that the materials used and the installations of those materials comply with the design drawings and technical specifications (Construction Documents). Accordingly, the CMP will be developed to describe construction elements requiring environmental monitoring, specifically those monitoring elements not described in the CQAP. Routine oversight during construction of the LBCR and RA activities is essential for achieving long term RAOs. The CMP will be developed as a draft because it should be updated and revised to incorporate specific information from the RA Contractor. The Draft CMP will be prepared to provide the following information:

- Environmental monitoring procedures to be performed in conjunction with the RA Contractor's Environmental Protection Plan (EPP).
- Data sampling protocols and analytical procedures to be performed in conjunction with the RA Contractor's EPP.
- Alternative procedures activities and resource requirements to prevent releases or threatened releases of hazardous substances, pollutants or contaminants should systems or processes fail.
- Corrective actions to be implemented in the event that construction standards are not met.
- Description of installed equipment and maintenance requirements.

Upon selection of a RA Contractor, the contractor will develop an EPP describing how pollution and erosion controls will be implemented during construction to satisfy specification requirements. The EPP will be reviewed and approved by the Coeur d'Alene Trust and incorporated into the CMP prior to commencement of construction activities. The LBCR will be conducted in a phased approach, requiring the contractor's EPP and CMP to be updated on an as-needed basis.

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Section 6

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Tables

Table 3-1
Remedial Action Objectives (RAOs)

Human Health	Remedial Action Objective(s)
Soil/Sediments/Source Materials	Reduce human exposure to soil, sediments, and source materials, including residential yard soil, that have concentrations of COCs greater than selected risk-based levels for soil.
Surface Water	Restore surface water designated as beneficial use for drinking water to meet drinking water and water quality standards. Prevent ingestion of surface water used as drinking water and containing COCs exceeding drinking water standards and associated risk-based levels for drinking water. Prevent discharge of seeps, springs, and leachate that would cause surface water to exceed drinking water and water quality standards.
Aquatic Food Sources	Prevent human exposure to unacceptable levels of COCs via ingestion of aquatic food sources (e.g., fish and water potatoes).
Ecological Receptors	**Remedial Action Objective(s)**
Ecosystem Physical Structure and Function	Reduce COCs in soil, sediments, and surface water to support a functional ecosystem for aquatic and terrestrial plant and animal populations (including, but not limited to, waterfowl, riparian songbirds, and other species protected under the Endangered Species Act, the Fish and Wildlife Conservation Act, and the Migratory Bird Treaty Act) in the Upper Basin.
Soil/Sediments/Source Materials	Reduce risks from COCs in soil, sediments, and source materials to acceptable exposure levels that are protective of ecological receptors. Reduce transport and deposition into surface water and groundwater of COCs from soil, sediments, and source materials at concentrations above levels that are protective of ecological receptors.
Surface Water	Reduce risks from COCs in surface water in the Upper Basin to acceptable exposure levels that are protective of ecological receptors.
Mine Water, including Adits, Seeps, Springs, and Leachate	Reduce discharge to surface water of mine water, including adits, seeps, springs and leachate, containing COCs at concentrations that cause surface water to exceed levels protective of ecological receptors.
Groundwater	Reduce discharge to surface water of groundwater containing COCs at concentrations that cause surface water to exceed levels protective of ecological receptors.

Notes:
1. RAOs from ROD Amendment, Section 8, EPA, 2012

Table 3-2
Threatened and Endangered Species Review

Federal Listed Species with Potential to Occur in Shoshone County, Idaho			
Species	**Status**	**Habitat Requirements**	**Likelihood of Occurrence**
Fish			
Bull Trout (*Salvelinus confluentus*)	FT, CH	Cold headwater lakes and streams and rivers that drain high mountainous areas. Critical habitat occurs in the Coeur d'Alene River Basin in Shoshone County.	Not present; no suitable habitat.
Mammals			
Canada lynx (*Lynx canadensis*)	FT	Montane coniferous forests. Highly dependent on the snowshoe hare (*Lepus americanus*) for food, which prefer diverse, early successional forests with dense stands of conifers and shrubby understories.	Low potential to occur in suitable habitat.
Wolverine *(Gulo gulo)*	FC	Found in a wide variety of high elevation habitats. Needs water source. Uses caves, logs, burrows for cover and den area. Hunts in more open areas. Can travel long distances.	Low potential to occur in suitable habitat.
Plants			
Water howellia (*Howellia aquatilis*)	FT	Restricted to small pothole ponds or orphaned river oxbows that are generally less than 3 feet deep, but occasionally up to 6 feet deep. Ponds are typically in a matrix of dense forest vegetation, and are nearly always surrounded by broadleaf deciduous trees. Bottoms of wetlands contain clay and organic sediments. Habitats are filled by snowmelt run-off and spring rains, and then dry out to varying degrees by the end of the growing season.	Not present; no suitable habitat.
Whitebark pine (*Pinus albicaulis*)	FC	Occur only at high elevation forests from 3,600 - 9,500 feet.	Potential to occur in suitable habitat.
Spaulding's catchfly (*Silene spaldingii)*	FT	Open grasslands with a minor shrub component and occasionally with scattered conifers. Found most commonly in the Idaho fescue/snowberry association at elevations of 1900-3050 feet.	Not present; no suitable habitat.

Source: USFWS Federal Listed Species by County, Idaho Fish and Wildlife Office, revised September 6, 2012.

Federal Protection
FT – Federal Threatened (listed)
FC – Federal Candidate
CH – Designated Critical Habitat (Federal) occurs in the County

Figures

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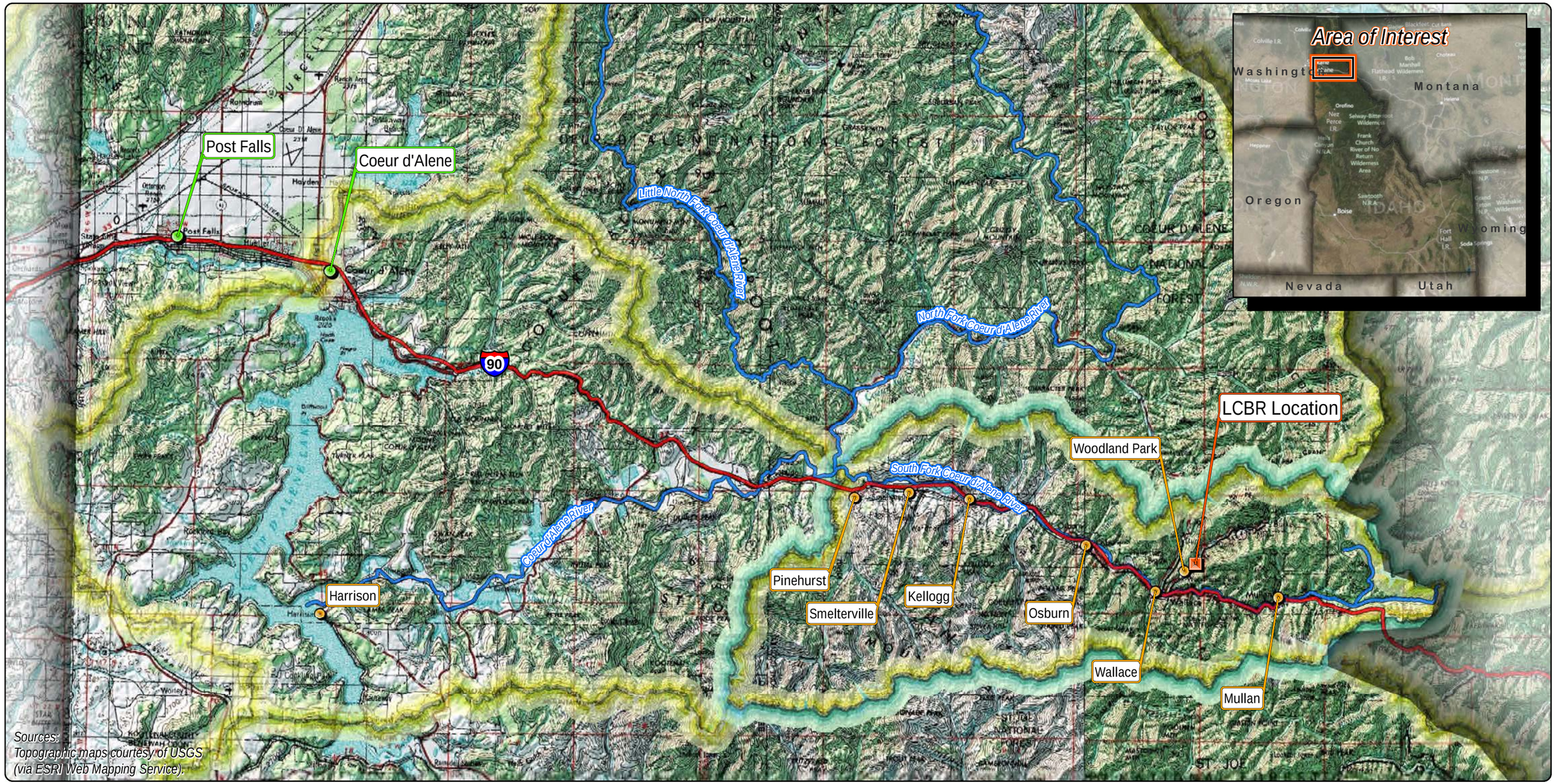

Figure 1-1
Site Location

Lower Burke Canyon Repository
Shoshone County, Idaho

LBCR Site Location
City
Town
Interstate
Site Watershed
Watershed Boundary
River

0 5 10 15
Miles

N W E S

CDM Smith

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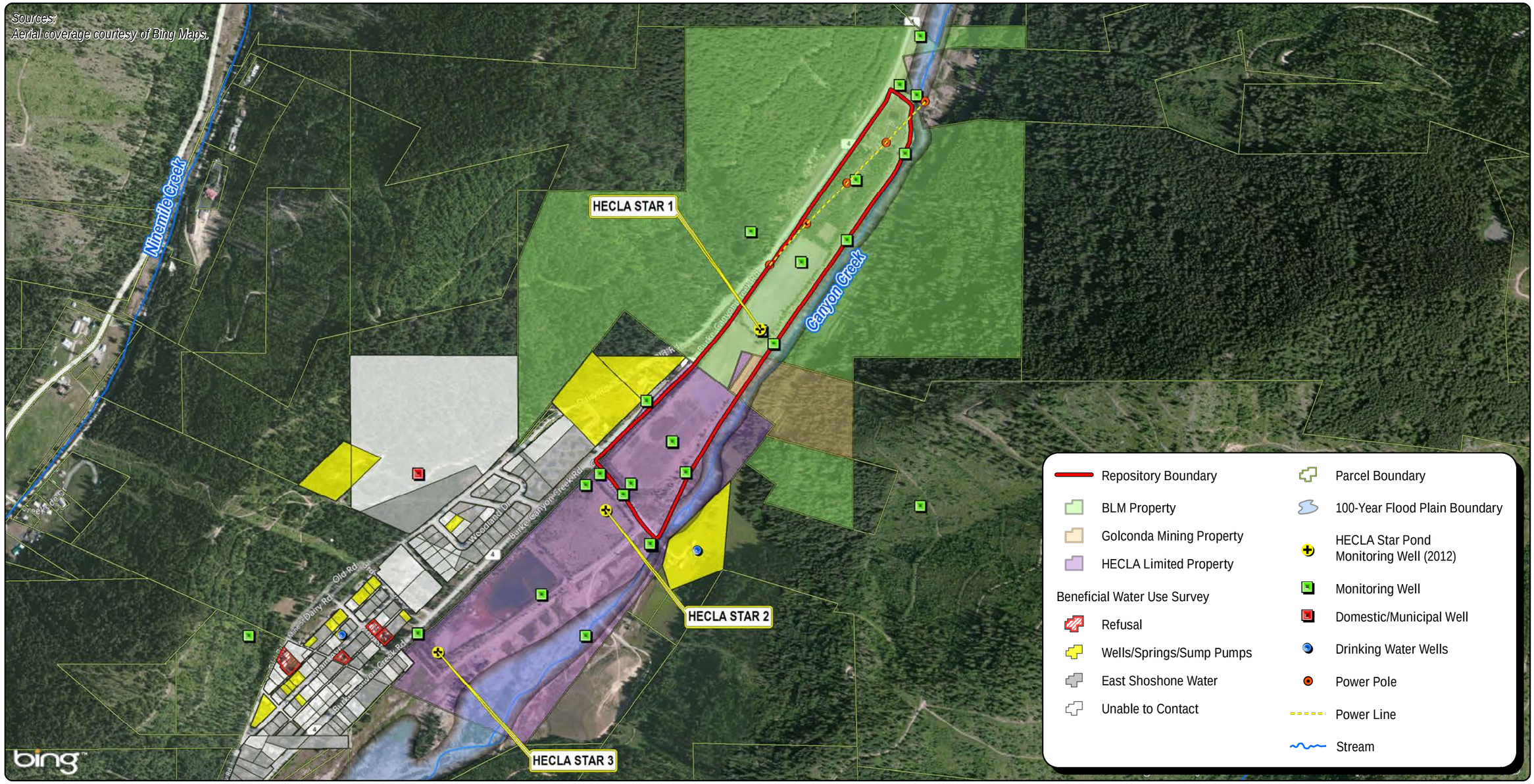


Figure 2-1
LBCR Site Details Map
Coeur d'Alene Trust

Lower Burke Canyon Repository
Shoshone County, Idaho

0 1,000 2,000 3,000
Feet

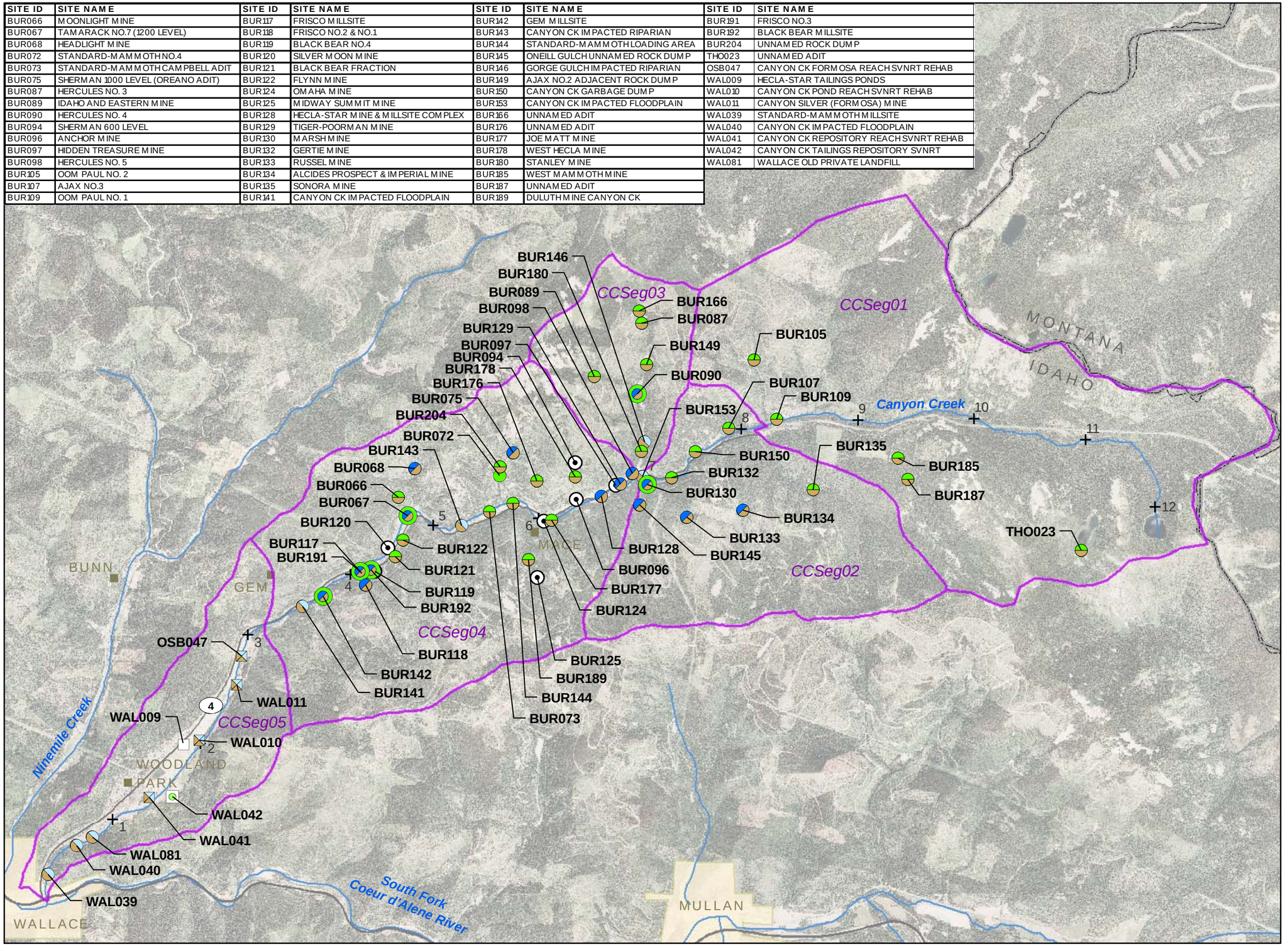
N
W E
S

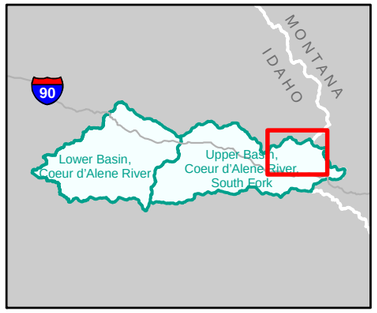
CDM Smith

Appendix A

Existing Reference Figures

SITE ID	SITE NAME	SITE ID	SITE NAME	SITE ID	SITE NAME	SITE ID	SITE NAME
BUR066	MOONLIGHT MINE	BUR117	FRISCO MILLSITE	BUR142	GEM MILLSITE	BUR191	FRISCO NO.3
BUR067	TAMARACK NO.7 (1200 LEVEL)	BUR118	FRISCO NO.2 & NO.1	BUR143	CANYON CK IMPACTED RIPARIAN	BUR192	BLACK BEAR MILLSITE
BUR068	HEADLIGHT MINE	BUR119	BLACK BEAR NO.4	BUR144	STANDARD-MAMMOTH LOADING AREA	BUR204	UNNAMED ROCK DUMP
BUR072	STANDARD-MAMMOTH NO.4	BUR120	SILVER MOON MINE	BUR145	ONEILL GULCH UNNAMED ROCK DUMP	THO023	UNNAMED ADIT
BUR073	STANDARD-MAMMOTH CAMPBELL ADIT	BUR121	BLACK BEAR FRACTION	BUR146	GORGE GULCH IMPACTED RIPARIAN	OSB047	CANYON CK FORMOSA REACH SVNRT REHAB
BUR075	SHERMAN 1000 LEVEL (OREANO ADIT)	BUR122	FLYNN MINE	BUR149	AJAX NO.2 ADJACENT ROCK DUMP	WAL009	HECLA-STAR TAILINGS PONDS
BUR087	HERCULES NO. 3	BUR124	OMAHA MINE	BUR150	CANYON CK GARBAGE DUMP	WAL010	CANYON CK POND REACH SVNRT REHAB
BUR089	IDAHO AND EASTERN MINE	BUR125	MIDWAY SUMMIT MINE	BUR153	CANYON CK IMPACTED FLOODPLAIN	WAL011	CANYON SILVER (FORMOSA) MINE
BUR090	HERCULES NO. 4	BUR128	HECLA-STAR MINE & MILLSITE COMPLEX	BUR166	UNNAMED ADIT	WAL039	STANDARD-MAMMOTH MILLSITE
BUR094	SHERMAN 600 LEVEL	BUR129	TIGER-POORMAN MINE	BUR176	UNNAMED ADIT	WAL040	CANYON CK IMPACTED FLOODPLAIN
BUR096	ANCHOR MINE	BUR130	MARSH MINE	BUR177	JOE MATT MINE	WAL041	CANYON CK REPOSITORY REACH SVNRT REHAB
BUR097	HIDDEN TREASURE MINE	BUR132	GERTIE MINE	BUR178	WEST HECLA MINE	WAL042	CANYON CK TAILINGS REPOSITORY SVNRT
BUR098	HERCULES NO. 5	BUR133	RUSSEL MINE	BUR180	STANLEY MINE	WAL081	WALLACE OLD PRIVATE LANDFILL
BUR105	OOM PAUL NO. 2	BUR134	ALCIDES PROSPECT & IMPERIAL MINE	BUR185	WEST MAMMOTH MINE		
BUR107	AJAX NO.3	BUR135	SONORA MINE	BUR187	UNNAMED ADIT		
BUR109	OOM PAUL NO. 1	BUR141	CANYON CK IMPACTED FLOODPLAIN	BUR189	DULUTH MINE CANYON CK		





- River Mile
- River/Creek
- City Limit
- State Boundary
- Watershed Segment

Remedial Action Types:

- Cap/Hydraulic Isolation
- Cap
- Excavation/Cap
- Excavation/Cap/Local Waste Consolidation Area
- Excavation/Local Waste Consolidation Area
- Excavation/Regional Repository
- Excavation/Regional Repository; Hydraulic Isolation
- Hydraulic Isolation
- Regrade/Consolidate/Revegetate
- **BUR187** (Site ID)

N

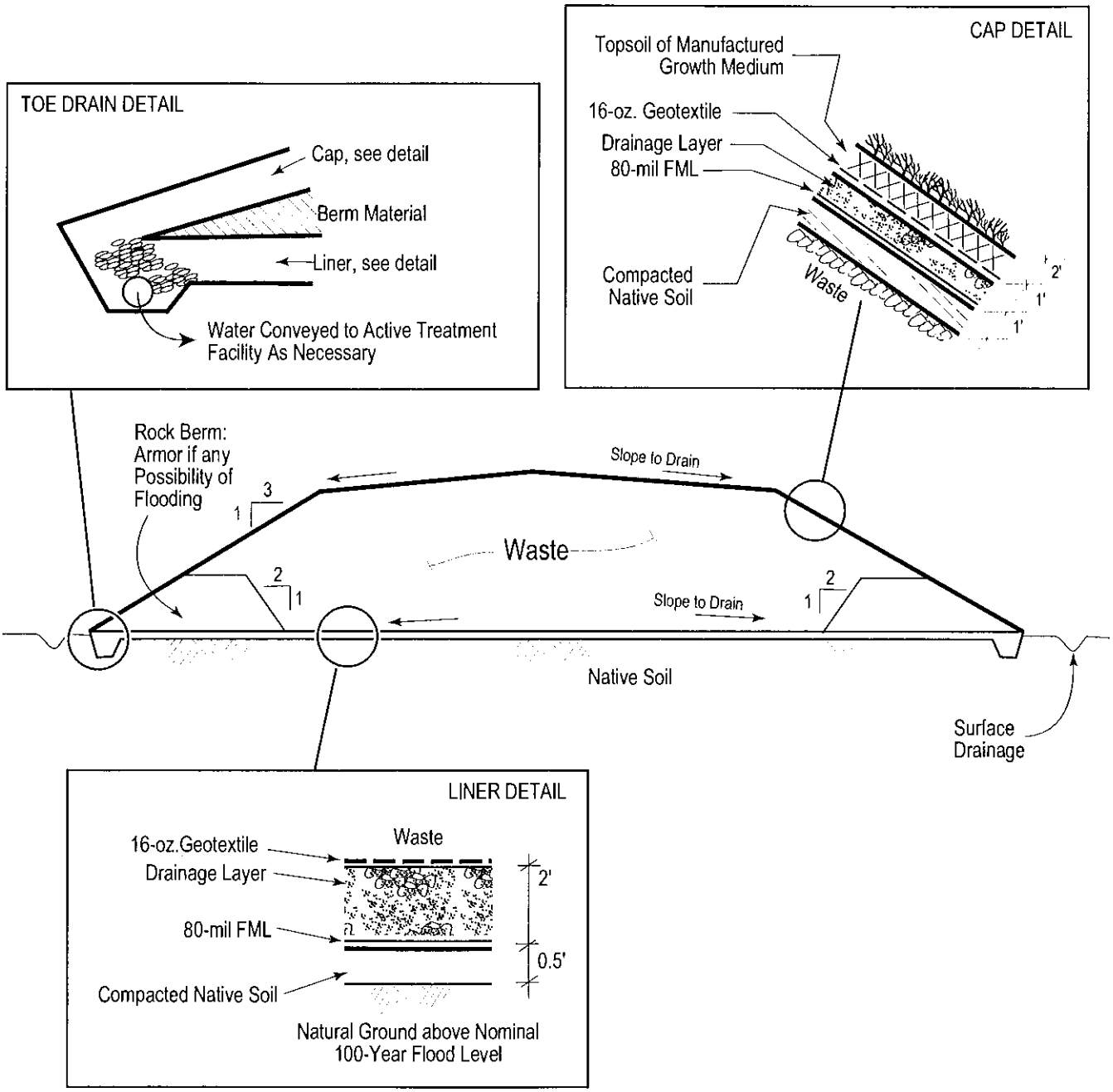
0 1,500 3,000 6,000 Feet

Source: NHDPlus (Rivers, Waterbodies); ESRI base data (Interstates 2006, Major Highways 2008); IDWR (Aerial Imagery 2006).

Figure 7-3
Overview of Remedial Actions, Alternative 3+, Canyon Creek Watershed
Focused Feasibility Study
Upper Basin of the Coeur d'Alene River
BUNKER HILL SUPERFUND SITE

EPA

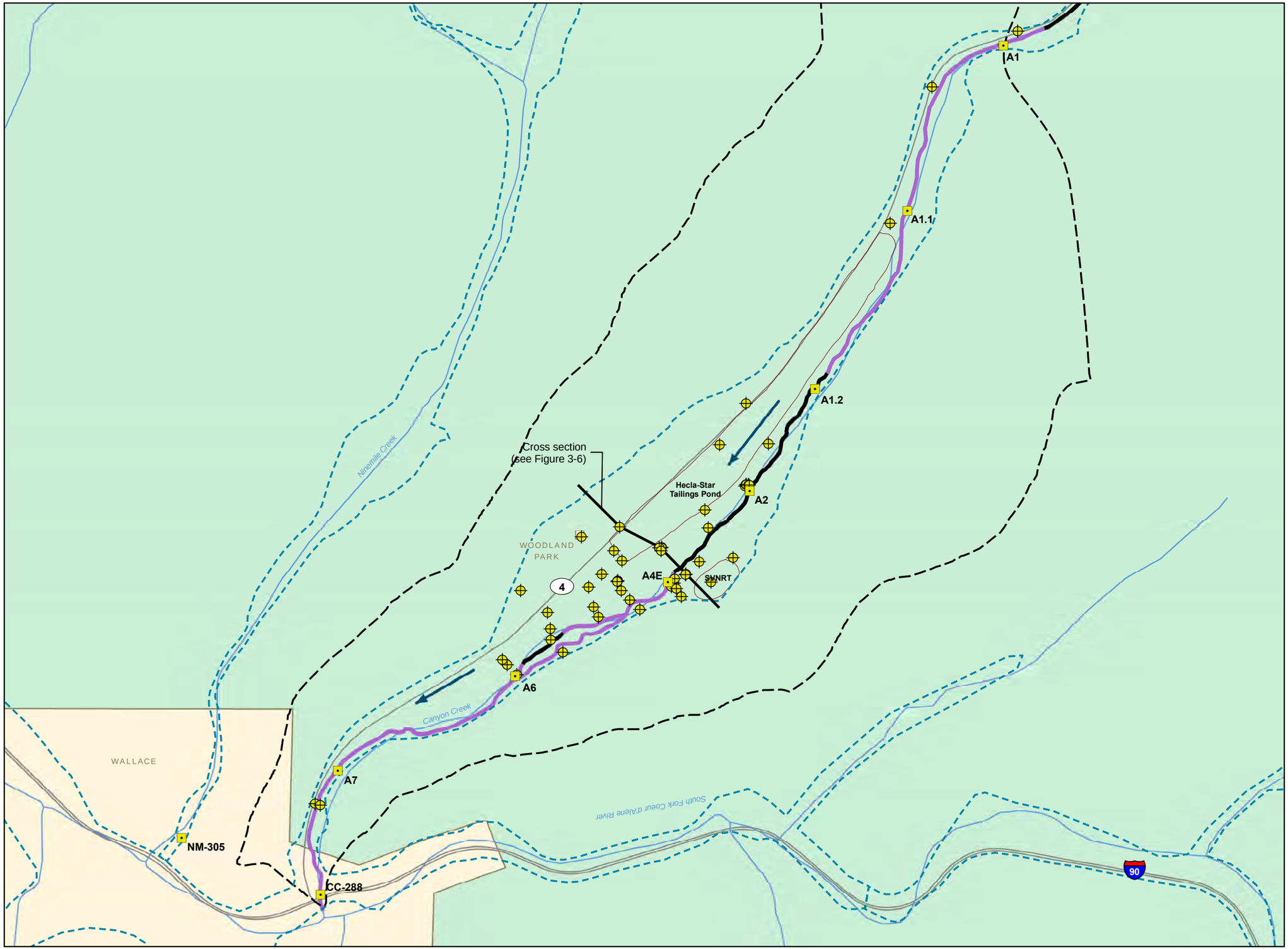
BOI \\CASTAIC\PROJ\EPA\CDABASIN_382081\GIS\MAPFILES\OU3\UPPERBASIN\FFS_SEC7_FIG07-03_CC_ALT3.MXD MHEADLEY 1/11/2010 21:12:58

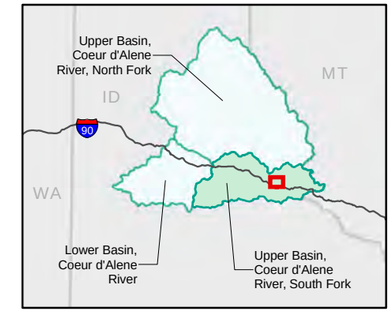


Note: This typical conceptual design (TCD) was developed for feasibility-level alysis of remedial alternatives. Actual designs would be developed during nedial design based on the selected remedy and site-specific conditions and requirements.

NOT TO SCALE

Figure C-8
Repository, TCD C08a
Focused Feasibility Study
Upper Basin of the Coeur d'Alene River
BUNKER HILL SUPERFUND SITE





Groundwater Monitoring Location
CC-288 Surface Water Monitoring Location
Approximate Groundwater Flow Direction, Base-Flow Conditions
SFCDR Primarily Gaining Reach
SFCDR Primarily Losing Reach
Cross Section
River/Creek
Major Highway
Approximate Alluvial Aquifer
Woodland Park Study Boundary
Contaminant Sources
Focused Feasibility Study Area
City Limit

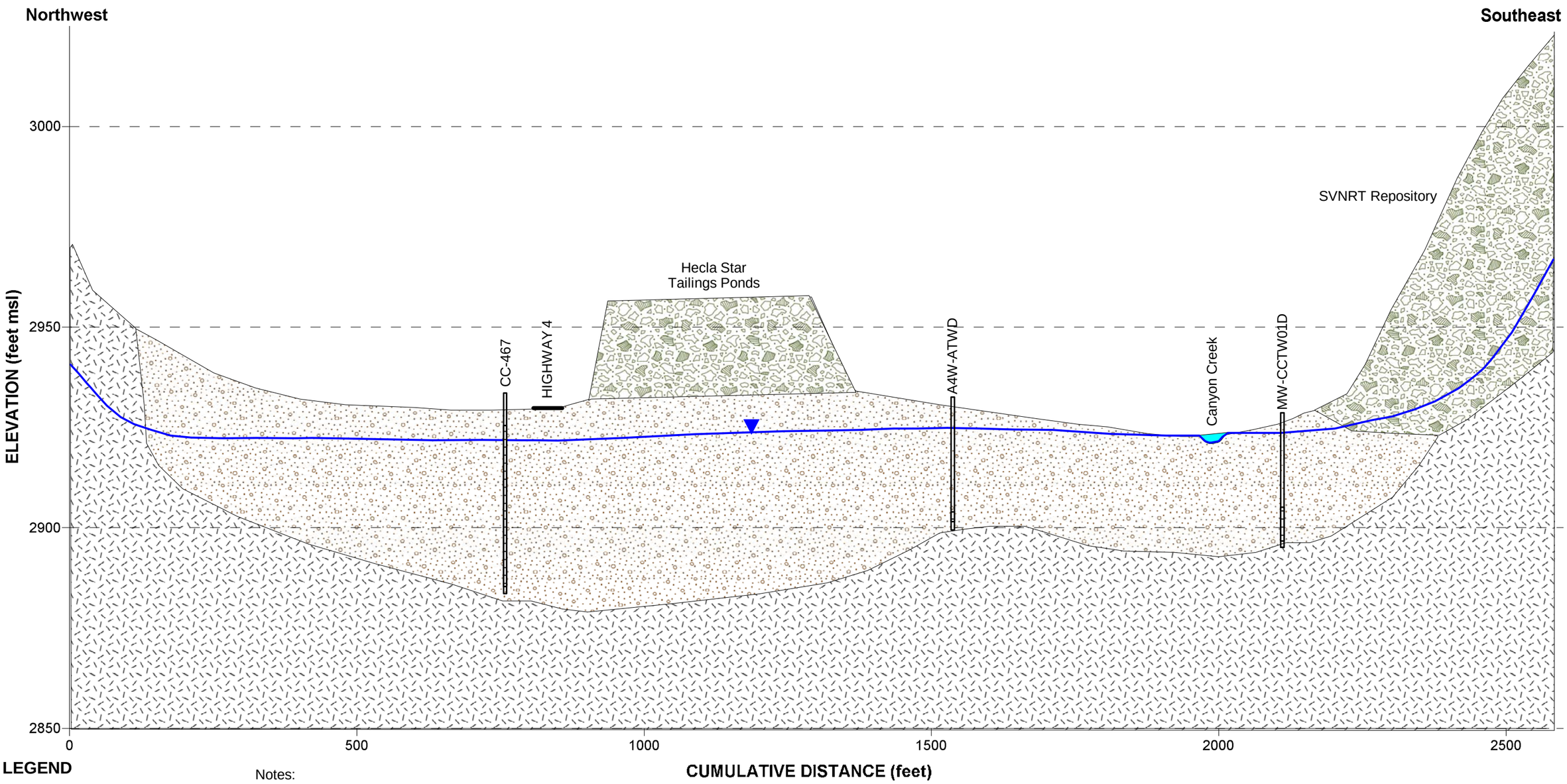
N
0 500 1,000 2,000 Feet

Source: NHDPlus (Hydrography, 2005); ESRI (Roads, Jurisdicitional Boundaries, 2006).

Notes:
1. Gaining and losing reaches were determined from base-flow numerical simulation results, and are presented as approximate conditions during base-flow conditions.
2. For cross section detail, see Figure 3-6.

Figure 3-5
Hydrogeology – Woodland Park
Focused Feasibility Study
Upper Basin of the Coeur d'Alene River
BUNKER HILL SUPERFUND SITE

EPA



LEGEND

- Contaminated Fill
- Alluvial Silty Gravel with Sand
- Bedrock
- Well Screen

Notes:

1. Contact between fill material and alluvial sediment is inferred.
2. A layer of tailings mixed with alluvium mantles the majority of the Canyon Creek floodplain in Woodland Park except where removal actions have occurred. This layer is not depicted on this figure.
3. This cross section is strictly conceptual, and monitoring wells are shown for reference only.
4. Cross section location is shown on Figure 3-5.

Scale 7:1 (V:H)
1 inch = 25 feet vertical

Figure 3-6
Cross Section – Woodland Park
Focused Feasibility Study
Upper Basin of the Coeur d'Alene River
BUNKER HILL SUPERFUND SITE

EPA

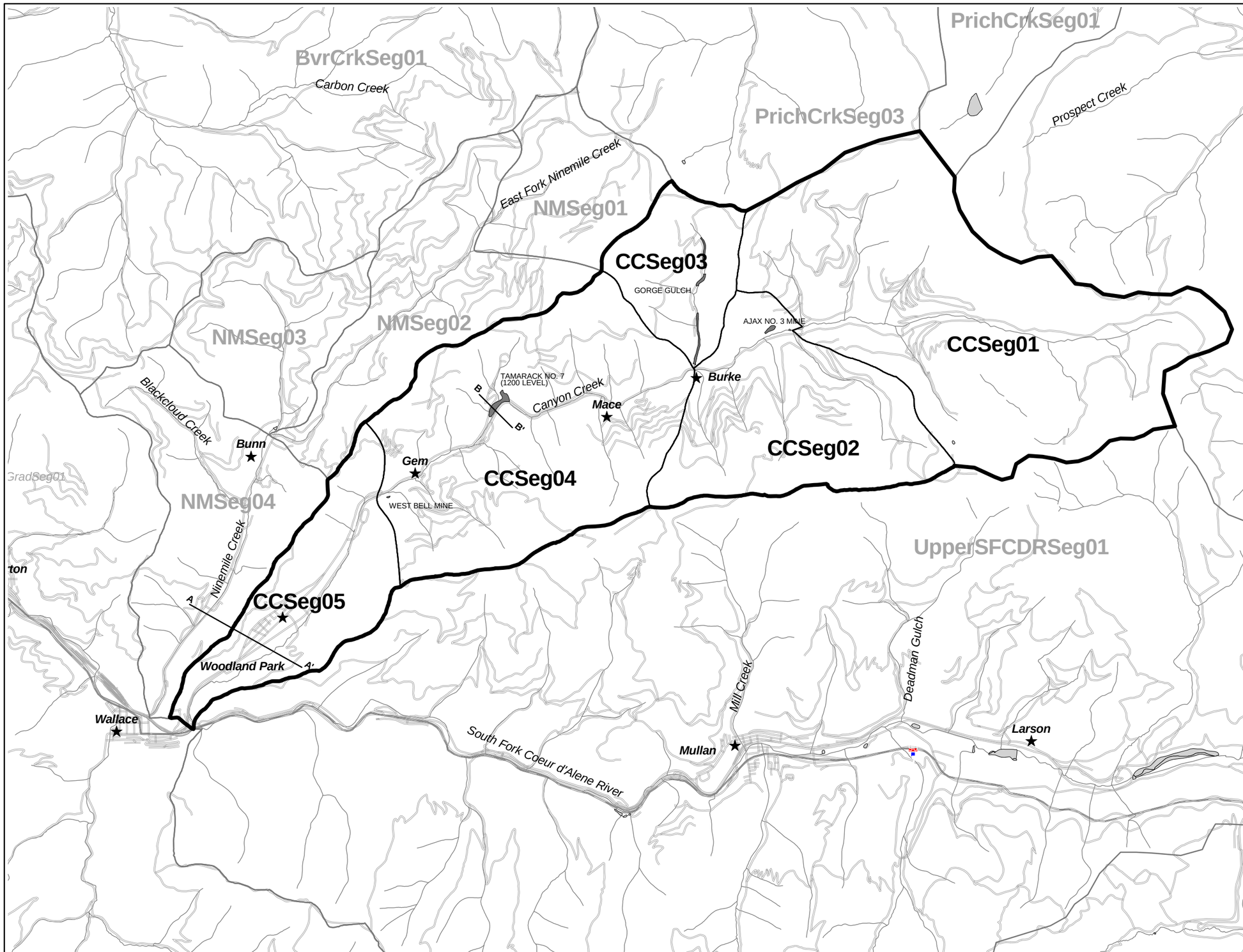
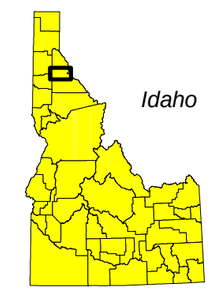


Figure 1.1-1
Canyon Creek Watershed

LEGEND

- Stream
- Road
- Interstate 90
- City
- Canyon Creek Watershed
- Canyon Creek Segment
- River Segment
- Lake/River
- A___A' Geologic Cross-Section



Location Map

NOTES

1) Base map coverages obtained from the Coeur d'Alene Tribe, URS Greiner Inc., CH2M HILL, and the Bureau of Land Management.

N

SCALE 1:48,000

0.5 0 0.5 Miles

027-RI-C0-102Q
Coeur d'Alene Basin RI/FS
RI REPORT

EPA REGION 10

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V:Canyon Creek
E: Watershed
L: Final RI Canyon Creek
7/19/2001
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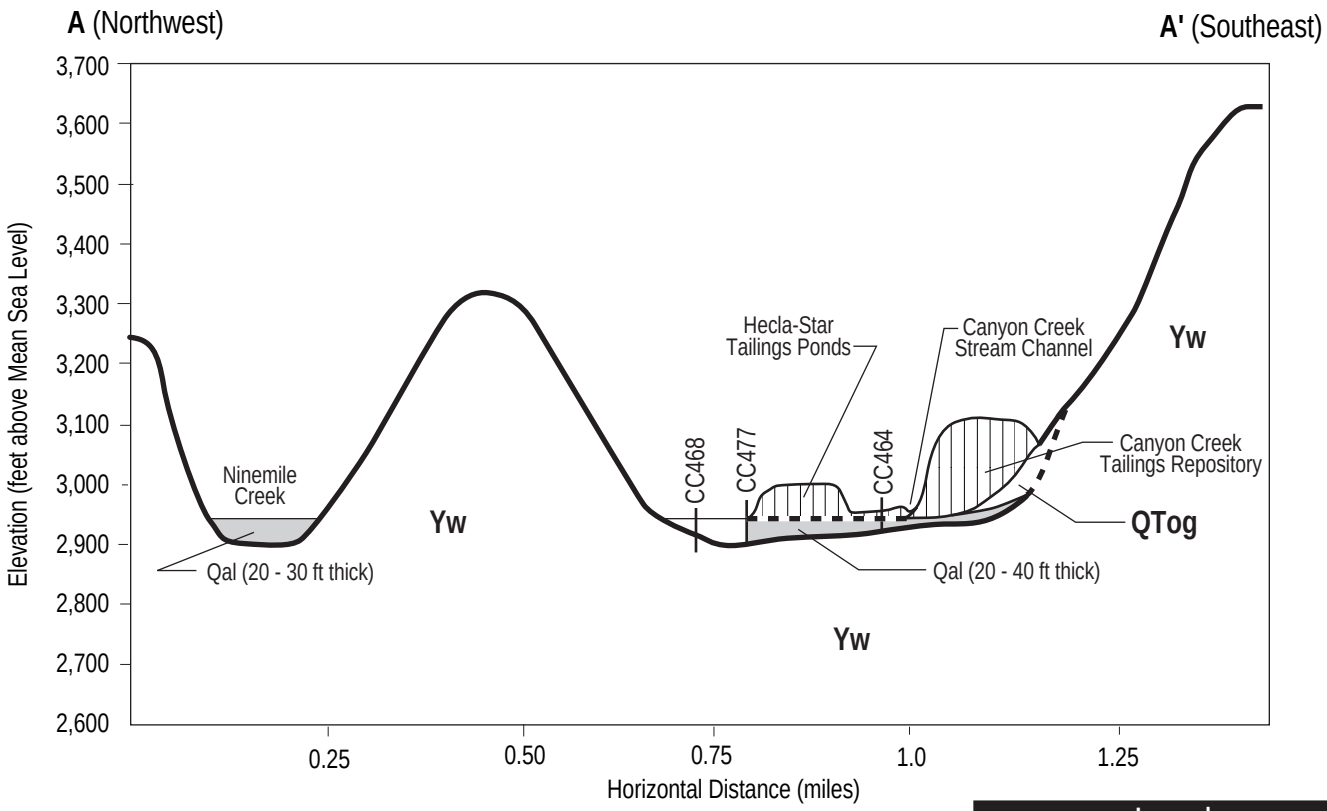
Date of Plot: July 19, 2001



Legend

Qal - Alluvium and Tailings

QTog - Channel and Terrace Gravels

Yw - Wallace Formation, Belt Supergroup

- Geologic Contact, Dashed Where Approximated

CC477 - Groundwater Monitoring Well

Vertical Exaggeration = 4x

EPA REGION 10

027-RI-CO-102Q
Coeur d'Alene Basin RI/FS
RI REPORT

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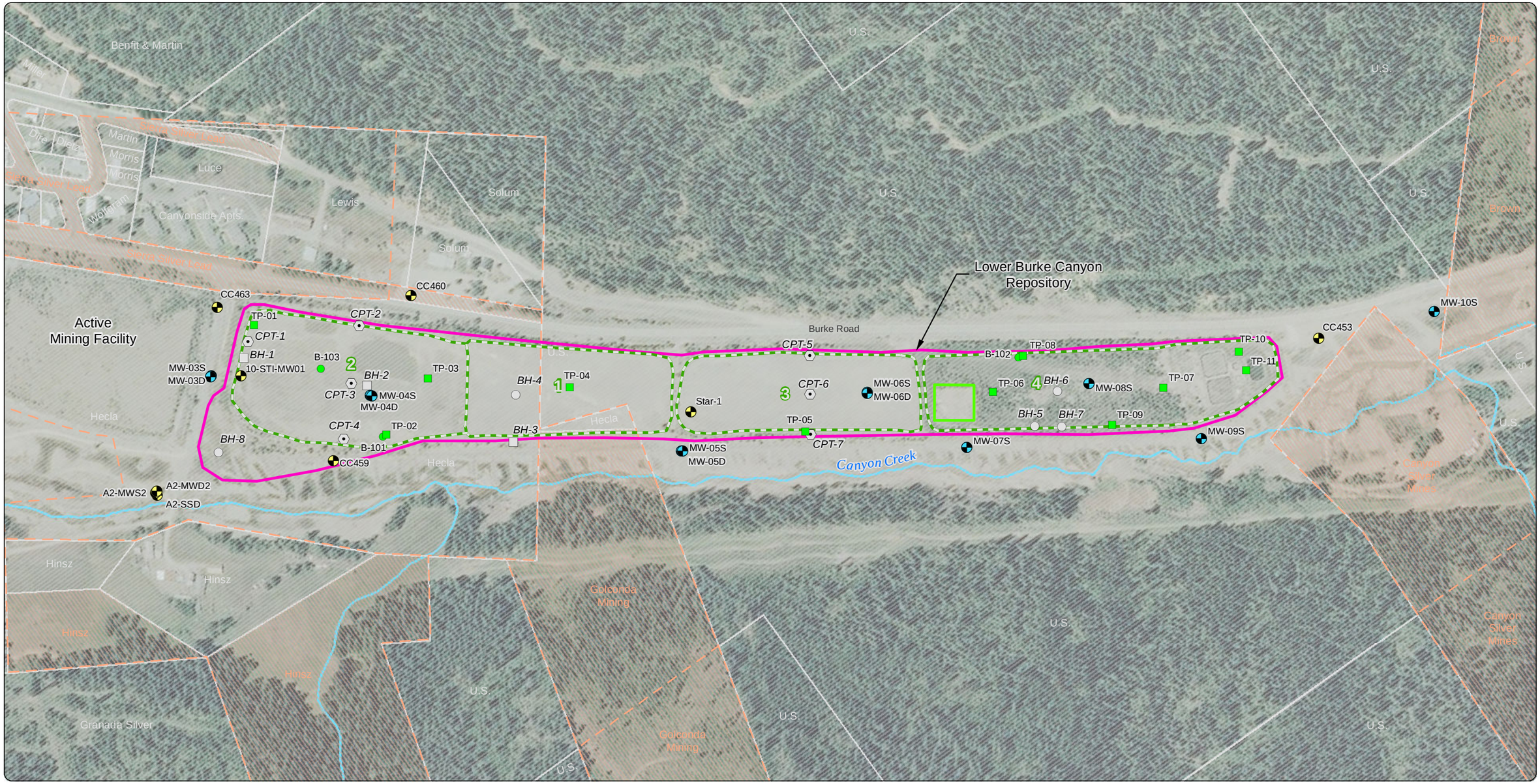
Figure 2.1-1
Geologic Cross Section A-A'



Source: Aerial photograph obtained from ESRI, Inc. ArcGIS Online/BingMaps; Parcels datasets (April 2012) obtained from Shoshone County Assessor's office; streams dataset generated using ArcGIS 10.0 Spatial Analyst toolset and a 2009 LiDAR Digital Elevation Model obtained from USEPA. Historical Sample locations obtained from TerraGraphics, Inc.

Notes:
1. Mining claim parcels are shown where there are gaps in the surface parcel data layer only, and may extend below depicted surface parcel ownership, below surface.

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This product is for informational purposes and may not have been prepared for, or be suitable for legal, engineering, or surveying purposes. Users of this information should review or consult the primary data and information sources to ascertain the usability of the information.

Legend

- Stream
- Monitoring Well Location (Trust 2012)
- Existing Monitoring Well Location

Historical Sample Location
- Boring Location
- Cone Penetration Location
- Test Pit Location

2012 Sample Locations
- Boring Location
- Test Pit Location

- Repository Boundary
- Historical Tailing Pond Number and Boundary (Approximate)
- Possible Exposed Tailings
- Hecla — Parcel Boundary
- Hinsz — Mining Claim Parcel

DRAFT

Figure 1-2
Site Features and Investigation Locations
Lower Burke Canyon Repository

Coeur d'Alene Trust
Canyon Creek Basin, Idaho

0 175 350
Feet

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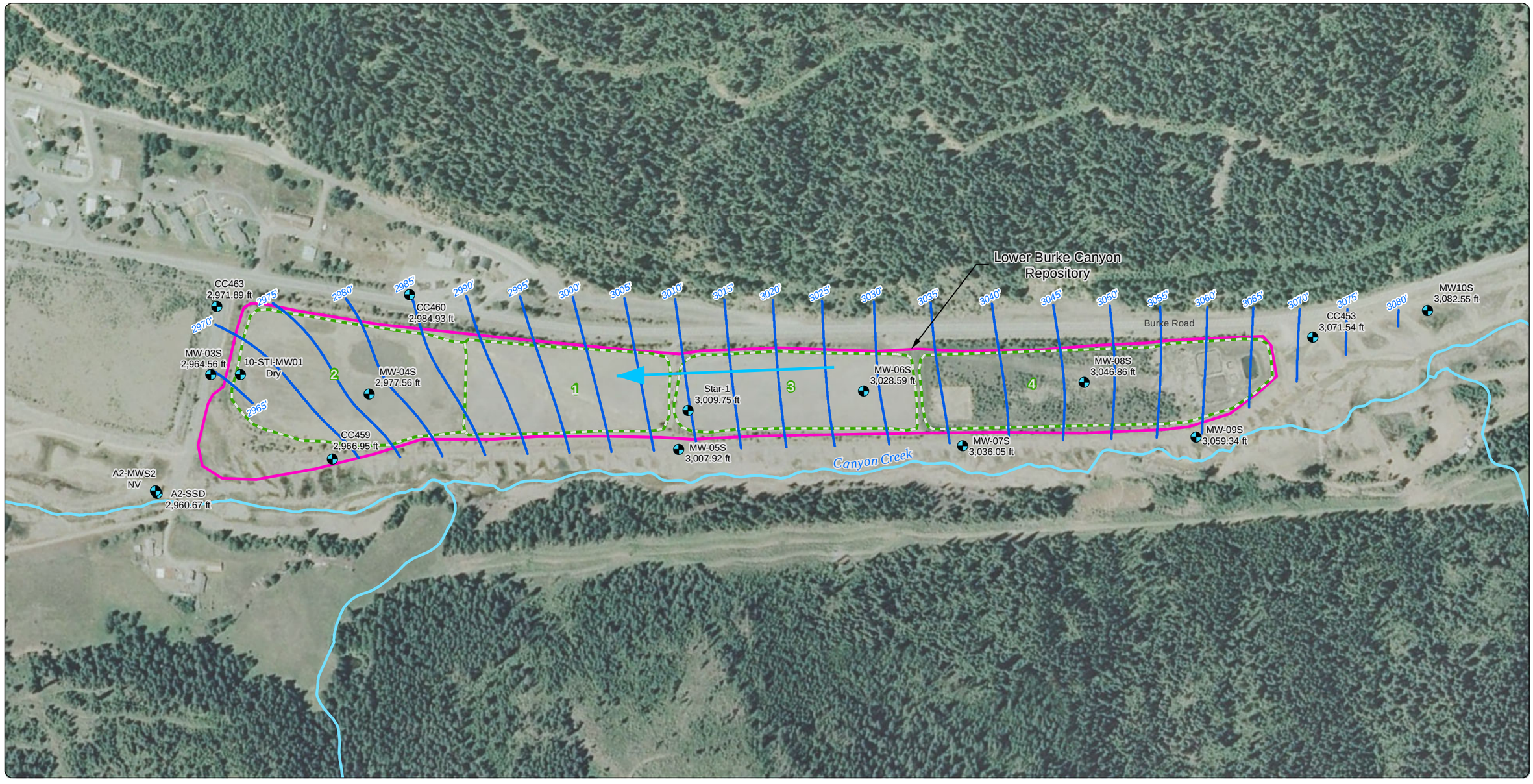
Project: 0442.02.01-02



Source: Aerial photograph obtained from ESRI, Inc. ArcGIS Online; streams dataset generated using ArcGIS 10.1 Spatial Analyst toolset and a 2009 LiDAR Digital Elevation Model obtained from USEPA.

Notes:
1. Water level collected on November 1, 2012.
2. Water level elevation datum is North American Vertical Datum 1988.
3. Note: A2-SSD is stream stage device and not included in potentiometric surface. A2-MWS2 not monitored.

Legend

- MW-05S 3,007.92 ft. — Monitoring Well Identification (WLE)
- Stream
- Water Level Elevation Contour (5')
- Flow Direction
- Proposed Repository Boundary
- Historical Tailing Pond Number and Boundary (Approximate)

DRAFT

Figure 4-1
Shallow Potentiometric Surface Lower Burke Canyon Repository

Coeur d'Alene Trust
Canyon Creek Basin, Idaho

0 175 350
Feet

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Approved By: A. Hughes
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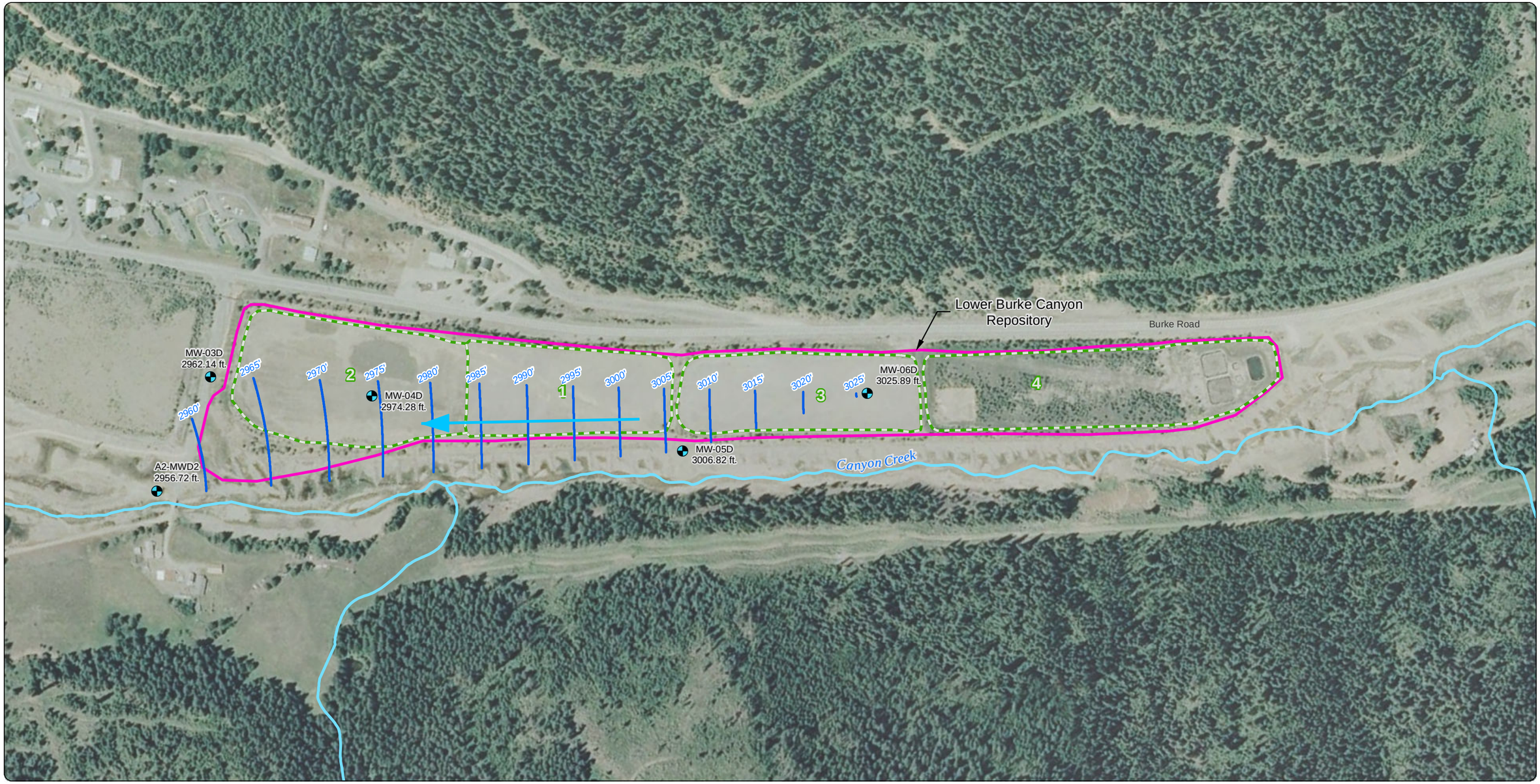
Project: 0442.02.01-02



Source: Aerial photograph obtained from ESRI, Inc. ArcGIS Online; streams dataset generated using ArcGIS 10.0 Spatial Analyst toolset and a 2009 LiDAR Digital Elevation Model obtained from USEPA.

Notes:
1. Water level collected on November 1, 2012.
2. Water level elevation datum is North American Vertical Datum 1988.
3. Note: A2-SSD is stream stage device and not included in potentiometric surface. A2-MWS2 not monitored.

Legend

- MW-05D 3,006.82 ft. — Monitoring Well Identification (WLE)
- Stream
- Water Level Elevation Contour (5')
- Flow Direction
- Proposed Repository Boundary
- Historical Tailing Pond Number and Boundary (Approximate)

DRAFT

Figure 4-2
Deep Potentiometric Surface
Lower Burke Canyon Repository

Coeur d'Alene Trust
Canyon Creek Basin, Idaho

0 175 350
Feet

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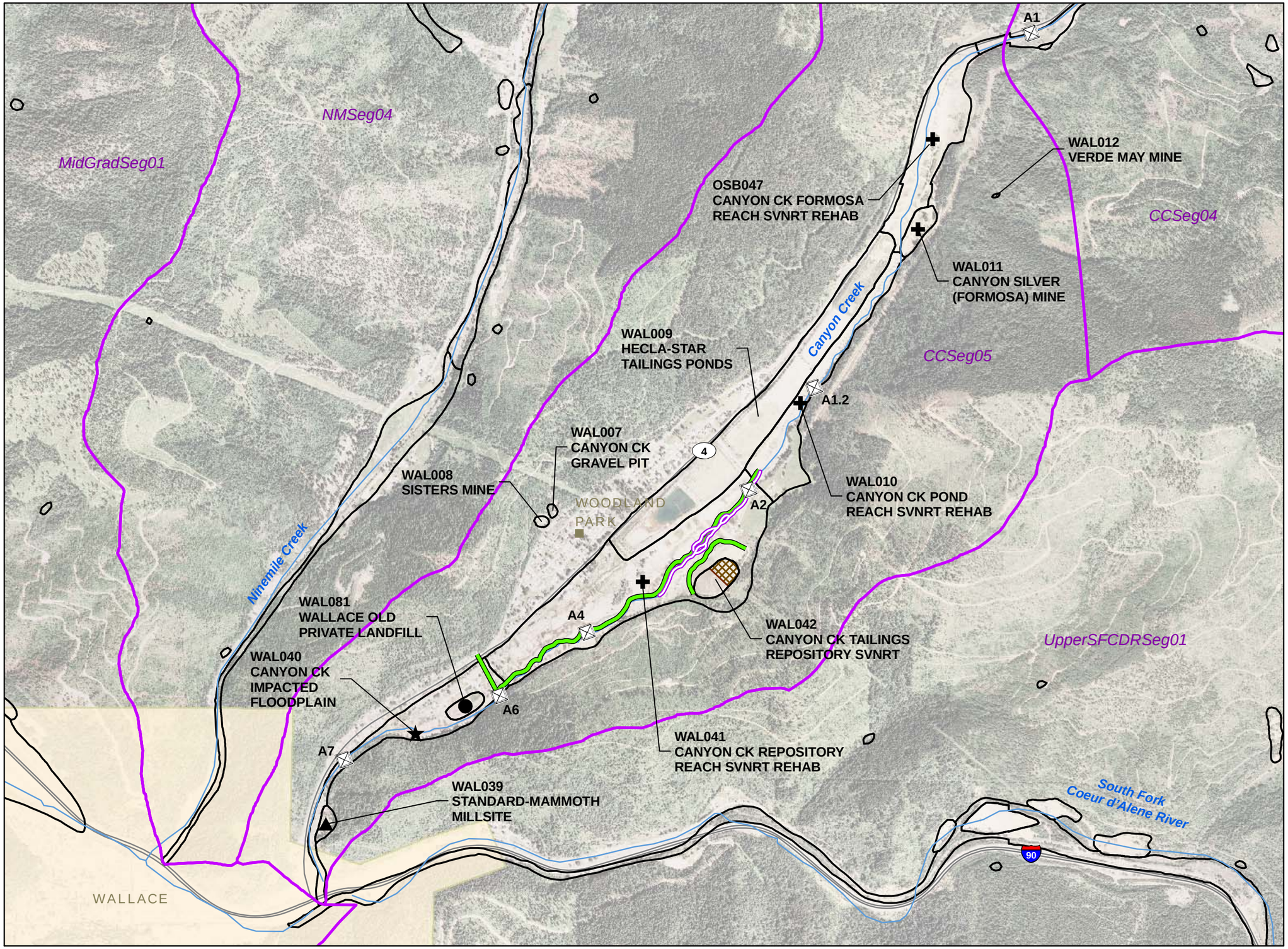
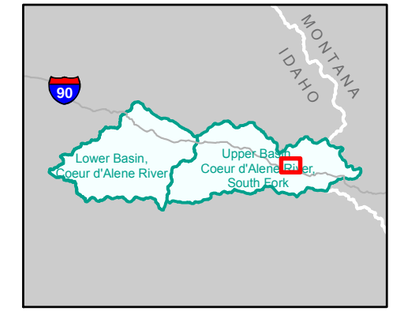
Path: X:\Cd\A0442\02.01_2012 Lower Burke Canyon Repository\2012 Investigation\Projects\Fig4-2_Deep Potentiometric Surface.mxd
Print Date: 12/18/2012
Approved By: A. Hughes
Produced By: apadilla
Project: 0442.02.01-02





River/Creek

City Limit

Watershed Segment[2]

Site

2006 Hydrologic Study Monitoring Station

French Drain

Stream Liner

Source Control Actions:

Excavate Floodplain Artificial Fill

Excavate Floodplain Sediments

Excavate Upland Tailings

Shallow Source Control

Native Soil Cap

WAL012 (Site ID)
VERDE MAY MINE (Site Name[1])

N

0 500 1,000 2,000 Feet

Source: NHDPlus (Rivers, Waterbodies); ESRI base data (Interstates 2006, Major Highways 2008); IDWR (Aerial Imagery 2006).

Notes:
1. The source IDs and names are based on the inventory of source sites conducted by the Bureau of Land Management (BLM) in 1999 in support of the Remedial Investigation/Feasibility Study (RI/FS) for the Coeur d'Alene Basin (U.S. Environmental Protection Agency [EPA], 2001a, 2001b).
2. **CCSeg05** = Segment within the Upper Watershed of the Coeur d'Alene River Basin, designated as such to focus the 1997-2001 Remedial Investigation (U.S. Environmental Protection Agency [USEPA], 2001).

FIGURE E-5
Option C:
Stream Liners, French Drains, and Source Control Actions
Updated Woodland Park Components of Ecological Alternatives 3 and 4
Upper Basin of the Coeur d'Alene River
BUNKER HILL SUPERFUND SITE

EPA

Appendix B

Design Drawings

Appendix C

Hecla STI Reports

MANUAL FOR

OPERATION AND INSPECTION

STAR TAILINGS IMPOUNDMENT FACILITIES

WALLACE, IDAHO

FOR

HECLA MINING COMPANY

Dames & Moore
Job Number 5457-010-32
December 4, 1979

APPROVED
IDAHO DEPARTMENT OF WATER RESOURCES

12/21/79 Norman C Young
DATE ADMINISTRATOR, RESOURCES ADMIN. DIVISION

R01663

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TWX: 610-923-5031

December 4, 1979

Hecla Mining Company
P. O. Box 320
Wallace, Idaho
83873

Attention: Mr. W. Crandall

Dear Sir:

We have prepared an operation and inspection manual for the Star tailings impoundment facilities constructed in Canyon Creek. Enclosed please find six copies of our "Manual for Operation and Inspection Star Tailings Impoundment Facilities, Wallace, Idaho".

This manual outlines procedures for monitoring and surveillance of all the existing Star ponds, including the recently completed Star No. 6. Seepage and dam safety are briefly discussed and requirements for future piezometer installations are included.

We recommend that the tailings impoundment facilities be inspected and monitored on a regular and systematic basis as outlined in the manual. Observations and data should be forwarded to us at regular intervals as recommended. Unusual observations or significant changes in data should be brought to our attention immediately.

o 0 o

We appreciate the opportunity of preparing this manual for you. If you have any questions concerning the contents, or if additional information is required, please contact us.

Respectfully Submitted,

DAMES & MOORE

G. C. Toland
Partner
Prof. Eng. No. 1333
State of Idaho

K. E. Robinson P. Eng.
Partner

M. M. Eivemark P. Eng.
Project Manager

cc: State of Idaho
Department of Water Resources
373 West Franklin Street
Boise, Idaho 83720

Attention: Mr. A. M. Stubblefield
Dam Safety Section

MME/KER/car

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R01666

MANUAL FOR

OPERATION AND INSPECTION

STAR TAILINGS IMPOUNDMENT FACILITIES

WALLACE, IDAHO

FOR

HECLA MINING COMPANY

INTRODUCTION

The purpose of this Manual is to provide guidelines and procedures for the operation and inspection of the Star tailings impoundment facilities constructed by Hecla Mining Company along Canyon Creek about 2½ miles northeast of Wallace, Idaho. The Star tailings impoundment area presently consists of six discrete basins separated by partition dikes. It is proposed to combine the ponds to result in two ultimate tailings ponds. The location and configuration of the facilities are shown on Plate 1, Layout of Tailings Impoundment Facilities.

Tailings and water stored behind an embankment represent potential energy which could jeopardize life and property downstream and could result in a mine production shutdown. Tailings ponds therefore must be properly designed, constructed, operated, and maintained to fulfill their intended purposes. To attain this goal, a system of checks and reviews must be implemented to periodically assess the performance and safety of the impoundment facility.

This manual sets forth guidelines for:

1. Operation of the facility including:
   a) Discharging of tailings into the impoundment basins;
   b) Raising of the perimeter dikes;
   c) Decanting of ponded water;
   d) Installation and monitoring of piezometers; and
   e) Provision of an ultimate abandonment plan.

2. Inspection of the facility including:
   a) Scope and composition of the inspection team;
   b) Frequency of on-site inspections;
   c) Procedural recommendations;
   d) Features to be specifically observed;
   e) Compilation of inspection reports and data files; and
   f) Appropriate distribution of compiled data.

Geotechnical studies for the facilities were performed by Dames & Moore and are summarized in the following reports:

1. "Report on Investigation and Design Star No. 2 Tailings Impoundment Extension, Wallace, Idaho", dated December 24, 1977.
2. "Report on Investigation and Design Star No. 6 Tailings Impoundment, Wallace, Idaho", dated May 29, 1979.
3. "Report on Site Inspection Star Pond 5 Dike Extension, Wallace, Idaho", dated July 26, 1979.
4. "Report on Construction Activities Star No. 6 Tailings Impoundment Facility, Wallace, Idaho", dated December 4, 1979.
5. "Report on Investigation and Design Star Nos. 1, 3 and 4 Tailings Impoundment Extensions, Wallace, Idaho", dated December 1979.

OPERATION

GENERAL

The tailings impoundment facility will be utilized to store the fine fraction of tailings from the Star Mine and will have an ultimate storage capacity of about three million tons of solids. At the present production rate of about 400 tons of solids per day, the impoundment area will have an operational life of about 20 years. The location and configuration of the facilities are shown on Plate 1, Layout of Tailings Impoundment Facilities.

Star mill tailings and mine water will flow under gravity from the concentrator to the impoundment through a 10-inch diameter, pressure-rated, polyethylene pipe which is fusion welded. Vertical head to the impoundment area is about 1000 feet over a distance of about 5.5 miles. The tailings slurry will flow to the crest of the dikes and then be distributed to a series of spigot discharge points along the length of each embankment. It is proposed that each of the six basins would be alternately filled with tailings. On filling of the ponds, the existing embankments would be raised incrementally until they are combined into two larger ponds. Maximum instantaneous slurry discharges at the pond will be about 2000 gallons per minute (gpm). The present discharge to the tailings ponds is about 500 gpm.

During most of the mill operating time total tailings will be cycloned at the mill. The coarse fraction, tailings sand, will be used for underground backfill while the fine fraction, tailings slimes, will be discharged to the tailings impoundment area. Occasionally total tailings will be discharged to the impoundment. It is anticipated that tailings deposited in the pond will consist of slimes at least 90 percent of the mill operating time.

Decant water will be removed from the reservoirs by decant towers leading to peripheral ditches. The ditches discharge into Canyon Creek.

TAILINGS DISCHARGE

Tailings discharge will be accomplished by spigots attached at intervals along the tailings slurry pipeline which will run along the crest of the tailings dams, or by moving a single point discharge as discussed below. Behind the dams, the slurry will segregate into a coarser fraction adjacent to the embankment, and the finest slimes and water around the decant towers. Because, in the case of Star Pond No. 6, the initial surface area of the tailings pond will be very small, the segregation described above will be incomplete. Therefore to achieve the build-up of the coarsest beach possible adjacent to the starter dike, which is particularly critical to the filter design, frequent changes in the location of the tailings discharge point will be required. During the first month of operation the discharge point for Star Pond No. 6 should be moved frequently in the tailings pond. As soon as a beach sloping 50 feet to the ponded water has developed, the frequency of spigot relocation can be somewhat relaxed, but closely observed to ensure that slime pockets do not accumulate adjacent to the perimeter embankment. For the existing, extended ponds, tailings discharge should follow a similar cycle.

Proper maintenance of the tailings discharge will probably result in about a one percent sloped beach on the tailings surface. To maximize storage volumes for a given dike height spigots, or discharge points, will be spaced at 75-foot centers around the perimeter of the dikes. The spigots should be designated by number or letter and clearly labelled so that records can be kept of pond position. Flexible pipe sections should be utilized at spigot points to direct the slurry to beach level if the slurry could otherwise cause erosion of the embankment face.

Based on 400 tons of solids per day at an assumed 25 percent solids to water ratio, we have computed that the minimum settling velocity for the tailings slurry in the 8-inch diameter pipeline would be in the order of 4.5 feet per second. The minimum corresponding transportation velocity should be 5.5 feet per second. To the best of our knowledge, no measurements are available for the fluid velocity in the lower end of the distribution line.

R01670

If it appears that the minimum transportation velocity for the 8-inch line cannot be maintained with several spigot points, we recommend two solutions to prevent sanding of the line. The first would be to utilize, in each pond, a single discharge point, which would be relocated from time to time to maintain the required beach. The second alternative would be to reduce the size of the slurry pipeline in the lower reaches of the tailings impoundment facilities to accommodate the actual slurry velocities. We have computed that for a 6-inch and 4-inch diameter pipeline, the minimum required transportation velocities would be 5.0 and 4.5 feet per second, respectively. It is our opinion that the single discharge point would be the more reliable solution.

DIKE CONSTRUCTION

Embankment construction for each of the basins is similar, Each pond is contained by a starter dam constructed of local gravelly alluvium and hillside borrow material supplemented with mine waste. The height of the starter dams varied up to about 30 feet. As the initial pond filled with tailings, a vertical extension was constructed by the upstream construction method. Dike extensions are usually 10 feet in height. As indicated on Plate 1, the disposal area is restricted between Canyon Creek and the highway. Each pond is long and narrow, abutting the next higher pond up the valley.

The original ground surface of the valley bottom ranged from about Elevation 3080 feet at the upper end of Star Pond No. 4 to about Elevation 2920 feet at the downstream toe of Star Pond No. 6. The existing crest levels of Ponds 4, 3, 1, 2 and 5 are at about Elevations 3077, 3042, 3018, 3000, and 2990 feet, respectively. As constructed, the Pond 6 starter dam has been built in three sections along its length with the maximum height of starter dam approximately 40 percent of the ultimate dike height. It is proposed to combine Ponds 3, 1 and 2, and 5 and 6 to form two basins. We have recommended that Star Pond No. 4 be abandoned after filling behind the starter dam because of unstable foundation conditions for extension construction.

Each future stage of construction will commence when the level of tailings at the perimeter of a pond reaches the existing crest. Discontinuities at the section boundaries of Pond 6 and at the junction points, when the existing ponds are combined, will be avoided by connecting the crests at each increment of height. Roads will be maintained on the crests of each extension to provide access around the entire perimeter of each tailings pond.

The downstream slopes of the starter dams vary from about 1.35 to 1.5 (horizontal) : 1 (vertical) for Ponds 1 to 5 and 2:1 for Pond 6. The corresponding upstream slopes vary from 1.3 to 1.5 : 1. The first extension above the starter dams is designed as a projection of the starter dam. Subsequent extensions will be set back about 15 feet into the tailings ponds to result in an overall downstream slope not steeper than 2:1. The maximum height above original grade to which the ultimate embankments will be constructed is anticipated to be about 80 feet.

DECANT SYSTEM

The decant system, as constructed for Star Pond No. 6, consists of two towers manifolded to a common pipeline discharging into a ditch at the southern perimeter of the starter dam, and an independent tower and pipeline at the northern end of the basin discharging to a ditch adjacent to the eastern perimeter of the dam. The towers were constructed with 12-inch diameter steel pipe stubs set in a concrete base. A reduction section was installed at the top of the stubs to mate with 10-inch diameter PVC pipe. The plastic pipe is rated for 160 psi and will be raised incrementally in five-foot sections. A square stoplog tower was constructed around each of the 12-inch diameter stubs and was bolted to the concrete base. The exterior towers consist of a ¼-inch thick sheet metal frame in which cedar stoplogs will be inserted into the open side. The exterior towers will also be raised in five-foot sections and intermediate water level control will be provided by the stoplogs. The riser section at the base of the tower, including the 12-inch steel pipe, the reduction section and the lower end of the first PVC section, are encased in concrete. The decant pipelines consist of 12-inch diameter dipped and wrapped

No. 10 gauge steel pipe, encased in concrete within the basin and under the embankment. The pipe sections are connected by Dresser couplings. Seepage collars, extending a minimum of three feet beyond the concrete encased decant lines, were installed around the pipelines where the lines pass under the dam. Two collars were installed on each line at the third-points of the base width of the dam. For extension the towers are accessible by catwalk.

During extension of Star Pond No. 5 in the Summer of 1979, the perimeter decant riser system was replaced with two centrally located towers. Gravel causeways were constructed on the dried tailings surface out from the north and south limbs of the embankment adjacent to the existing riser pipes. The new towers were constructed in the same manner as the Star No. 6 decant system with exterior stoplog towers and an inner 10-inch diameter PVC riser mated to a 12-inch diameter steel pipe stub set in concrete in excavation in the gravel berms. The decant lines were laid in the gravel berms and manifolded into the existing outfalls at the north and south ends of the tailings pond. The lines were sloped to take into account the anticipated differential settlements resulting from future tailings deposition. When the decant pond reaches the overflow level of the new towers, the existing fiberglass risers along the east and west limbs will be plugged and abandoned. The old north and south risers will be maintained for emergency pond control.

The existing decant system in Star Ponds 1 to 4 consists of 10-inch diameter fiberglass risers constructed adjacent to the perimeter embankments on the east, south and west sides of the respective ponds. The bases of the risers are connected by elbows to steel decant lines passing through the embankment limbs. Because this system encourages ponding of water and slimes against the embankments, it is unsatisfactory for embankment stability and seepage control. Therefore, as subsequent extensions are constructed on the embankments, we have recommended that new decant towers be constructed closer to the centers of the respective tailings basins, and the perimeter risers be plugged and abandoned, or maintained only for emergency spillage. In order to raise the dikes to the ultimate proposed heights, the decant ponds should be maintained a minimum distance of 50 feet from the upstream toes of the embankments.

R01673

The method of reconstruction of the decant system implemented for Star Pond No. 5 has been recommended for Star Ponds No. 1 through No. 3.

With the recommended tower design, the towers will be raised in five-foot vertical increments. The steel frame of the exterior tower will be maintained five feet above the inner riser, and intermediate water levels will be controlled by the stoplog system. The inner riser will be raised also in five-foot sections and coupled to the preceding section by means of a sleeve-joint. We recommend that the lower section of the tower be concreted to the base of the operating inner riser section to provide long-term stability for the tower.

Ingress of floating debris into the overflow section of the decant towers will be prevented by a two-foot section of nominal 24-inch diameter pipe suspended by chains around the exterior tower.

With ponded water maintained a distance of 50 feet from the perimeter dike and a beach formed at a slope of one percent, a minimum freeboard of 0.5 feet would be developed with respect to the decant towers. Therefore, the final elevation of the decant towers for each construction stage should be a minimum of two feet lower than the elevation of the dike crest.

PIEZOMETERS

The long-term stability of the tailings embankments can be adversely affected by pore water pressures and the position of the phreatic surface both within the dike and in the tailings deposited adjacent to the dike. Because the design of the embankments has been based on assumptions concerning both pore pressures and position of the phreatic surface, piezometers have been installed in the foundation soils just below the starter dike and through the crests of the extensions to monitor subsurface water levels and to verify design assumptions. The piezometers consist of ½ to 2-inch diameter PVC pipe with the lower ten feet slotted, inside a 2 to 4-inch diameter perforated pipe casing, or uncased in some instances.

Lines of open-standpipe piezometers, complete with properly graded filters constructed around the open-end or well-point must be installed in the tailings below future dike extensions at the locations shown on Plates 2 through 23.

The piezometers should be permanently labelled, and the identification system should include the pond number, the limb of the embankment and the sequence of installation. Thus P6WA1 would identify the first piezometer installed along Line A of the west limb of the Star Pond No. 6 embankment. The proposed identification system will change the designation of the piezometers utilized at the time of installation. Table 1 shows the conversion for piezometer designation.

Piezometers to be installed in the future must have their slotted sections in the tailings and not in the foundation gravels. The slotted standpipes for future piezometers should be washed down to the required depth prior to construction of the next vertical extension of the embankment. The installed riser pipes must be adequately protected during subsequent fill placement.

Depths of piezometer well points are shown on Plates 2 through 23. They should consist of 2-inch diameter PVC pipe with the bottom plugged and the lower five feet slotted at 3-inch spacings with a hacksaw. The slotted zone should be wrapped with a U. S. Standard No. 40 size mesh, and backfilled with a clean, medium to coarse sand.

ABANDONMENT PLAN

There are two options for permanent control of surface flood water in the pond areas. The Dames & Moore original concept for reclamation of the tailings impoundment facilities included the use of the decant systems. An alternative would be the use of a permanent spillway from each pond to the ditch on the east side running parallel to the railway line.

The former concept would include utilizing the concrete-encased non-erodable PVC inner riser pipe constructed into the completed decant towers. If the decant towers are not incorporated into the abandonment plan, then they would have to be plugged prior to decommissioning.

The ponds should be graded to provide positive drainage from half the surface to each decant. A screen or other protective device would be required for safety. The surface would then be covered with suitable topsoil and fertilizers to encourage grass growth.

As an alternative, a spillway can be constructed into the final lift of each tailings embankment to function after the tailings pond has been abandoned and the decant system has been decommissioned. The spillways must be capable of discharging a 100-year, 1-hour storm falling over the surface area of the ponds upstream from the spillway under consideration, which would correspond to peak flows varying from 1.5 cfs for Star Pond No. 4 at the upstream end of the tailings area to 6.0 cfs for Star Pond No. 6 at the downstream end.

Preparation for abandonment should commence in the latter stages of tailings discharge. During this time spigotting should be controlled to provide a tailings surface topographic low along the eastern side of each pond, adjacent to the railway. After completion of tailings deposition, the spillway ditch should be excavated from this topographic low, through the tailings embankment to the ditch.

The ditch in the tailings should be graded at 0.5 percent from the topographic low to the eastern perimeter embankment with a "V"-shape having side slopes of 2 to 1, horizontal to vertical. The ditch should be protected along its length with six inches of coarse mine waste or fine rock having a d_{50} size of 2½ inches, or with a thin liner of concrete. This would prevent scour of the ditch during maximum flow conditions.

R01676

Passage of a spillway through the crest of a dike at the east side could be provided by either an open ditch or a culvert half-section. The open ditch, graded at 0.5 percent, should have side slopes of 2 to 1 and should be lined with the same fine rock or concrete to 4 feet vertically above the invert. A culvert or flume would be required to pass the discharge across the downstream slope of the embankment to the drainage ditch.

Alternatively, a culvert could be buried in the dike fill. For a slope of 0.5 percent, an 18-inch culvert would be required to handle the design flood. The culvert size could be reduced to 16-inch, 14-inch, or 12-inch by steepening the gradient to 1.0, 2.0 and 4.0 percent, respectively.

R01677

INSPECTION

GENERAL

An inspection is a comprehensive evaluation and observation of the visible physical features of the tailings impoundment facilities. A designated team of Hecla Mining Company staff members should inspect the facilities on a regular basis to take piezometer readings, and to assess potential problems such as abruptly rising pond levels, plugged discharge lines, seepage at the face of the dikes, breaks in the discharge lines, and anything of a suspicious or unusual nature such as embankment cracking and differential settlements. The inspection team should be identified prior to the discharge of tailings into the impoundment reservoir. The team could consist of one member or several members, none of whom need be professional engineers, but who should have some technical training and be familiar with the facilities and the potential problems that could develop.

Several activities must be undertaken to assess the safety of the tailings impoundment facilities. At the outset, the inspection team must review the project files, design reports, construction records, monitoring requirements, and conduct a thorough on-site inspection of each facility. These project files and records should be maintained in the engineering office of Hecla Mining Company, along with all data recorded during subsequent site inspections.

Assessment of the facilities' safety will be a continuing effort. Maintenance and operation personnel should also be observant of any adverse conditions that may develop. When suspect conditions are observed, regardless of how minor, maintenance and operation personnel should report them promptly to the inspection team for evaluation.

The tailings impoundment facilities must be subjected to a regular program of inspection throughout their life by a professional engineer experienced in dam design and construction, who would look for and record signs of tension cracking. slumping, seepage and erosion. Performance of the tailings dams would be evaluated and the need for remedial measures would be identified on the basis of this inspection. Should the regular Hecla Mining Company staff inspections indicate a problem, the engineer should be notified immediately so that a detailed inspection and assessment can be completed.

SCOPE AND FREQUENCY

The initial inspection of the facilities should be conducted between completion of construction and commencement of tailings discharge into the reservoirs. It should provide close scrutiny of unexpected conditions noted and/or any modifications and revisions made during construction. This initial inspection should be completed with one of Dames & Moore's engineers who is familiar with the project and a State of Idaho Department of Water Resources staff member. The compilation and plotting of data would commence at this time and would be updated by the addition of data from future inspections.

Inspection of the tailings impoundment facilities and monitoring of piezometers should be performed on a weekly basis from the initial discharge of tailings into the reservoirs until a beach sloping 50 feet to the ponded water has developed around the entire dike perimeter for each pond. Thereafter the inspections and monitoring should be performed on a biweekly basis. However special inspections and readings should be performed immediately after the facilities have been subjected to unusually large floods, and after the occurrence of significant earthquakes, intense local rainfalls, or other unusual events. Prior to inspections, the team should note conclusions and recommendations of the previous inspection. All inspection should be carried out by carefully traversing the length of the dikes on the crest and at the downstream toe.

Operation and maintenance of the facilities should be discussed with the individuals responsible for the day to day operation of the facilities. These discussions serve to verify if the operators understand the required operating procedures and understand the significance of safety requirements such as the 50-foot setback to the pond. They should be quizzed to determine their understanding of the maintenance requirements and schedules for servicing. These personnel should also complete daily inspections of the facilities, together with keeping daily records of the operating spigots and any unusual features observed in the facilities. If unusual conditions are observed they should immediately notify the regular inspection team, who may or may not, advise the professional engineer depending upon the conditions observed and the immediate risks, if any. The daily record of spigot operation should be provided to the inspection team prior to each inspection and would form part of the Log Book discussed below.

Results of the weekly, biweekly and special inspections should be forwarded to the office of the professional engineer every three months for review. Should water levels rise abruptly or reach the designated maximum levels, or unusual conditions develop, such as a reduced distance to the pond or signs of distress in the dam, the professional engineer should be notified immediately. Based on continued observations it may be determined that additional piezometers should be installed sooner than discussed above, and remedial drainage measures may have to be implemented.

Inspection by the professional engineer should be completed on a yearly basis. Approval from the professional engineer should be obtained prior to raising the dam, completing additional construction or operational changes.

PROCEDURE

The fundamental objective of safety inspections is the detection of any existing or developing structural or hydraulic weakness. This involves evaluations of the complex interrelationships of the design of the impoundment facilities, and the characteristics and performance of the materials involved. The characteristics to look for in conducting the field examination are discussed in the following paragraphs.

The embankment for each reservoir should be examined thoroughly during the field inspection. Both the upstream face and the downstream face should be inspection and locations of data points documented accurately using horizontal stationing.

The slopes and crest of the embankment should be examined for vertical or horizontal displacements or misalignments, cracks, sinkholes, springs, boils, sags, escarpments, sloughs, bulging or slides. Generally, displacements can be checked by sighting down the pipeline along the embankment or the embankment crest. Cracks can often be attributed to desiccation and shrinkage of materials; however, their depth and orientation may signal the initiation of a slide. Cracks that are suspect should be described, located properly and photographed. Springs and boils signal the short-circuiting of subsurface flow and should be further examined for unusual coloration and suspended solids. Sags, escarpments, sloughs, bulging and slides are easily recognized signs of incipient slope failures.

The slopes and adjacent topography should be examined closely for wet spots or other signs of seepage. Some telltale signs of seepage include abnormal vegetative growth, more lush or color-differing vegetation, and types of vegetation which require greater amounts of water. During severe winters, seepage could cause areas of abnormal icing. When less cold, seepage may be identified as areas of more rapid snowmelt. All slopes on the dam should be inspected for erosion. Erosion of the embankment is usually caused by storm runoff. Particular attention should be paid to seepage around the abutments. Slopes should be free of vegetation, large decayed roots, buried debris and animal burrows.

R01681

Decant water within the tailings ponds should be examined for position relative to spigot points, distance from crest and unusual conditions. These records should be maintained by the operators and the inspector would evaluate the condition of the reservoir based on these records and his field observations. If the reservoir basin is accessible during the initial stages of tailings discharge, it should be examined for depressions, sinkholes, deposition and erosion.

The tailings line from the mill to the impoundment must be inspected for vulnerability to obstruction by debris and landslides and examined for deterioration, cracked or separated joints, chemical reaction, offset vertical joints and undercutting at the spigot discharge points. Slopes near the discharge points should be examined for erosion or evidence of damaging eddies caused by inadequate energy dissipation.

Decant tower inlets, decant lines and emergency spill pipe outlets should be inspected for relative inflow and outflow volumes, siltation and discoloration, and occurrence of breaks, leaks, corrosion, blockages or other imminent breakdown features. The decant towers must be provided with trash racks or other facilities to prevent debris from entering and blocking the decant system.

DATA COMPILATION

Data collected on a daily basis by operating and maintenance personnel, and on a weekly to bi-weekly basis by the inspection team should be systematically filed in the engineering office of Hecla Mining Company as a continually expanding Log Book. Each pond should have a separate Log Book. The project file should contain design reports and construction records of the facility. The inspection team will be responsible for the upkeep of the file. This file, including the Log Book, will serve as a detailed record relating to the safety of design, construction and operation of the facility.

For each pond, data collected, reduced and plotted should be compiled in four Log Book Volumes of loose leaf binders titled:

1. Decant Pond Position;
2. Inspection Reports;
3. Piezometer Readings; and
4. Plots of Piezometer Data

Each binder should contain preface sheets to serve as continuous logs of dates of inspections and entries. The preface sheet should identify the original authors and date of preparation.

The Volume of Decant Pond Position should include a master copy of a blank form as shown on Plate 24. The form is designed to record the position of the pond relative to spigot points and piezometer lines on a daily basis for a period of one week. Each day the pond position should be checked off by personnel operating the facility as beyond 50 feet all the way around the perimeter, if this is the case, with notations of estimated distances of piezometer lines. A notation of where the pond is relative to specific spigot numbers should be made where the pond is less than 50 feet from the crest with follow-up comments on remedial action taken to change the pond locations, where necessary. At the end of each week, the completed and signed form must be submitted to the inspection team for perusal and filing.

The Volume of Inspection Reports should include a master copy of a blank inspection report as shown on Plate 25. The items on the inspection report should be checked off during the inspection and comments on unusual conditions or construction activities should be documented. The name of the person contacted regarding an unusual observation should be documented. Each report should be dated, signed and filed.

The Volume of Piezometer Readings should include a master copy of a blank piezometer form as shown on Plate 26. Plots of phreatic surface levels with respect to time and pond water level should be filed in the fourth Volume, Plots of Piezometer Data. Plate 27 shows a typical form for plotting phreatic surface levels with time for any piezometer over a period of one year. Plots of recorded phreatic surfaces should be continually updated and checked against the allowable levels presented on Plates 28 to 32. A note should be made on Plate 26 as to whether any of the phreatic surfaces plotted above the maximum allowable phreatic surface elevation. If one or more plotted above, an explanation must be included as to the steps taken, such as the notification of a specific responsible individual. Each sheet of readings should then be dated, signed and filed.

During any inspection of each facility, blank forms for inspection observations and piezometer readings should be taken into the field. The Log Book should remain inside the engineering office of Hecla Mining Company at all times. At the end of each three month period, xerox copies of all data recorded during that time should be forwarded to the dam design professional engineer for review.

The following list of plates completes this manual:

Plate 1	Layout of Tailings Impoundment Facility
Plate 2	Dike Profile of Piezometer Line P1EA
Plate 3	Dike Profile of Piezometer Line P1WA
Plate 4	Dike Profile of Piezometer Line P1WB
Plate 5	Dike Profile of Piezometer Line P2EB
Plate 6	Dike Profile of Piezometer Line P2EA
Plate 7	Dike Profile of Piezometer Line P2WA
Plate 8	Dike Profile of Piezometer Line P2WB
Plate 9	Dike Profile of Piezometer Line P3EA
Plate 10	Dike Profile of Piezometer Line P3WA
Plate 11	Dike Profile of Piezometer Line P3WB

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Plate 12	Dike Profile of Piezometer Line P4EA
Plate 13	Dike Profile of Piezometer Line P4EB
Plate 14	Dike Profile of Piezometer Line P4WC
Plate 15	Dike Profile of Piezometer Line P4WA
Plate 16	Dike Profile of Piezometer Line P4WB
Plate 17	Dike Profile of Piezometer Line P5WA
Plate 18	Dike Profile of Piezometer Line P5EA
Plate 19	Dike Profile of Piezometer Line P5SA
Plate 20	Dike Profile of Piezometer Line P6SA
Plate 21	Dike Profile of Piezometer Line P6EA
Plate 22	Dike Profile of Piezometer Line P6WA
Plate 23	Dike Profile of Piezometer Line P6EB
Plate 24	Decant Pond Position
Plate 25	Inspection Report
Plate 26	Piezometer Readings
Plate 27	Plot of Piezometer Readings
Plate 28	Allowable Phreatic Surface Pond 1
Plate 29	Allowable Phreatic Surface Pond 2
Plate 30	Allowable Phreatic Surface Pond 3
Plate 31	Allowable Phreatic Surface Pond 5
Plate 32	Allowable Phreatic Surface Pond 6

Respectfully Submitted,

DAMES & MOORE

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Partner
Prof. Eng. No. 1333
State of Idaho

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Partner

M. M. Eivemark P. Eng
Project Manager

MME/KER/car

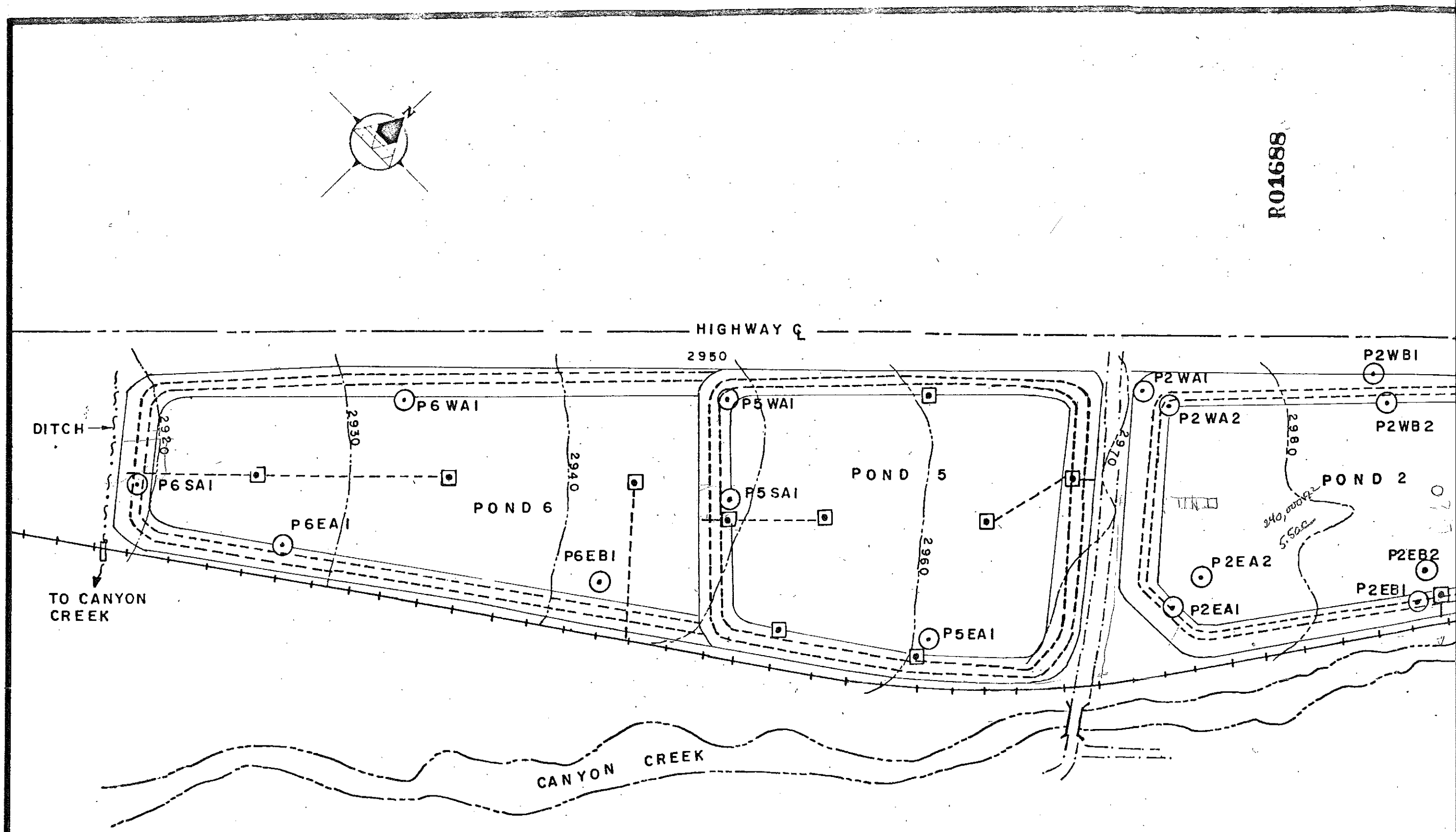
R01686

TABLE 1

PIEZOMETER DESIGNATION

Tailings Pond	As-installed Designation	Proposed Final Designation
Star Pond No. 1	P1-1	P1EA1
	P1-2	P1WA1
	P1-3	P1WB1
Star Pond No. 2	B-1	P2EB1
	B-2	P2EB2
	B-3	P2EA1
	B-4	P2EA3
	B-5	P2WA1
	B-6	P2WA2
	2-1	P2WB1
	B-8	P2WB3
Star Pond No. 3	P3-1	P3EA1
	P3-2	P3WA1
	P3-3	P3WB1
Star Pond No. 4	P4-1	P4EA1
	P4-2	P4EB1
	P4-3	P4WC1
	P4-4	P4WA1
	P4-6	P4WB1
Star Pond No. 5	P5-1	P5WA1
	P5-2	P5EA1
	P5-3	P5SA1
Star Pond No. 6	P6-1	P6SA1
	P6-2	P6EA1
	P6-3	P6WA1
	P6-4	P6EB1

R01688



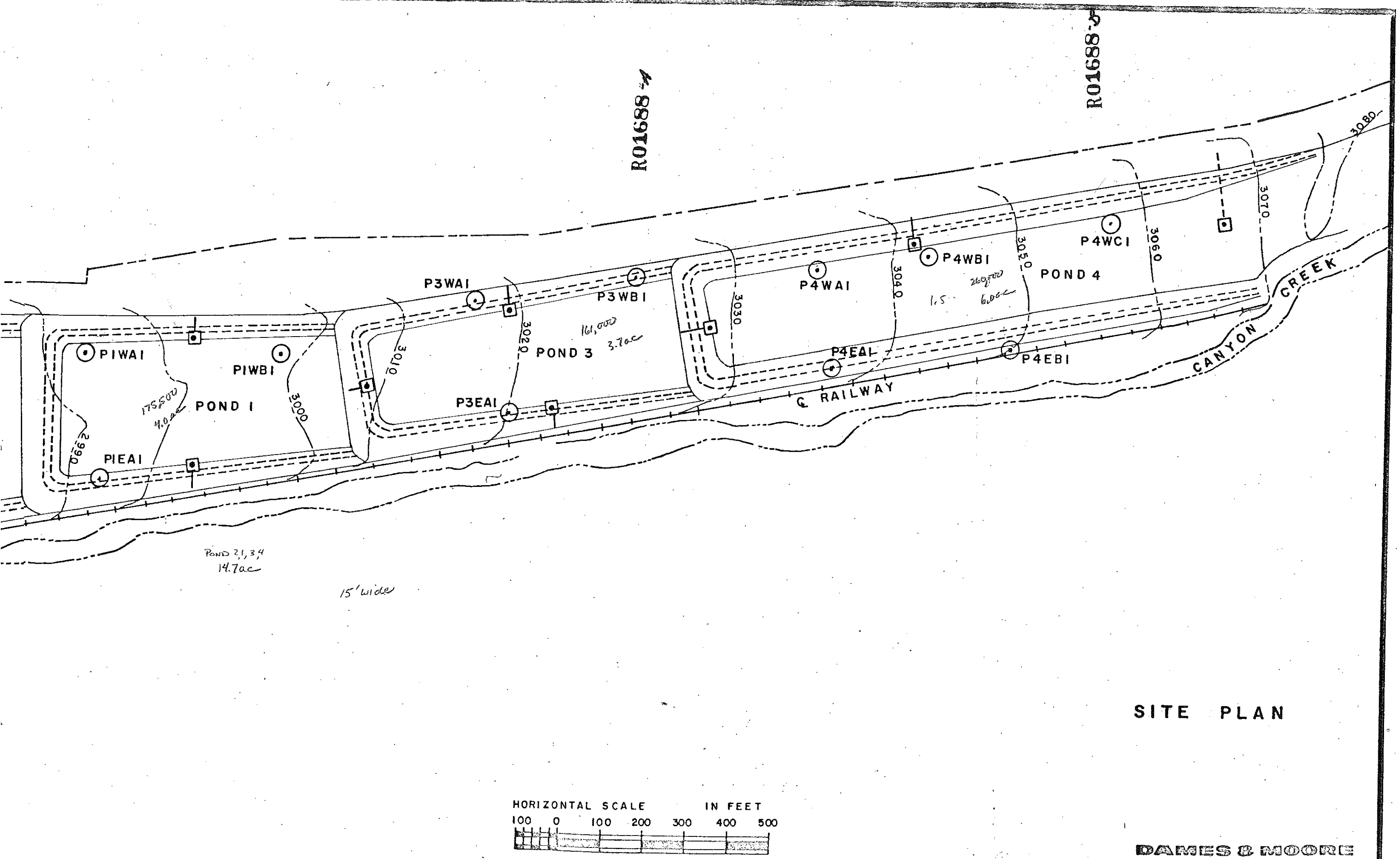
REFERENCES:

1. DRAWING C-7e HECLA DTD. 9-2-66.
2. DRAWING 2469-3 HECLA.
3. MAP VALLEYS OF CANYON CREEK AND SOUTH FORK COEUR D'ALENE RIVER, HECLA.

LEGEND:

⊙ BORING DRILLED AND PIEZOMETER INSTALLED UNDER DAMES & MOORE SUPERVISION.

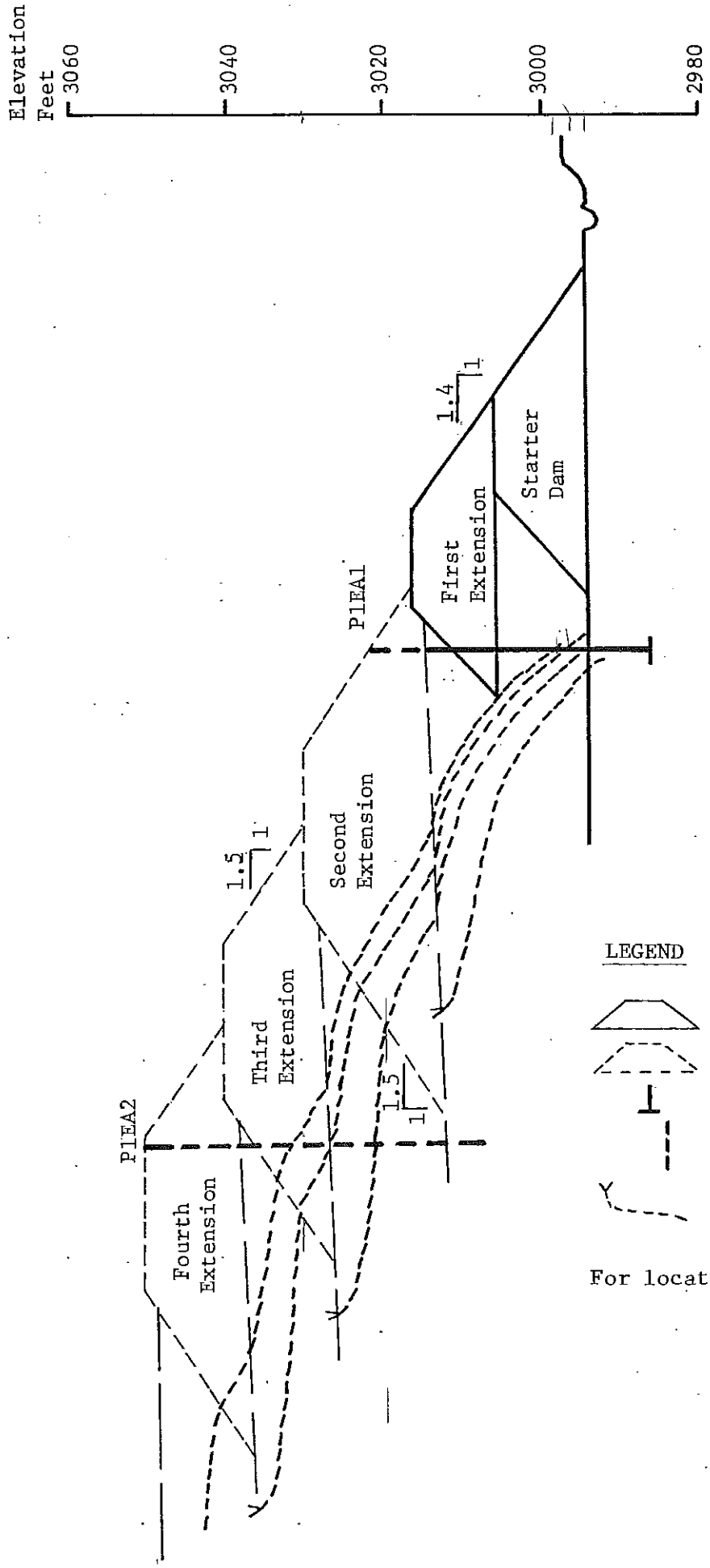
⊡— DECANT TOWER WITH OUTFALL.



SITE PLAN

DAMES & MOORE

PLATE 1



LEGEND

- Existing Dam
- Future Construction
- Existing Piezometer
- Future Piezometer or Extensions
- Allowable Phreatic Surface

For locations see Plate 1.

Scale: 1" = 20'

R01689

DIKE PROFILE OF
PIEZOMETER LINE
P1EA

DAMES & MOORE

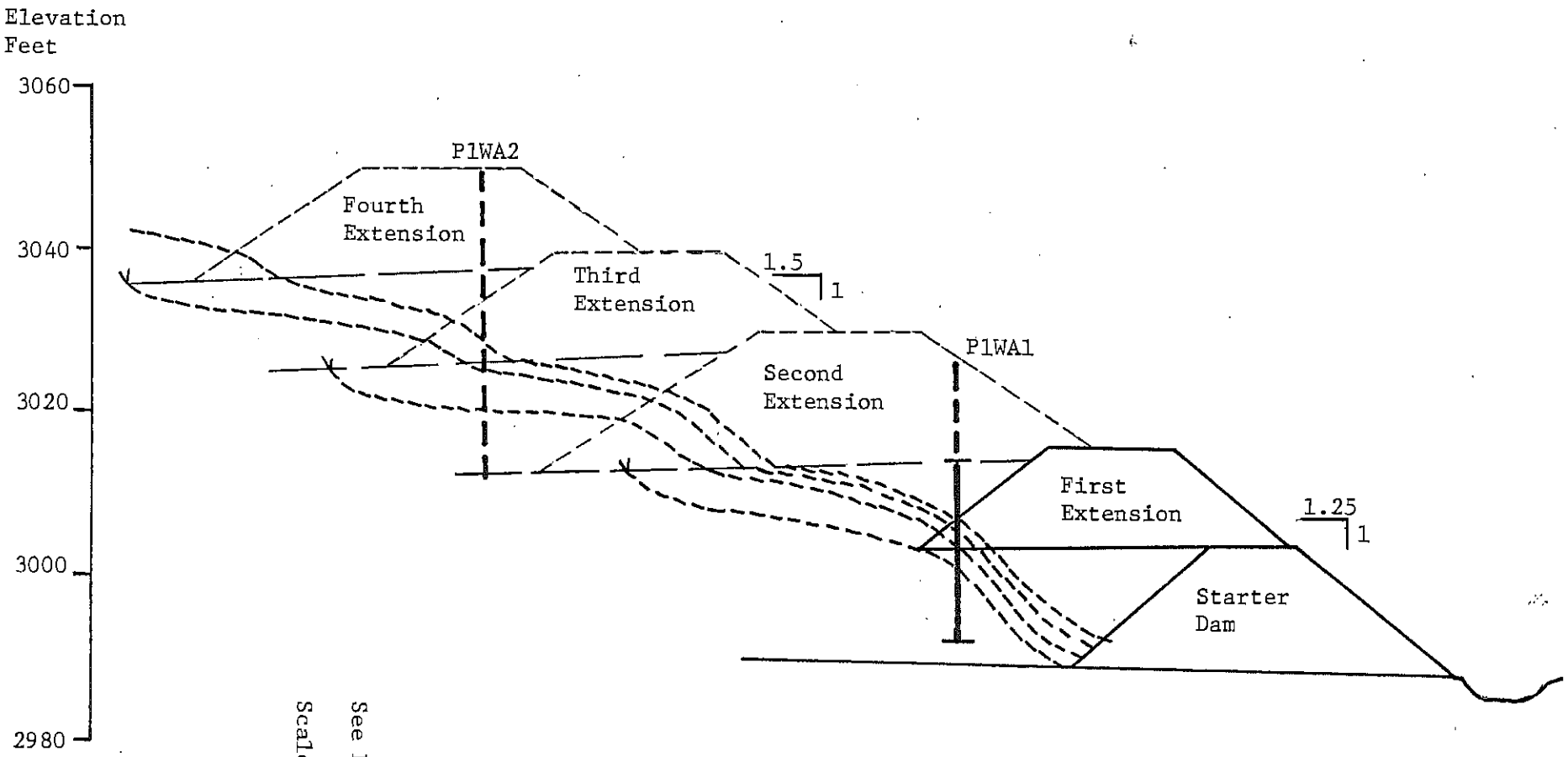
REVISIONS
BY _____ DATE _____

FILE _____

BY _____ DATE _____
CHECKED BY _____

BY _____ DATE _____
CHECKED BY _____ FILE _____

REVISIONS
BY _____ DATE _____



See Plate 2 for Notes

Scale: 1" = 20'

R01690

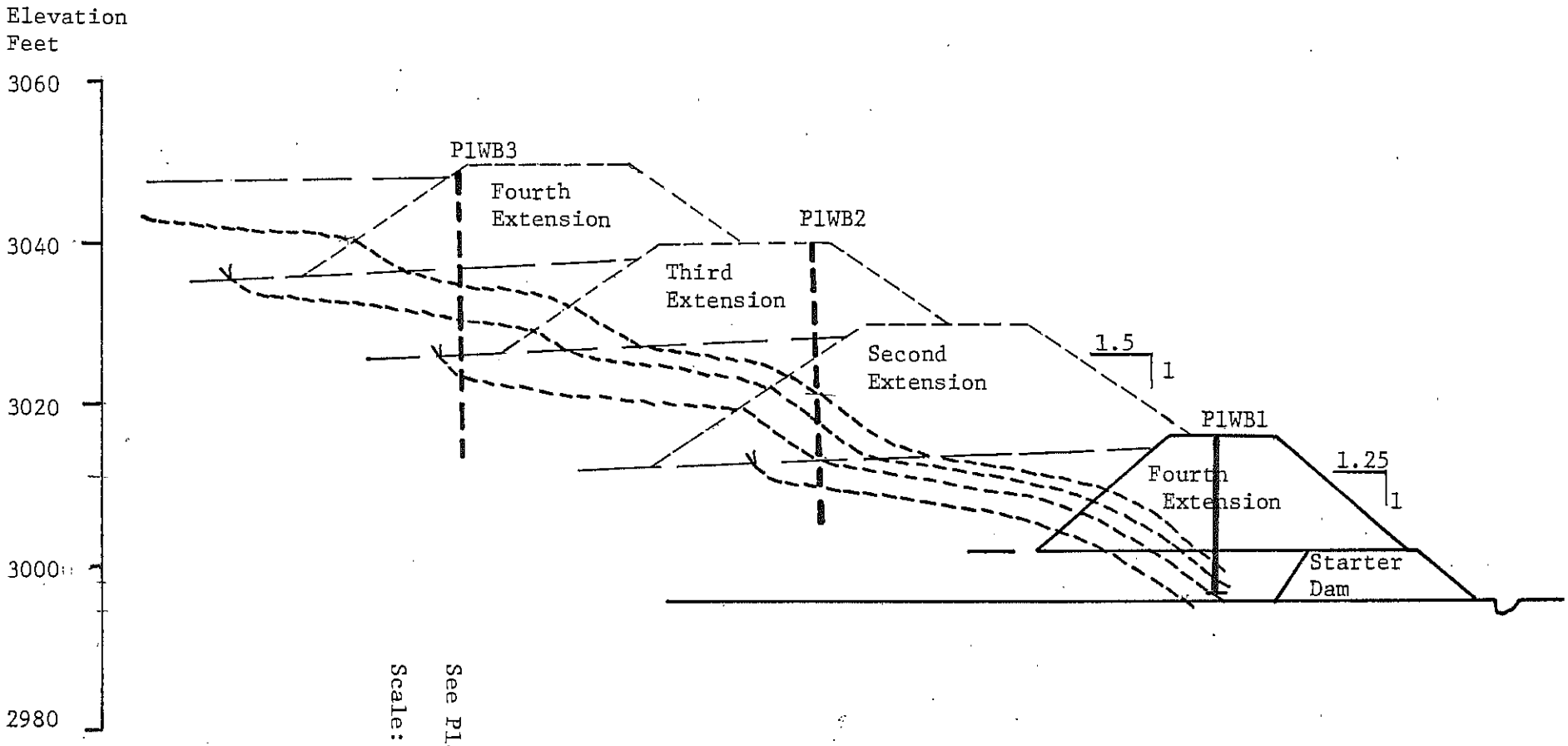
DIKE PROFILE OF
PIEZOMETER LINE
P1WA

DAMES & MOORE

PLATE 3

BY _____ DATE _____
CHECKED BY _____ FILE _____

REVISIONS
BY _____ DATE _____



See Plate 2 for Notes

Scale: 1" = 20'

R01691

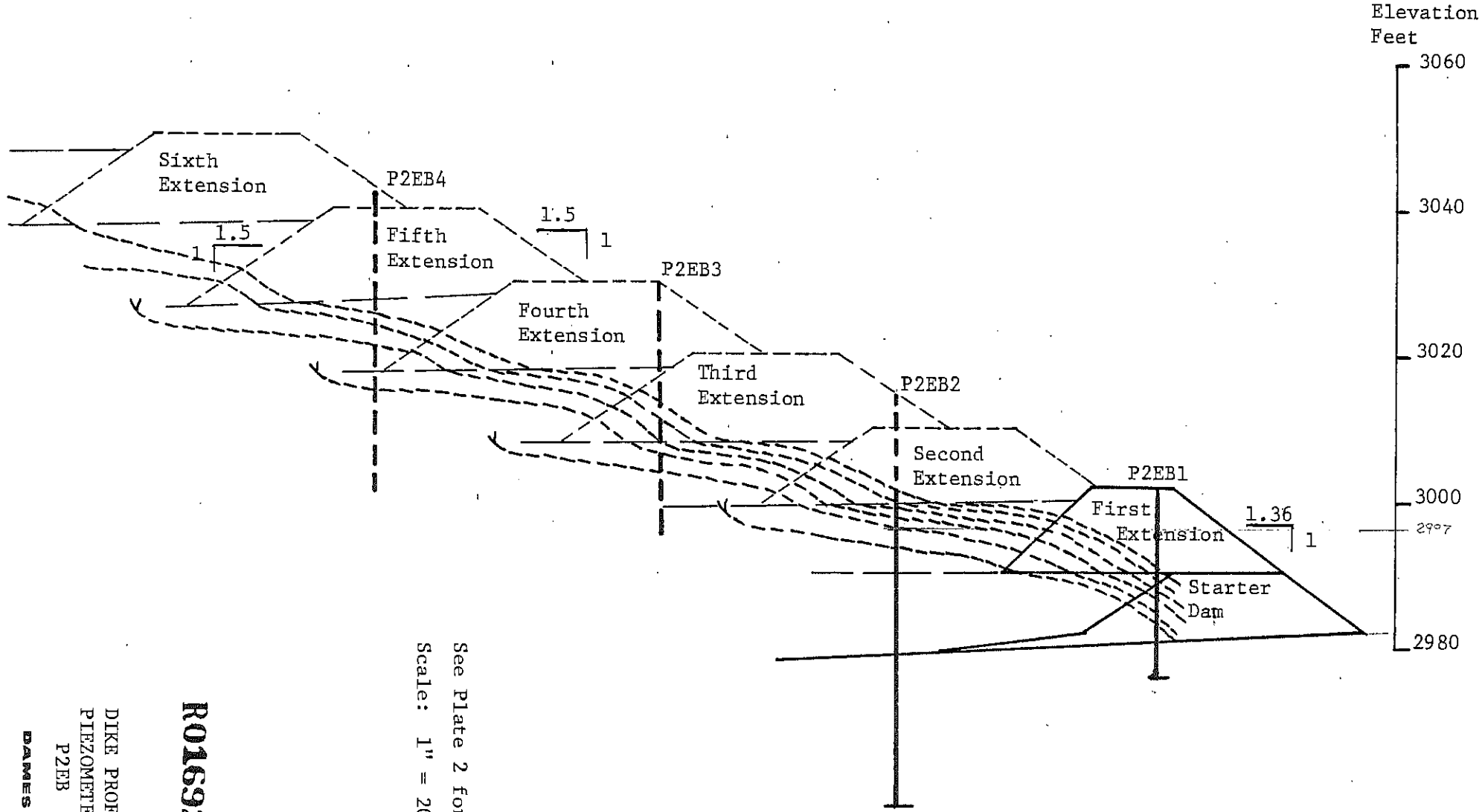
DIKE PROFILE OF
PIEZOMETER LINE
P1WB

DAMES & MOORE

PLATE 4

BY _____ DATE _____
CHECKED BY _____ FILE _____

REVISIONS
BY _____ DATE _____



See Plate 2 for Notes
Scale: 1" = 20'

R01692

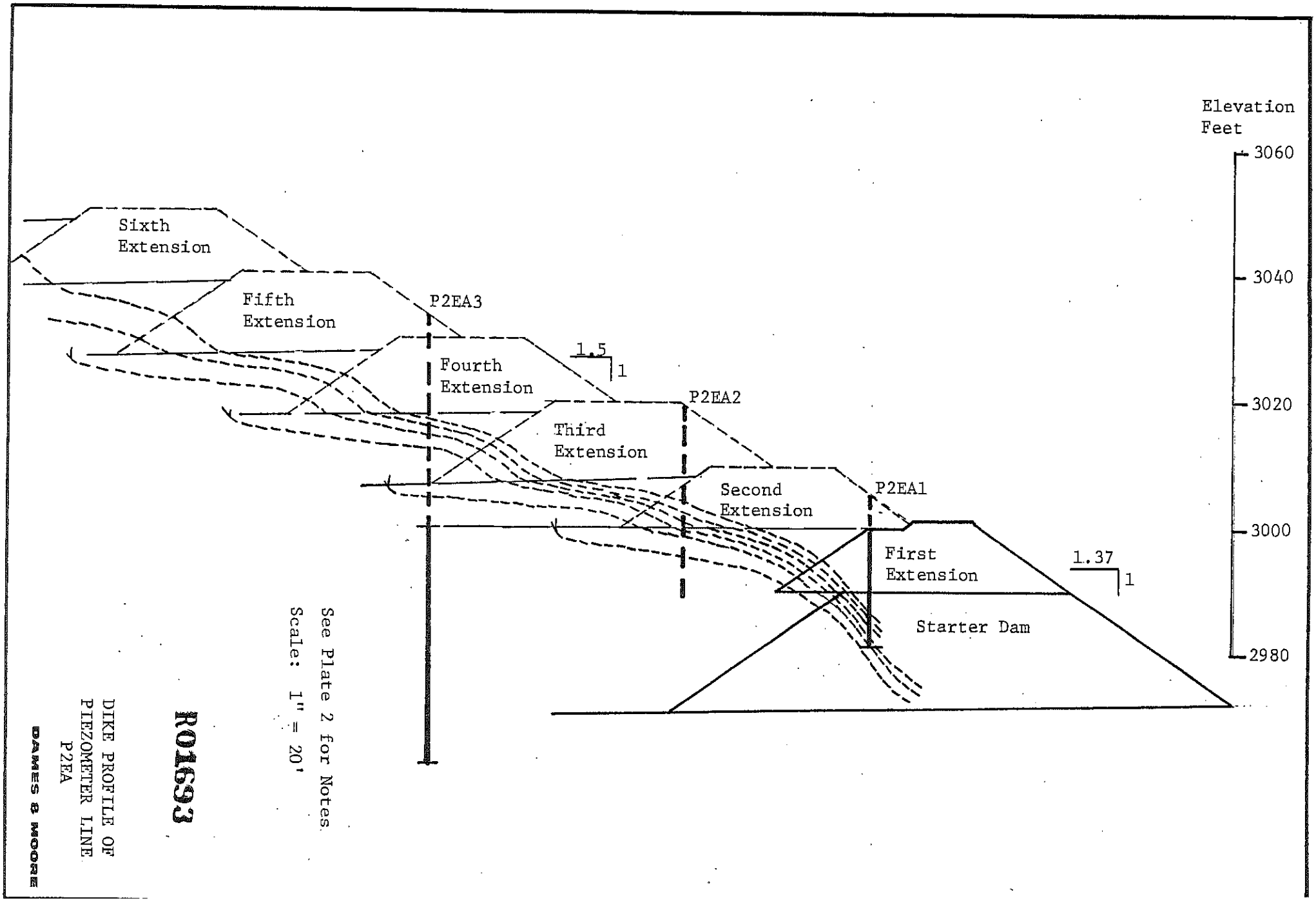
DIKE PROFILE OF
PIEZOMETER LINE
P2EB

DAMES & MOORE

PI ATF 5

BY _____ DATE _____
CHECKED BY _____ FILE _____

REVISIONS
BY _____ DATE _____



See Plate 2 for Notes.
Scale: 1" = 20'

R01693

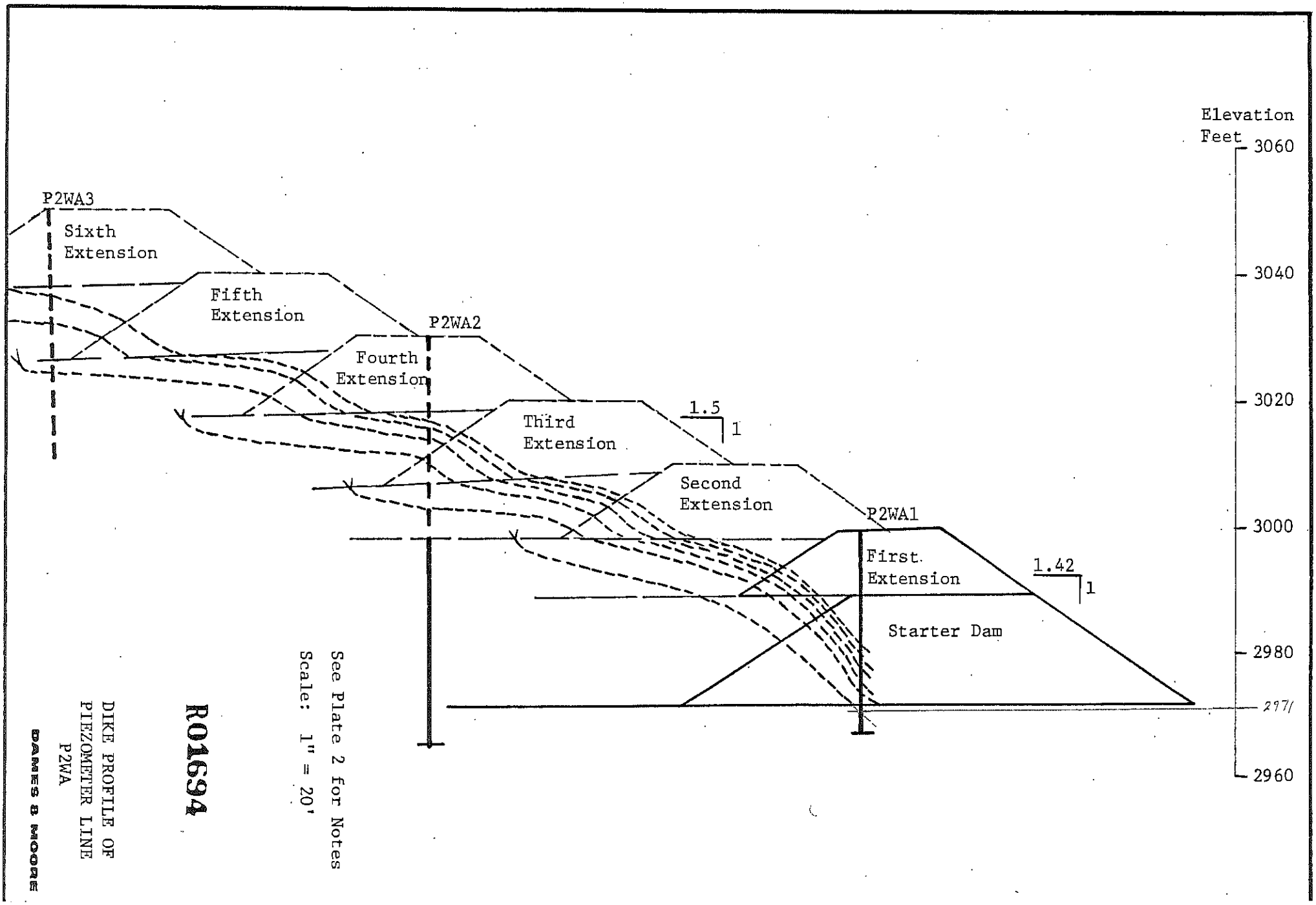
DIKE PROFILE OF
PIEZOMETER LINE
P2EA

DAMES & MOORE

PLATE 6

BY _____ DATE _____
CHECKED BY _____ FILE _____

REVISIONS
BY _____ DATE _____



See Plate 2 for Notes
Scale: 1" = 20'

R01694

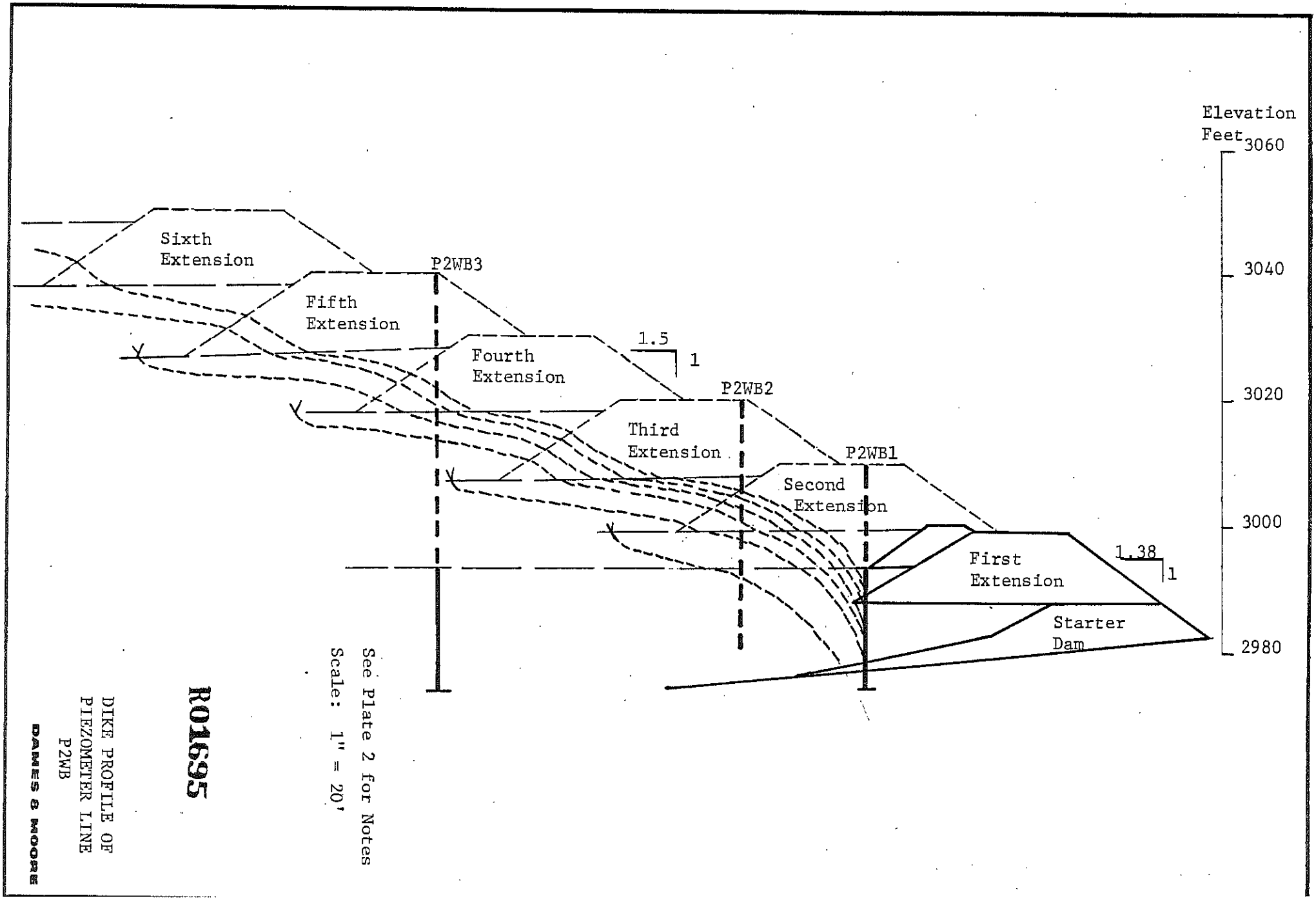
DIKE PROFILE OF
PIEZOMETER LINE
P2WA

DAMES & MOORE

PLATE 7

BY _____ DATE _____
CHECKED BY _____ FILE _____

REVISIONS
BY _____ DATE _____



R01695

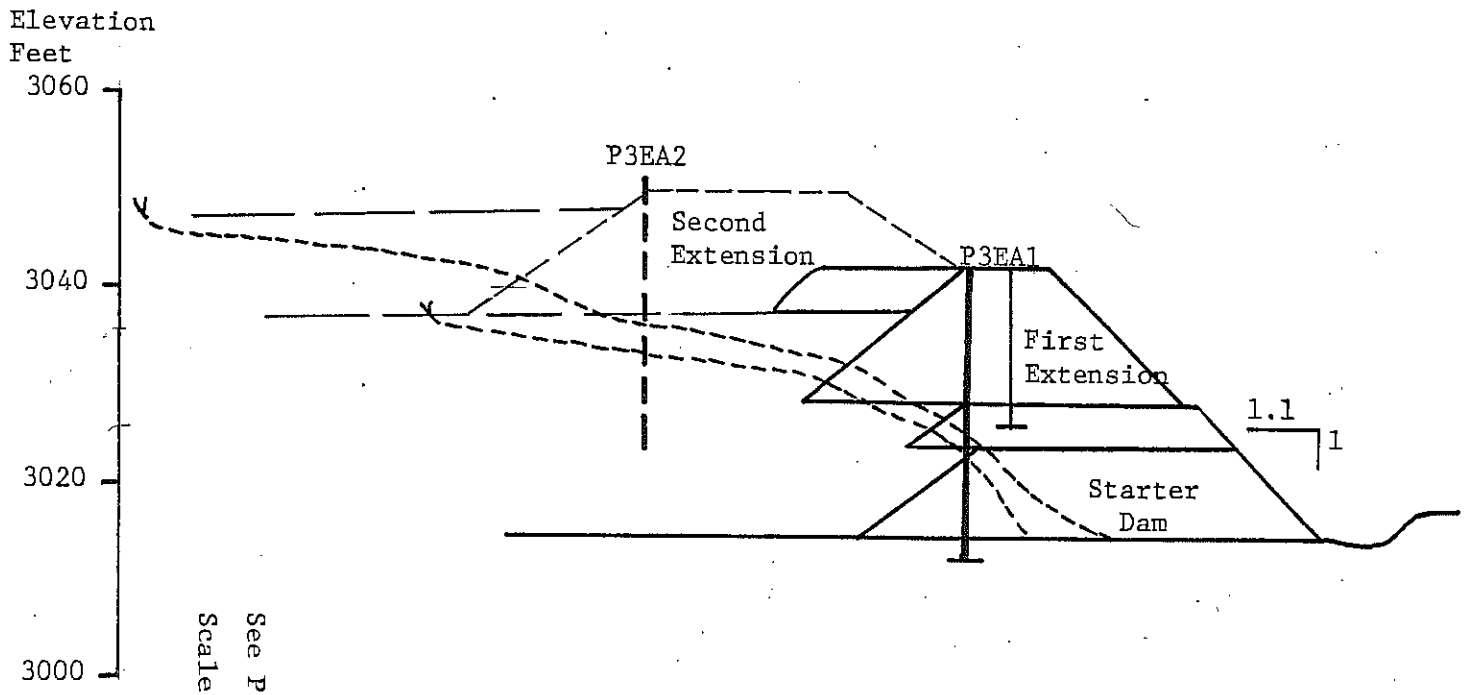
DIKE PROFILE OF
PIEZOMETER LINE
P2WB

DAMES & MOORE

PLATE 8

BY _____ DATE _____
CHECKED BY _____ FILE _____

REVISIONS
BY _____ DATE _____



See Plate 2 for Notes
Scale: 1" = 20'

R01696

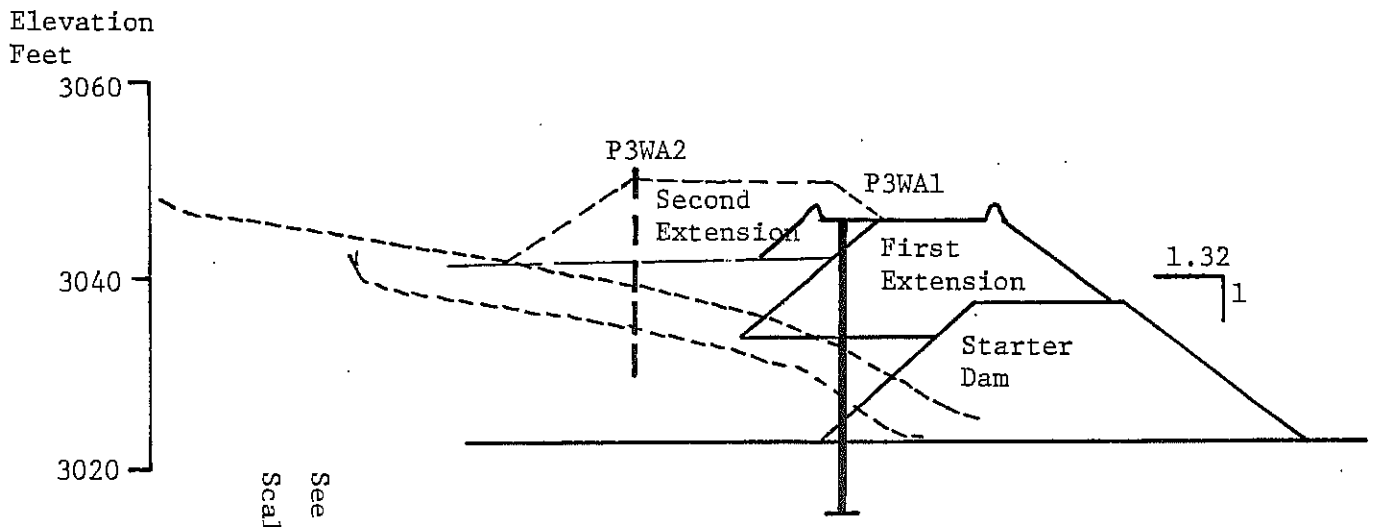
DIKE PROFILE OF
PIEZOMETER LINE
P3EA

DAMES & MOORE

PLATE 9

BY _____ DATE _____
CHECKED BY _____ FILE _____

REVISIONS
BY _____ DATE _____



See Plate 2 for Notes
Scale: 1" = 20'

R01697

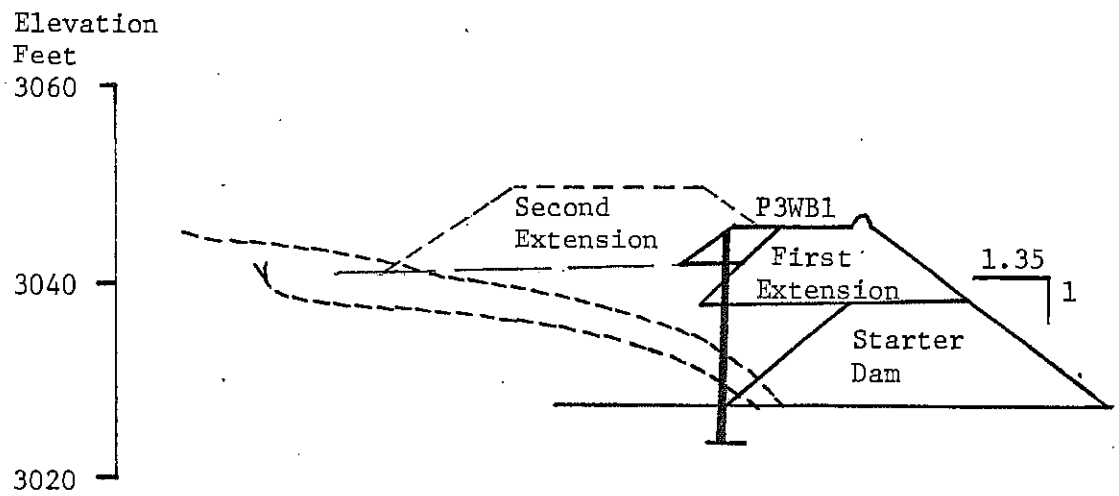
DIKE PROFILE OF
PIEZOMETER LINE
P3WA

DAMES & MOORE

PLATE 10

BY _____ DATE _____
CHECKED BY _____ FILE _____

REVISIONS
BY _____ DATE _____



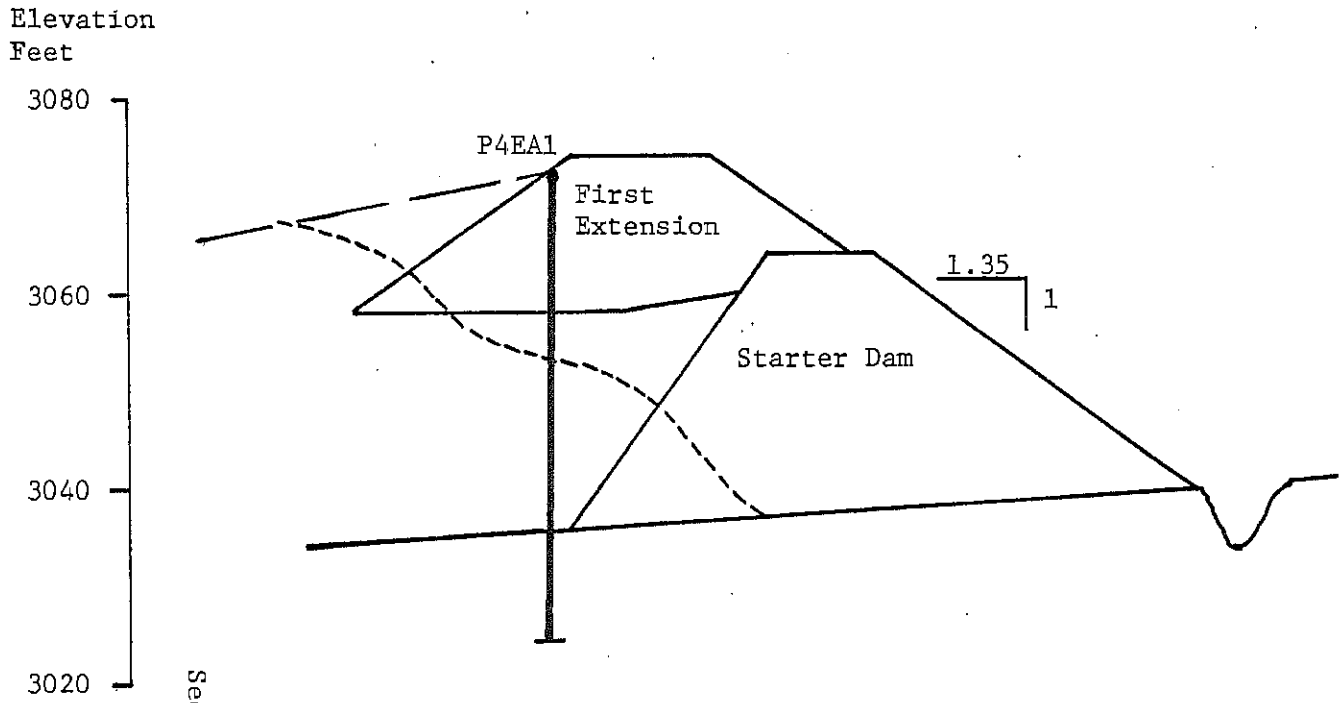
R01698

DIKE PROFILE ON
PIEZOMETER LINE
P3WB

DAMES & MOORE

PLATE 11

BY _____ DATE _____
CHECKED BY _____ FILE _____ REVISIONS
BY _____ DATE _____



See Plate 2 for Notes

Scale: 1" = 20'

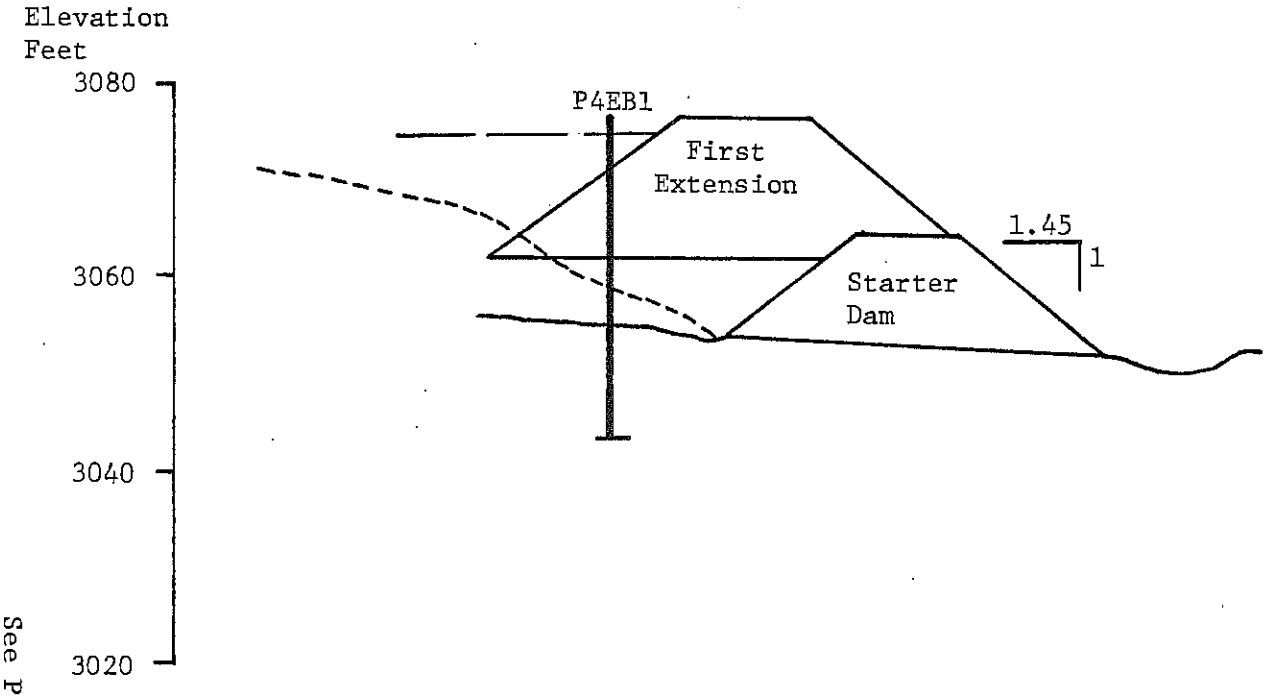
R01699

DIKE PROFILE OF
PIEZOMETER LINE
P4EA

DAMES & MOORE

BY _____ DATE _____
CHECKED BY _____ FILE _____

REVISIONS
BY _____ DATE _____



See Plate 2 for Notes
Scale: 1" = 20'

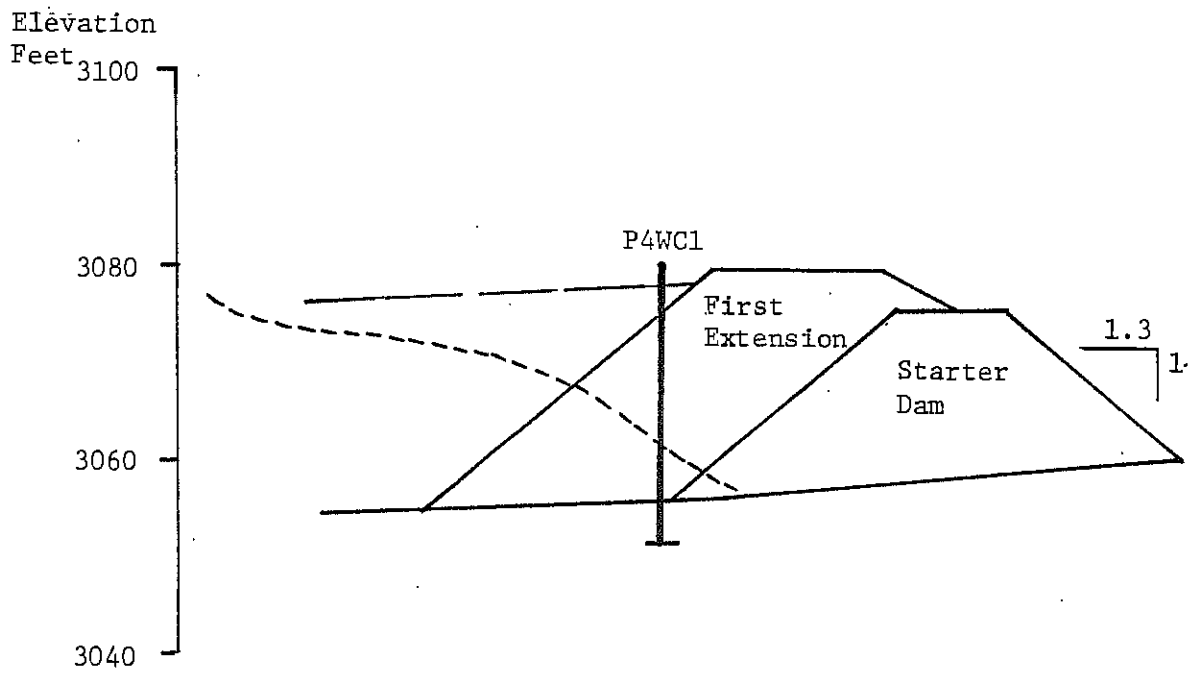
R01700

DIKE PROFILE OF
PIEZOMETER LINE
P4EB

DAMES & MOORE

BY _____ DATE _____
CHECKED BY _____ FILE _____

REVISIONS
BY _____ DATE _____



See Plate 2 for Notes

Scale: 1" = 20'

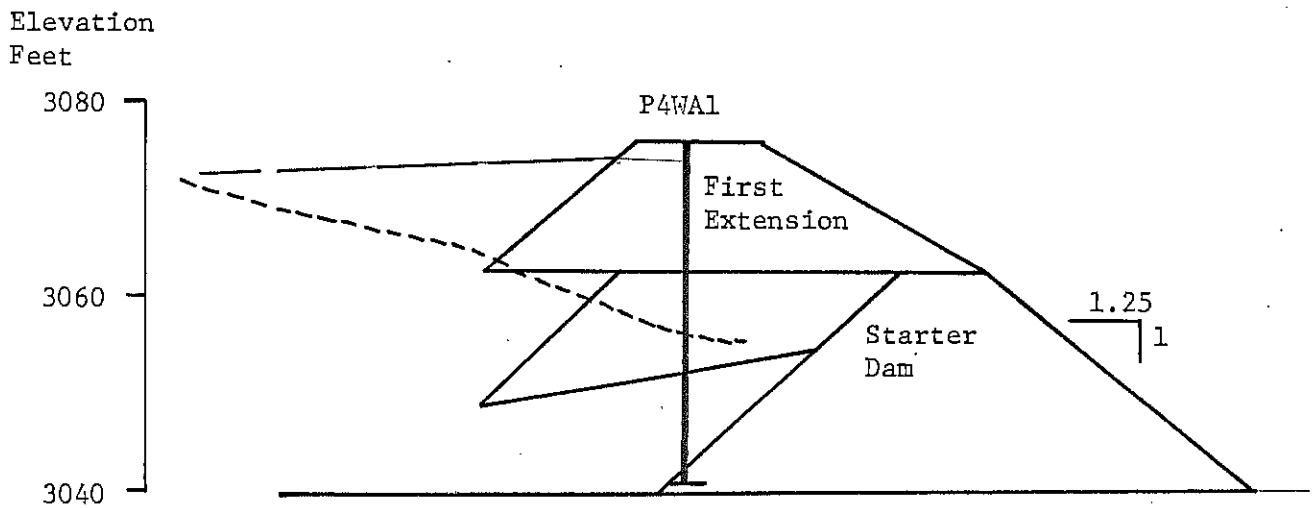
R01701

DIKE PROFILE OF
PIEZOMETER LINE
P4WC

DAMES & MOORE

BY _____ DATE _____
CHECKED BY _____ FILE _____

REVISIONS
BY _____ DATE _____



See Plate 2 for Notes

Scale: 1" = 20'

R01702

DIKE PROFILE OF
PIEZOMETER LINE
P4WA

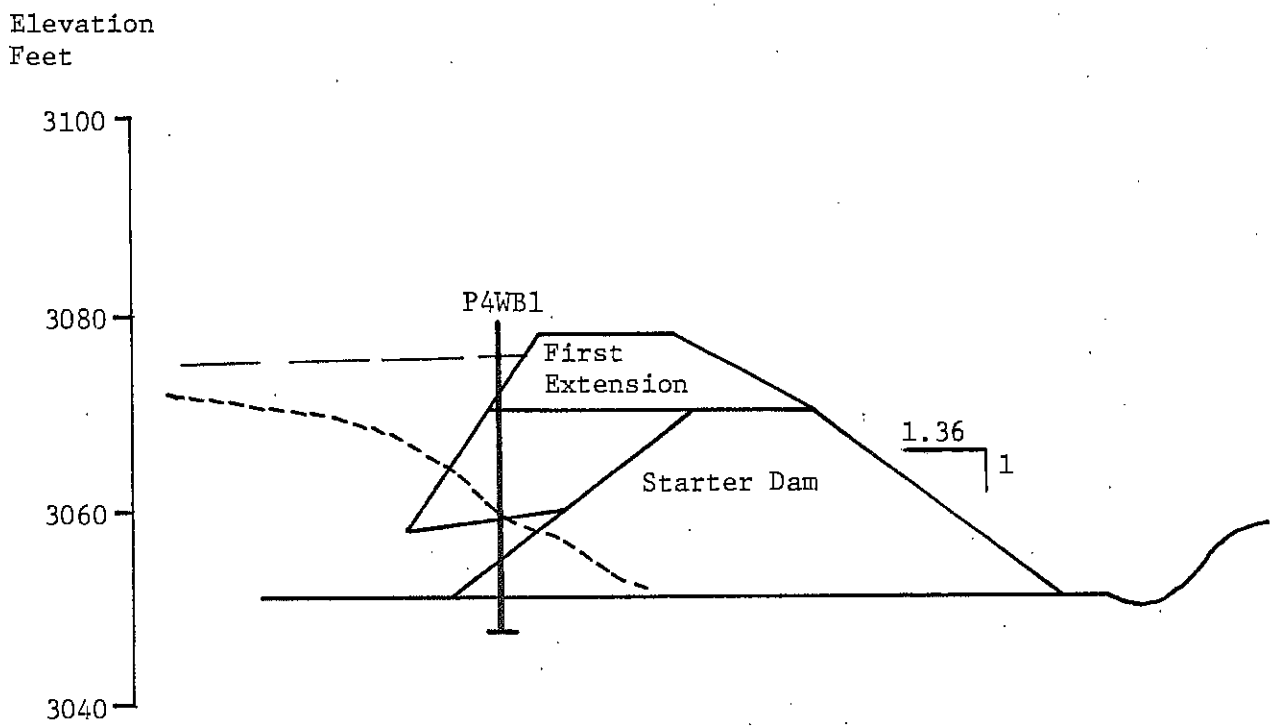
DAMES & MOORE

946

BY _____ DATE _____
CHECKED BY _____

FILE _____

REVISIONS
BY _____ DATE _____



R01703

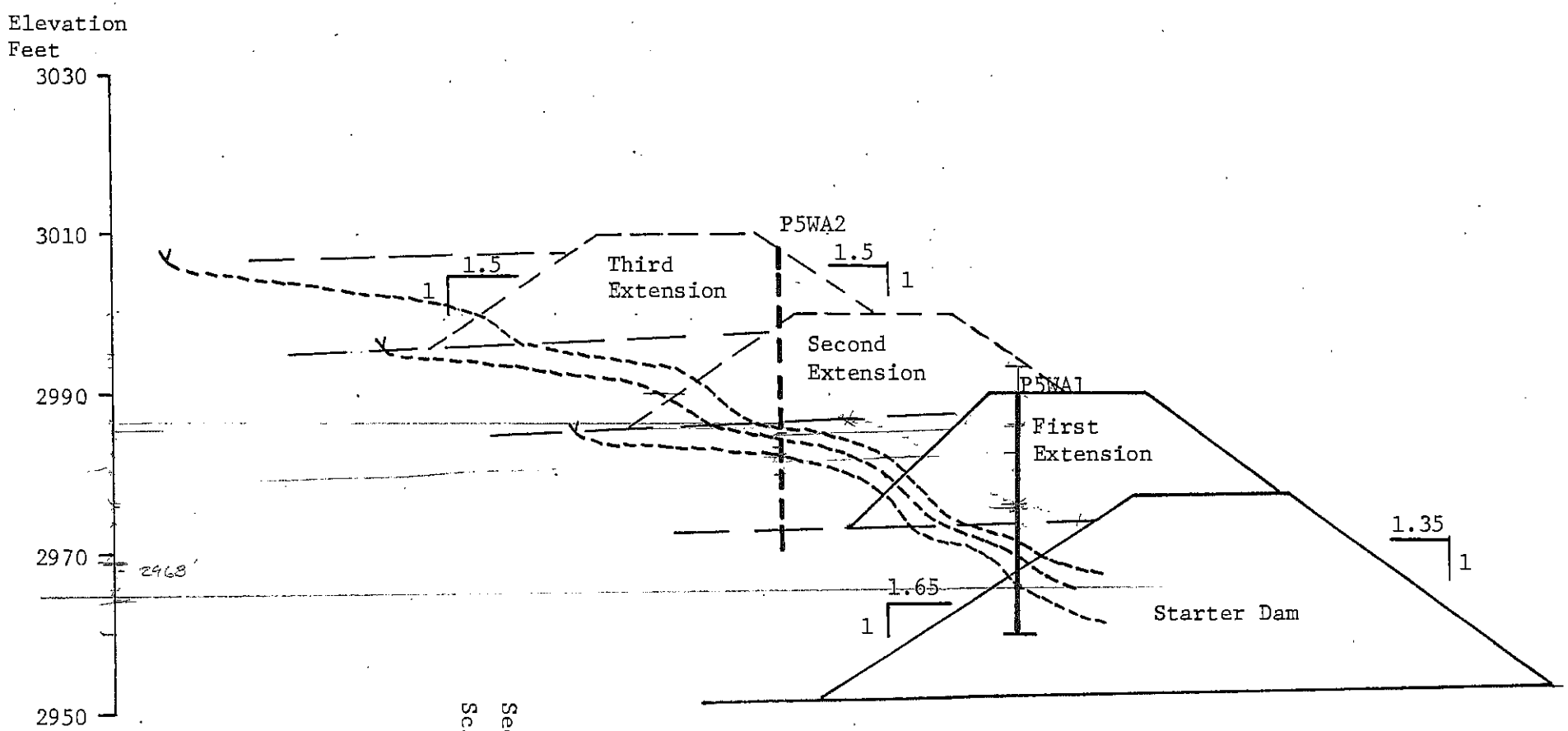
DIKE PROFILE OF
PIEZOMETER LINE
P4WB

DAMES & MOORE

PLATE 16

BY _____ DATE _____
CHECKED BY _____ FILE _____

REVISIONS
BY _____ DATE _____



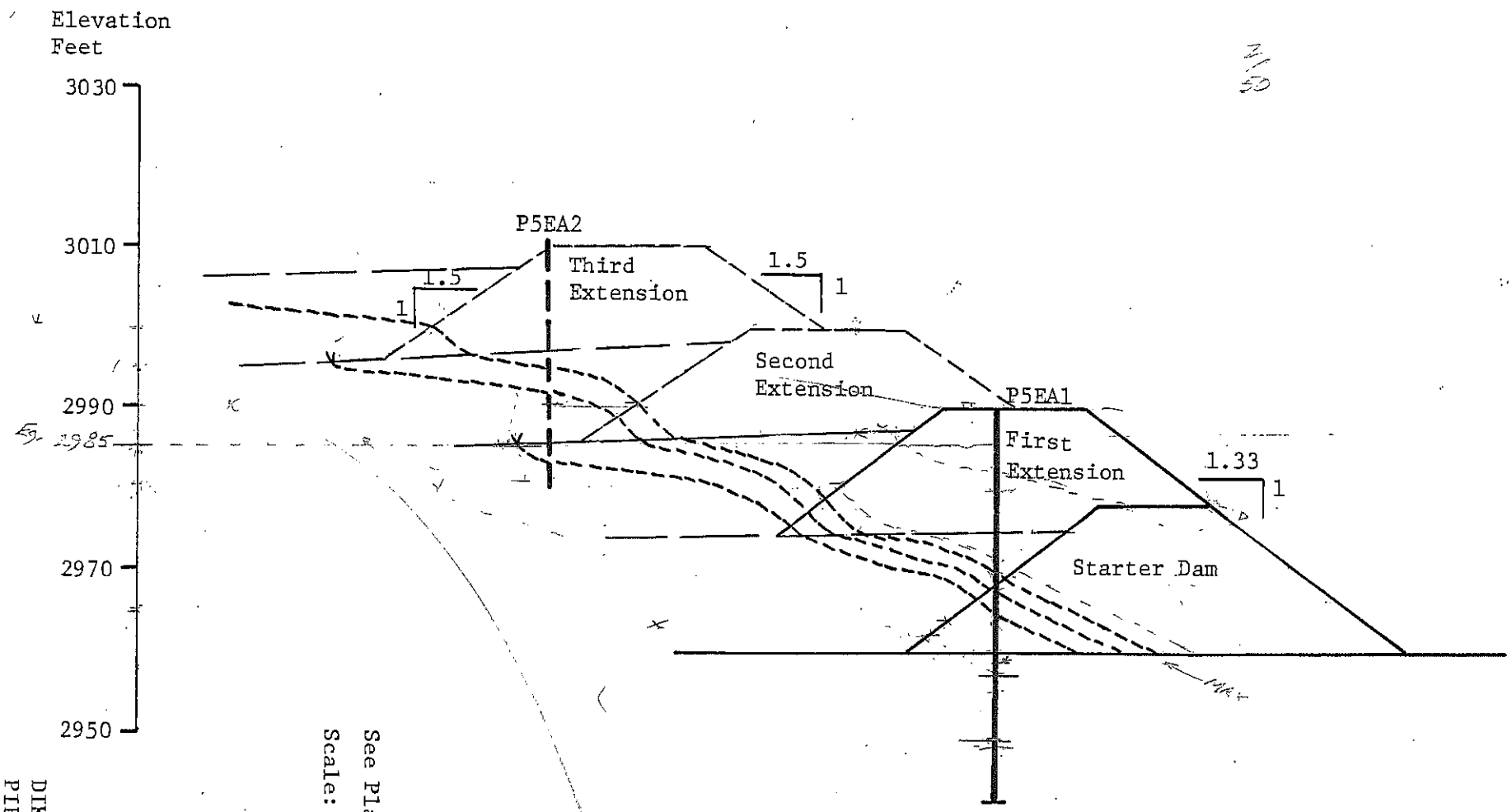
See Plate 2 for Notes
Scale: 1" = 20'

R01704

DIKE PROFILE OF
PIEZOMETER LINE
P5WA
DAMES & MOORE

BY _____ DATE _____
CHECKED BY _____ FILE _____

REVISIONS
BY _____ DATE _____



See Plate 2 for Notes
Scale: 1" = 20'

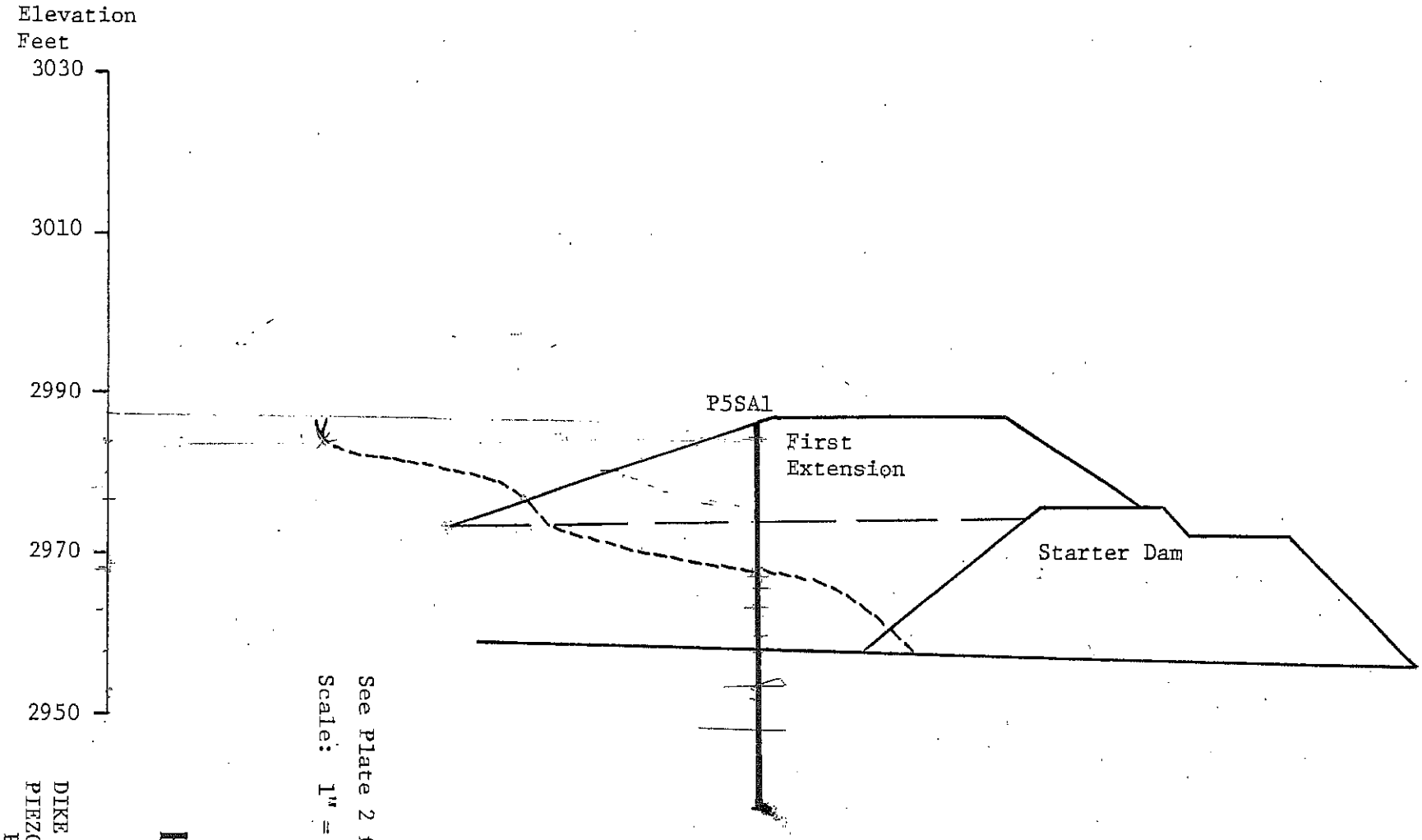
R01705

DIKE PROFILE OF
PIEZOMETER LINE
P5EA

DAMES & MOORE

BY _____ DATE _____
CHECKED BY _____ FILE _____

REVISIONS
BY _____ DATE _____

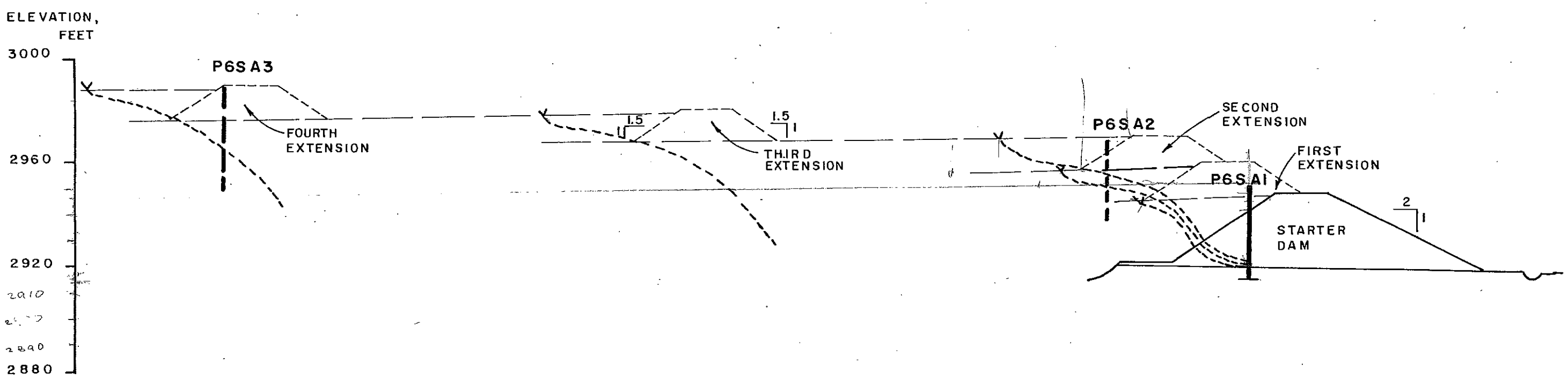


See Plate 2 for Notes
Scale: 1" = 20'

R01706

DIKE PROFILE OF
PIEZOMETER LINE
P5SA
DAMES & MOORE

R01707



SCALE 1"= 40'

SEE PLATE 2 FOR NOTES.

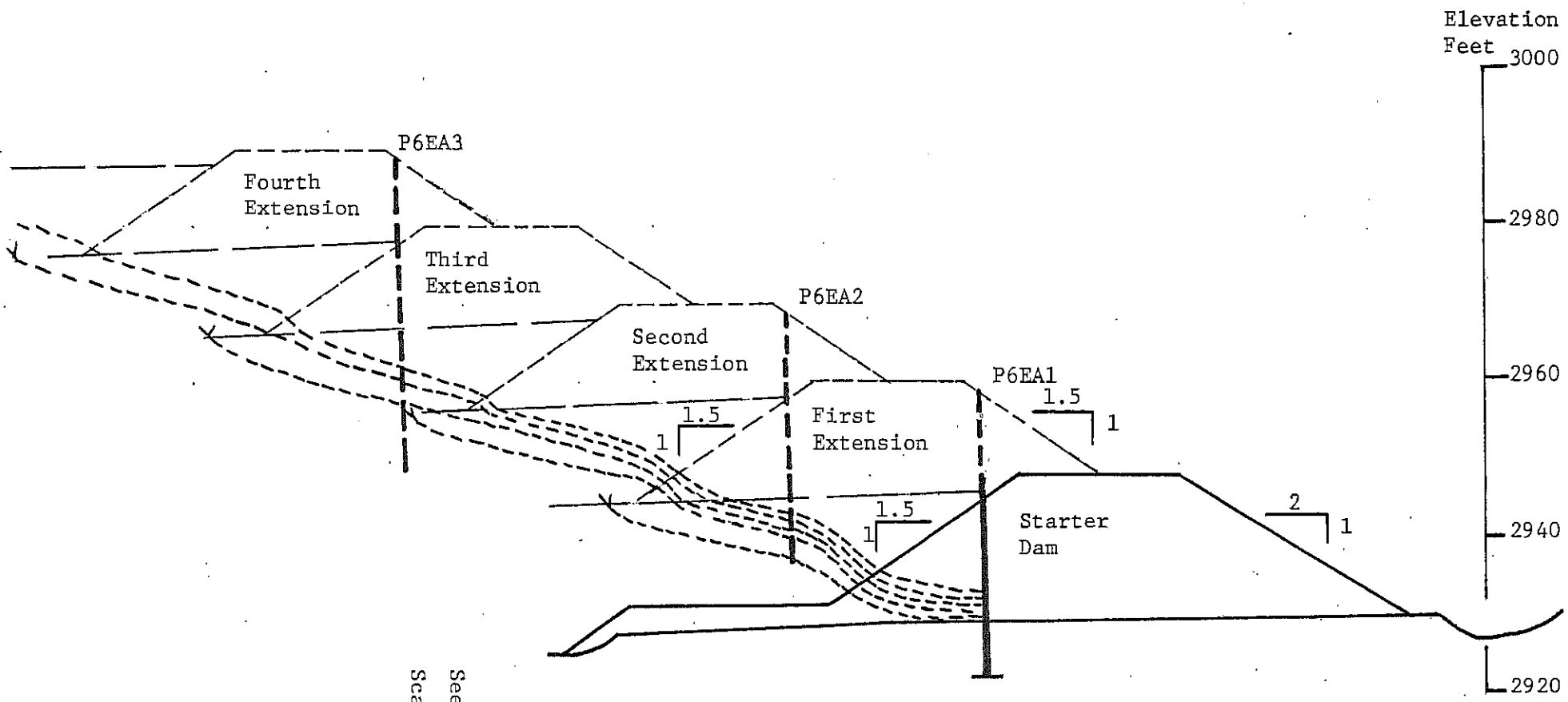
DIKE PROFILE OF PIEZOMETER LINE P6SA

DAMES & MOORE

946 7 (REV. 6 61)

BY _____ DATE _____
CHECKED BY _____ FILE _____

REVISIONS
BY _____ DATE _____



See Plate 2 for Notes
Scale: 1" = 20'

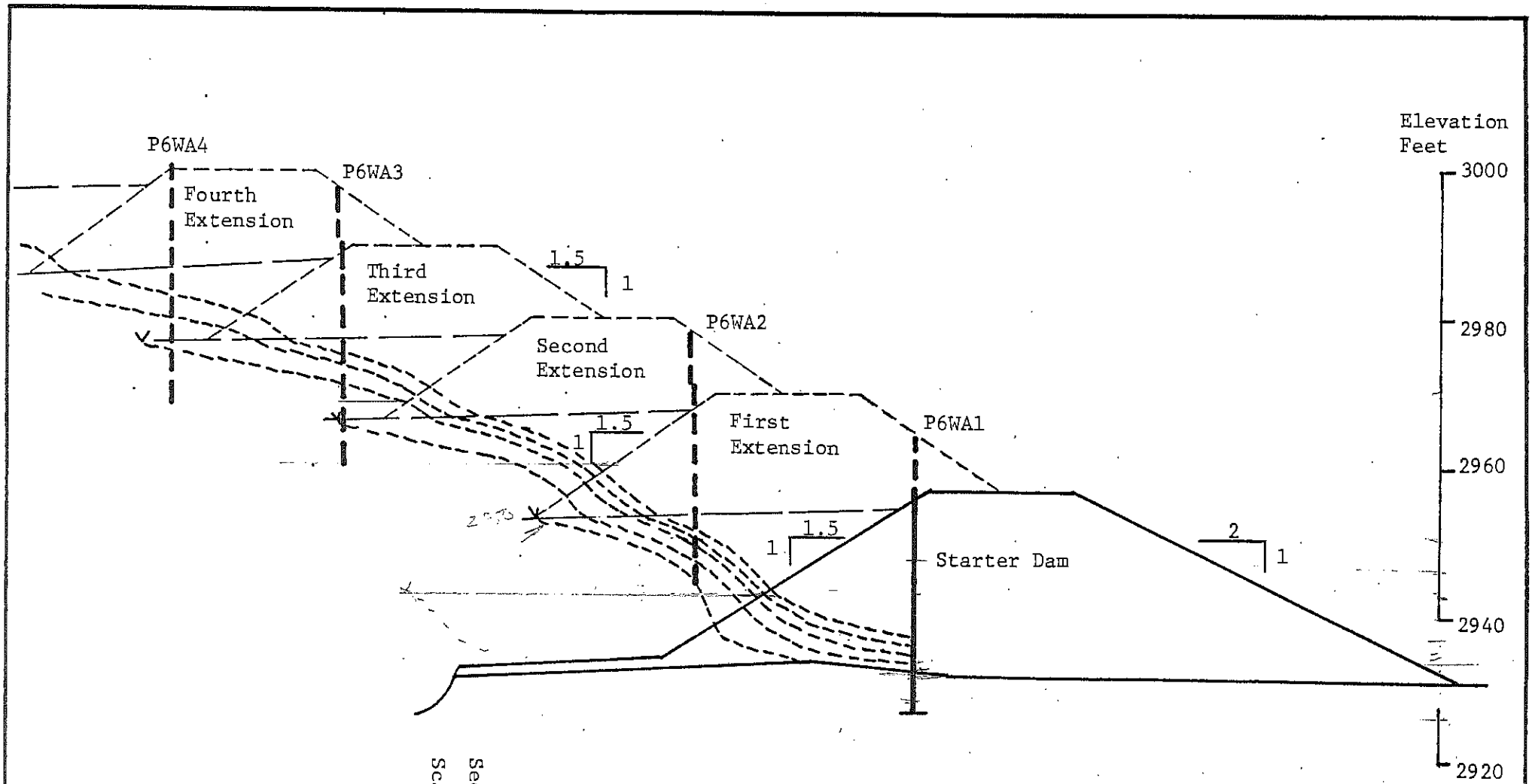
R01708

DIKE PROFILE OF
PIEZOMETER LINE
P6EA
DAMES & MOORE

PLATE 21

BY _____ DATE _____
CHECKED BY _____ FILE _____

REVISIONS
BY _____ DATE _____



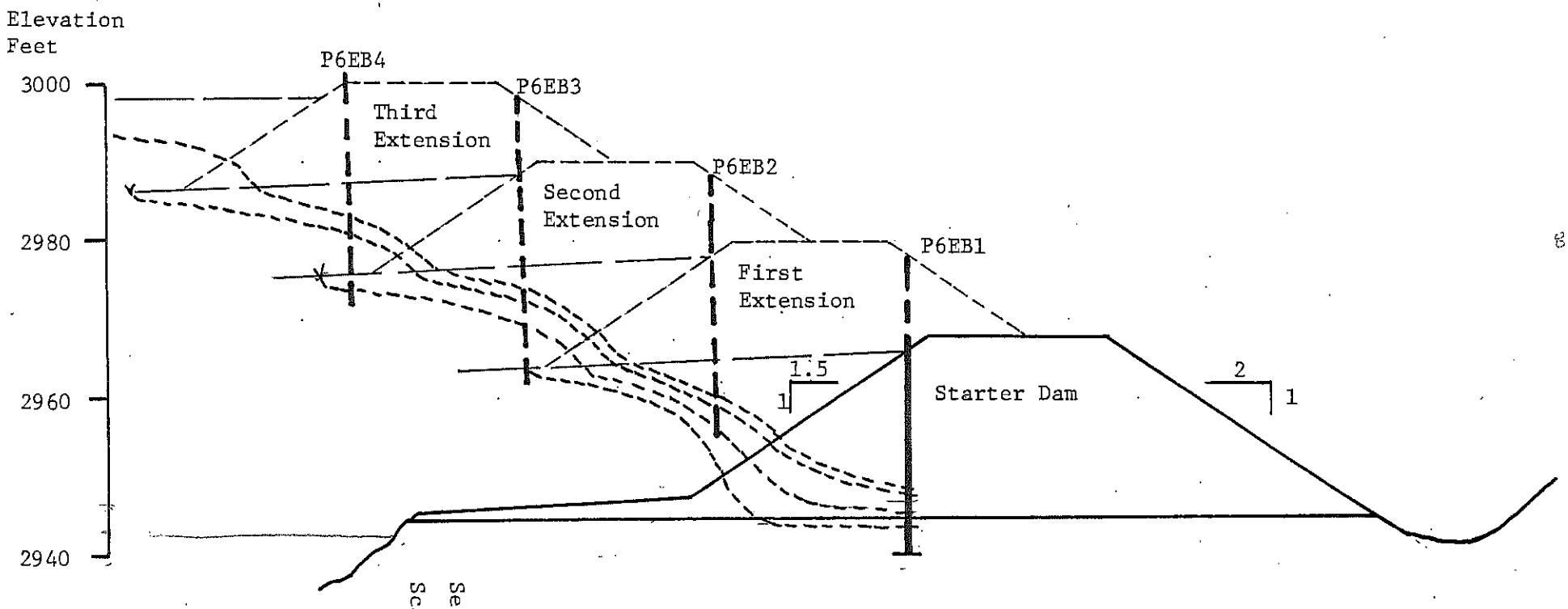
See Plate 2 for Notes
Scale: 1" = 20'

R01709

DIKE PROFILE OF
PIEZOMETER LINE
P6WA
DAMES & MOORE

BY _____ DATE _____
CHECKED BY _____ FILE _____

REVISIONS
BY _____ DATE _____



See Plate 2 for Notes
Scale: 1" = 20'

R01710

DIKE PROFILE OF
PIEZOMETER LINE
P6EB

DAMES & MOORE

DECANT POND POSITION

Inspection Report for Week Ending: _____

Date: _____ Inspector: _____

GENERAL POND POSITION

Day	Horizontal Distance to Decant Pond (feet) at Piezometer Lines					
Sun.						
Mon.						
Tues.						
Wed.						
Thur.						
Fri.						
Sat.						

LOCATIONS WHERE POND LESS THAN 50 FT. FROM CREST

Spigot Number	Distance to Pond	Reason for nearness

SUMMARY OF REMEDIAL ACTION WHERE DISTANCE FROM CREST OF DIKE TO DECANT POND IS LESS THAN 50 FEET: _____

_____

_____

_____

_____

_____

_____

R01711

INSPECTION REPORT

For Week Ending _____.

Date: _____ Inspector: _____.

TAILINGS DISCHARGE:	Main Tailings Line Yes	Main Tailings Line No	Dike Crest Branch Yes	Dike Crest Branch No
Normal and adequate procedures?				
Pipe cracks, leaks or movement?				
Landslides or erosion near pipe?				
Pond within 50 feet of crest?				
Tailings at crest level?				

DIKE:	Upstream Slope Yes	Upstream Slope No	Downstream Slope Yes	Downstream Slope No	Dike Crest Yes	Dike Crest No
Erosion?						
Movement or cracks?						
Seepage or wet areas?						
Vegetative Growth?						
Animal burrows?						

DECANT SYSTEM:	Northeast Tower Yes	Northeast Tower No	Southwest Tower Yes	Southwest Tower No	Cental Decant Tower Yes	Cental Decant Tower No	North Spillpipe Outlet Yes	North Spillpipe Outlet No	South Spillpipe Outlet
Debris & blockage?									
Pipe breaks or scour?									
Corrosion or erosion?									
Normal flow?									
Protectors intact?									

R01712

The following unusual conditions were observed or reported during the week _____

_____

_____.

PIEZOMETER READINGS

Piezometer	Elevation of Water In Tailings Pond	Elevation of Top of Pipe	Depth to Phreatic Surface from Top of Pipe	Elevation of Phreatic Surface

Data Plotted ? Yes No

Data Plotted above or below maximum allowable phreatic surface elevation?

If data plotted above the maximum allowable elevation, the following steps were taken _____

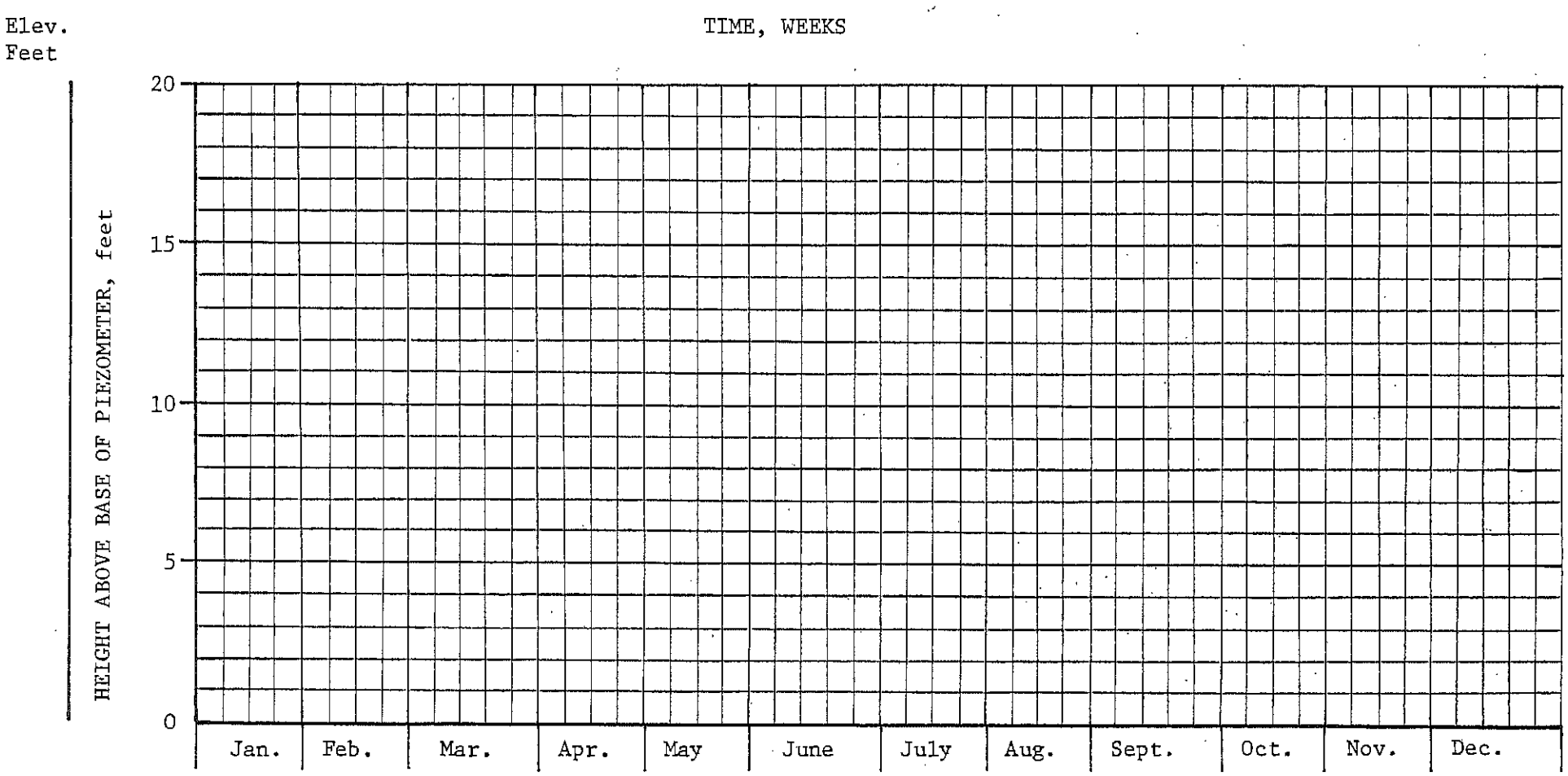
_____

Date: _____ Signed: _____

R01713

BY _____ DATE _____
CHECKED BY _____ FILE _____

REVISIONS
BY _____ DATE _____



PLOT OF PIEZOMETER READINGS

R01714

DAMES & MOORE

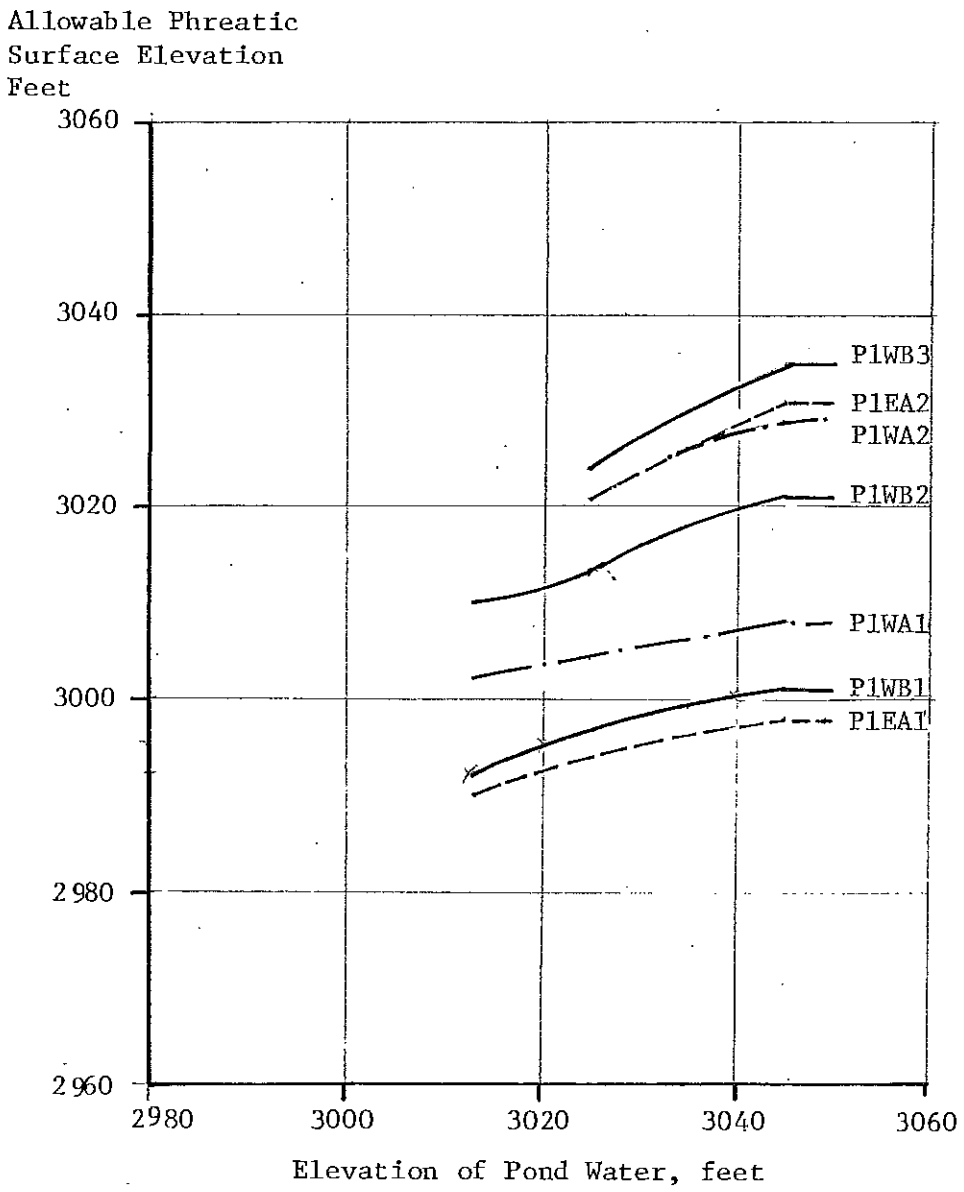
PLATE 27

REVISIONS BY _____ DATE _____

FILE _____

BY _____ DATE _____

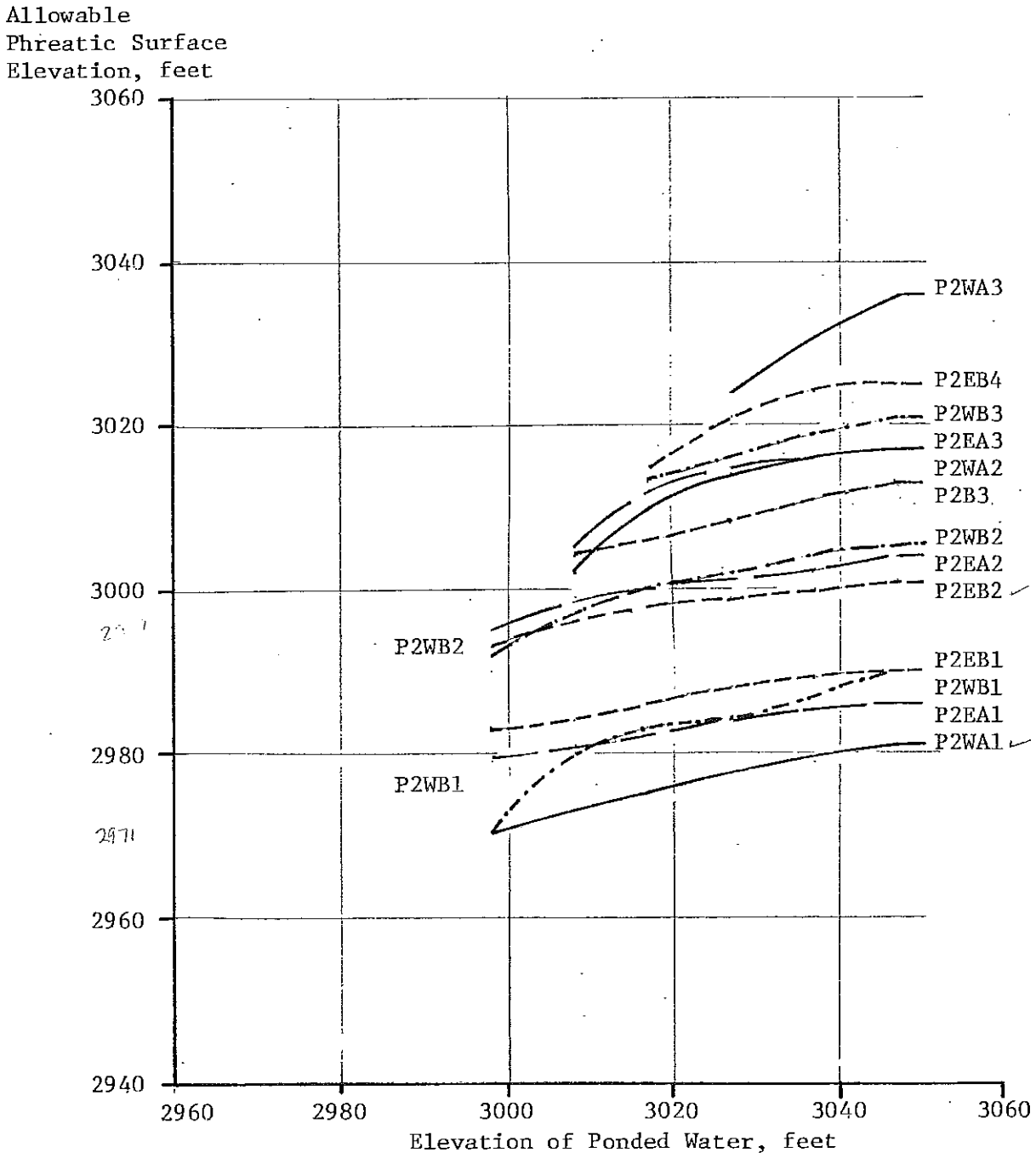
CHECKED BY _____



R01715

STAR POND NO. 1
ALLOWABLE
PHREATIC SURFACES

DAMES & MOORE



R01716

STAR POND NO. 2
ALLOWABLE
PHREATIC SURFACES

DAMES & MOORE

PLATE 29

REVISIONS BY DATE

FILE

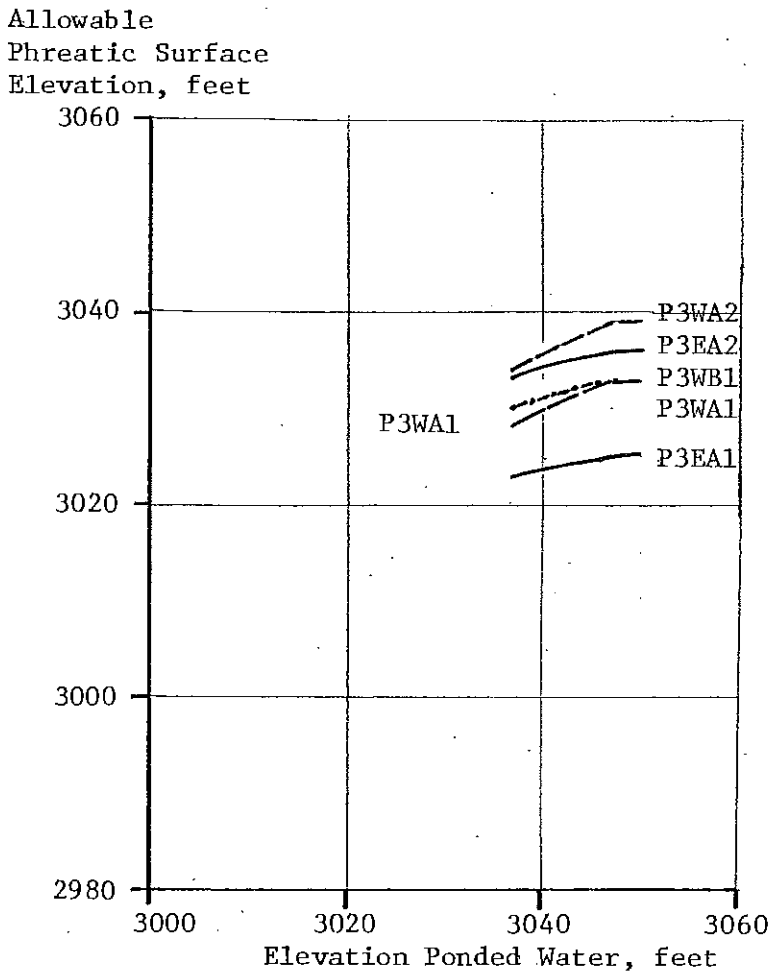
BY DATE

CHECKED BY

REVISIONS BY _____ DATE _____

FILE _____

BY _____ DATE _____
CHECKED BY _____



R01717

STAR POND NO. 3
ALLOWABLE
PHREATIC SURFACES

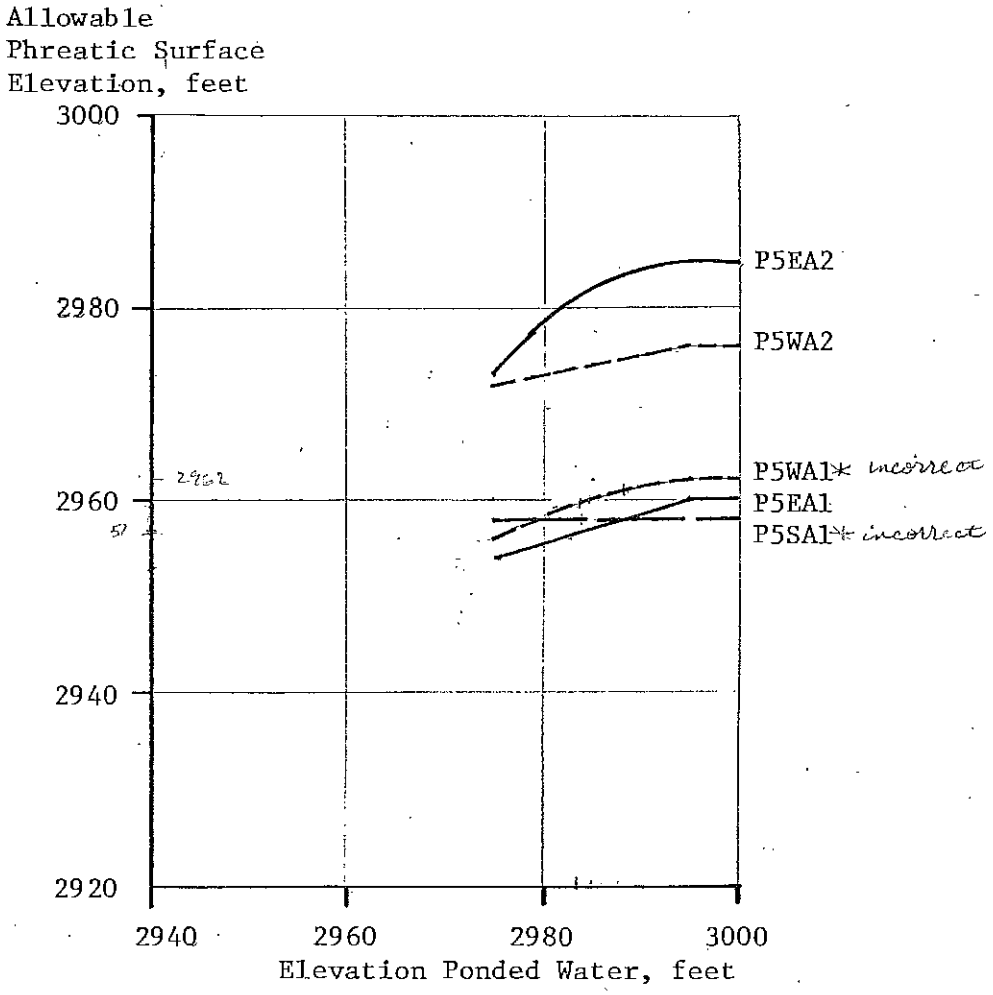
DAMES & MOORE

REVISIONS BY ____ DATE ____

FILE ____

BY ____ DATE ____

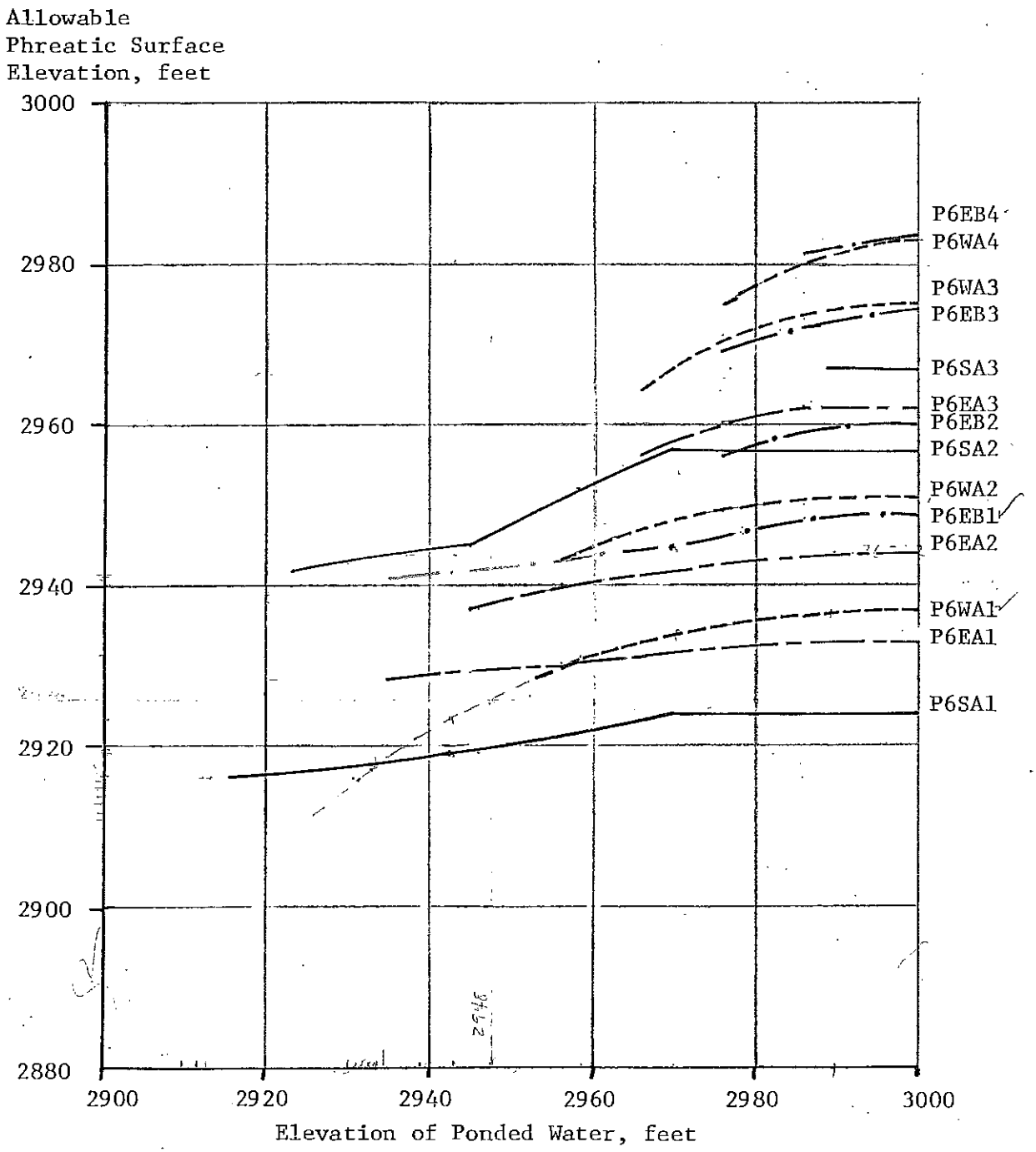
CHECKED BY ____



R01718

STAR POND NO. 5
ALLOWABLE
PHREATIC SURFACES

DAMES & MOORE



R01719

STAR POND NO. 6
ALLOWABLE
PHREATIC SURFACES

DAMES & MOORE

PLATE 32

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REPORT ON
INVESTIGATION AND DESIGN
STAR NOS. 1 to 5 TAILINGS
IMPOUNDMENT EXTENSIONS
WALLACE, IDAHO
FOR HECLA MINING COMPANY

Dames & Moore
March 19, 1980
Job No. 5457-012-32

The embankment configurations that we propose would be stable under normal operating conditions and under dynamic loading, provided the phreatic surface within the tailings remains at or below the design levels. If the water level rises above that indicated, then remedial treatment can be undertaken to reduce potential areas of instability.

We would be available for construction inspection or spot visits, as requested. We would review field data forwarded to our office during construction and complete any follow-up inspections as required.

o 0 o

We appreciate the opportunity of performing these studies for you. If you have any questions concerning this report, of if additional information is required, please contact us.

Yours very truly,

DAMES & MOORE

K. E. Robinson P. Eng.
Partner

C. M. Urlich P. Eng.
Project Engineer

for G. C. Toland
Partner
Prof. Eng. No. 1333
State of Idaho

cc: Idaho Department of Water Resources
373 West Franklin Street
Boise, Idaho
83720

Attention: Mr. A. M. Stubblefield
Dam Safety Section

CMU/KER/bc

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REPORT ON

INVESTIGATION AND DESIGN

STAR NOS. 1 to 5 TAILINGS IMPOUNDMENT EXTENSIONS

WALLACE, IDAHO

FOR

HECLA MINING COMPANY

INTRODUCTION

This report presents the results of our geotechnical investigation and design studies for extending Star Ponds 1 to 5 by the upstream construction method. An investigation was carried out at Pond 2 in 1977 for the first pond raised. Subsequently, a 1979 investigation centered around Ponds 1, 3, 4 and 5. Results of both programs are presented herein, along with our design recommendations for the proposed buildup sections. Separate investigation, design and construction programs on the recent raising of Pond 5 and the building of new Pond 6 were performed in 1979. Details of these activities have been presented in other reports, but are briefly discussed herein in relation to future raising of Pond 5.

This report incorporates information obtained from the following Dames & Moore reports:

1. "Report on Investigation and Design, Star No. 2 Tailings Impoundment Extension, Wallace, Idaho", dated December 14, 1977.
2. "Report on Investigation and Design, Star No. 6 Tailings Impoundment, Wallace, Idaho", dated May 29, 1979.

3. "Report on Site Inspection, Star Pond 5 Dike Extension, Wallace, Idaho", dated July 26, 1979.

4. "Report on Construction Activities, Star No. 6 Tailings Impoundment Facility, Wallace, Idaho", dated December 4, 1979.

5. "Manual for Operation and Inspection, Star Tailings Impoundment Facilities, Wallace, Idaho", dated December 4, 1979.

The December 14, 1977 report has been superseded by the present report since all its contents are updated and included herein. The December 4, 1979 manual referenced the "Report on Investigation and Design, Star Nos. 1, 3 and 4 Tailings Impoundment Extensions" dated December 1979. This report was not submitted to Hecla Mining Company but was replaced by the present report on all five ponds.

The location and configuration of the Star tailings impoundment facility is shown with respect to existing topography on Plate 1.

PURPOSE AND SCOPE

The purpose and scope of this study were outlined in discussions between Messrs. Don Ferguson of Hecla Mining Company and Keith Robinson of Dames & Moore in September 1979. The study was to evaluate existing site conditions at Star Ponds 1 to 5 and to provide design and construction recommendations for the dike extensions.

To accomplish this purpose, the following scope of work was performed:

1. A field exploration program consisting of drilling test borings, installing piezometers and performing insitu density tests to supplement the 1977 field program;
2. Laboratory testing of samples obtained during the field program to supplement the 1977 laboratory program to assess the engineering properties of stored tailings, dike fill and foundation soils;
3. An office engineering program, during which all field and laboratory data were evaluated, and recommendations concerning the design, construction and operation of the ponds were developed; and
4. The preparation and submittal of this report, which includes all field and laboratory data, and the presentation of our conclusions and design recommendations.

FIELD AND LABORATORY INVESTIGATION

The 1977 and 1979 field exploration programs were performed to investigate stored tailings, dike fill and foundation soils at Star Ponds 1 to 5. They included drilling, logging and sampling 29 borings, installation of piezometers in 22 of the completed boreholes, and performing 17 insitu density tests. Three of the designated borings were water wells drilled through the foundation soils and into bedrock in the vicinity of Pond 4.

The laboratory testing program was performed to assess the engineering properties of stored tailings, dike fill and foundation soils. It included determination of moisture and density, gradation, specific gravity, consolidation characteristics, relative density, shear strength from direct shear and triaxial compression tests, permeability, and liquefaction potential of the tailings from cyclical shear tests.

The method of laboratory testing, results and background information regarding the field investigation and laboratory testing program are summarized in Appendix A. Locations of all field explorations are shown on Plate 2.

SITE CONDITIONS

GENERAL

The Star tailings impoundment facility is located in the center of the Canyon Creek Valley, about 5½ miles southwest of the Star Mine and 2½ miles northeast of Wallace. The facility consists of six tailings impoundments, Ponds 1 to 6, built in series over a mile section of the valley floor, as shown on Plates 1 and 2. The valley bottom slopes from Elevation 3060 feet at the upstream end of Pond 4 to Elevation 2910 feet at the downstream toe of Pond 6. The pond embankments are bounded on the northwest by a paved road, on the southeast by Canyon Creek and a railway, and on the southwest by tailings stored in the adjacent downstream ponds. With the exception of Pond 5, the northeast edge of each pond is backed up against the southwest embankment of the adjacent upstream pond. Ponds 5 and 2 are separated by a gravel road, aligned across the valley, which provides access to a farmstead on the southeast side of Canyon Creek. A longitudinal profile of the ponds is presented on Plate 3.

The existing embankments of Ponds 1 to 5 consist of starter dams and extensions built over, and upstream of, the starter dams. The tailings discharge line is located along the crest of the northwest embankments, from where tailings are fed by gravity to a series of discharge points around the ponds. Water levels in the ponds are controlled by decanting through towers located adjacent to the embankments. The tower bases are connected by elbows to decant lines passing through the embankments and discharging into ditches that flow along the embankment toes and into Canyon Creek. Existing embankment profiles are presented in Appendix A and on Plates 4 through 21.

Prior to the 1979 field program, tailings were discharged into Pond 4. To maximize retention time, tailings water from Pond 4 was decanted to

Pond 3, and finally to Pond 1, before being discharged from the pond system through a decant tower near the northwest embankment of Pond 1. During this period Ponds 4 and 3, and the northern half of Pond 1, were mostly inundated. During the 1979 field program tailings deposition was switched from Pond 4 to the newly built Pond 6. For the short term tailings disposition will be alternated between Ponds 5 and 6.

POND EMBANKMENTS

The existing embankments of Ponds 1 to 5 were constructed in two phases as tabulated:

Pond Number	Starter Dam Elev. (ft)	Starter Dam Height (ft)	Extension Elev. (ft)	Extension Height (ft)
1	3002 - 3006	5 - 18	3015 - 3016	10 - 14
2	2888 - 2993	8 - 20	2999 - 3002	7 - 13
3	3029 - 3039	11 - 22	3042 - 3046	8 - 13
4	3063 - 3071	12 - 30	3074 - 3079	4 - 12
5	3976 - 2979	12 - 28	2987 - 2993	11 - 12
6	2948 - 2968	20 - 30	-	-

The new Pond 6 embankment was constructed in one phase. For our design studies, existing crest elevations of 3016, 3000, 3045, 3075 and 2990 feet were assumed for Ponds 1 to 5, respectively.

We understand that starter dams were all constructed from gravels scraped up from the reservoir basins, with the exception of Ponds 4 and 6 which combined adjacent hillside material with the gravels. The starter dams for Ponds 1 to 5 were compacted with grid rollers. The Pond 6 starter dam was compacted with a Bromag pad-foot vibratory roller. The starter dams of Ponds 1 to 5 were raised by placing fill over the previous crest, and upstream over the tailings. Fill consisted of hillside borrow material and waste from the Star Mine.

The compacted gravel fill of the starter dams ranges from medium dense to very dense. For the gravels tested, the amount of material passing the No. 200 U. S. Standard sieve ranged from 0 percent to 28 percent by weight. The gravel content of these samples ranged from 36 percent to 88 percent.

The hillside borrow and mine waste construction materials included in the existing dike extensions is generally in a medium dense to dense state, but increases to very dense in zones containing cobbles and boulders. For the dike extension materials tested, the amount passing the No. 200 U. S. Standard sieve ranged from 13 percent to 45 percent by weight. The gravel content of these samples ranged from 40 percent to 100 percent.

Shear strength tests of the construction materials were not completed. However, it can be safely assumed that these granular soils have effective angles of internal friction in excess of 35 degrees. For slope stability analyses, a friction angle of 35 degrees and an insitu total density of 130 pounds per cubic foot were assumed.

TAILINGS BACKFILL

Tailings backfill in the vicinity of the embankments consists mostly of grey silt with occasional layers of light grey sand. The silt is the fine portion of tailings known as slimes. Abrupt gradation changes from slimes to sands within borings, are due to the relocation of discharge and decant lines as the ponds were being filled. The percentage of slimes appears to increase in the vicinity of the decant towers, as expected. We understand that Ponds 1 and 2 contain more slimes in the deposited tailings than the other ponds.

The tailings sands are loose and contain from 20 to 65 percent by weight of material passing the No. 200 U. S. Standard Sieve, and more than 90 percent passing the No. 40 U. S. Standard Sieve. The natural moisture content and insitu dry density of the sands varied from 2 to 31 percent and 83 to 106 pounds per cubic foot, respectively. The effective angle of internal friction of disturbed samples of sand from Pond 2 reconstituted to approximately the minimum insitu densities varied from 31 to 31.5 degrees in direct shear tests.

The tailings slimes range in consistency from very soft to soft. The natural moisture content and insitu dry density of the slimes varied from 22 to 45 percent and 72 to 87 pounds per cubic foot, respectively. The effective angle of internal friction of disturbed samples of slimes from Pond 2 reconstituted to approximately the minimum insitu densities varied from 28 to 29.5 degrees in direct shear tests. The effective and total stress angles of internal friction were measured as 30.5 and 12.5 degrees, respectively, in triaxial tests.

SUBSURFACE CONDITIONS

Sections of the starter dams of Ponds 1 to 5 overlie up to three feet of clayey and sandy silt topsoil, wood debris, and "jig" tailings which had been discharged into Canyon Creek and spread by overbank flooding. Alluvial deposits consisting of very dense gravel, cobbles and boulders with occasional sand, silt and clay zones, extend to bedrock. Typically the alluvial deposit contains 30 to 65 percent of gravel size or coarser material and less than five percent passing the No. 200 U. S. Standard Sieve size.

From logs of wells drilled in the vicinity of Pond 4, we understand that the depth to bedrock is 15 to 25 feet. It appears that bedrock consists of alternate zones of fractured and firm blue, green and grey shale to the maximum exploration depth of 100 feet.

GROUNDWATER

At the time of our site investigations in August, 1977 and October 1979, groundwater levels were measured in borings from five feet above, to seven feet below, original ground level. Most readings were within three feet of the original ground level. In addition to a gradient of groundwater flow parallel to the slope of the existing ground surface, there also appeared to be a component of flow transverse to the valley axis and toward Canyon Creek. A few measurements which indicate the phreatic surface to be up to 15 feet above original ground level are probably due to the saturated and slow draining tailings slimes.

We understand from discussions with Hecla Mining Company that impoundment of tailings has resulted in elevated water levels downstream of the tailings ponds. Without background records prior to tailings impoundment in this area, our groundwater measurements are inadequate to verify or preclude this phenomenon. However, with seepage from the tailings ponds, some elevation of local groundwater levels would be anticipated.

The only contribution of runoff water into the ponds comes from precipitation on the pond surfaces. We understand that annual precipitation in the vicinity of the Star ponds varies from about 30 to 45 inches, the majority of which falls between the months of October and March. In recent years, the maximum monthly precipitation occurred in January 1974, when 15.7 inches was recorded at the U. S. Weather Station in Mullan. A maximum one-hour precipitation of 4.4 inches was recorded during this storm.

SEISMICITY

The Canyon Creek Valley in the vicinity of the proposed tailings impoundment facility is apparently located in a relatively inactive earthquake zone. According to Milne and Davenport (1969)[1], the site is located in Zone 1 at a location where the 100-year earthquake would produce a ground acceleration of 0.01g. However, in a probabilistic study, Algermissen and Perkins (1976)[2] estimated that in the vicinity of the site a 50-year earthquake could produce a rock acceleration

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1. Milne W. G. and Davenport A. G., "Earthquake Probability" - presented to the Fourth World Conference on Earthquake Engineering, Chile, Jan 1969 - also printed as seismological series of the Dominion Observatory 1968-4 by the Department of Energy, Mines & Resources, Ottawa, Canada.

2. Algermissen S. T. and Perkins D. M., "Probabilistic Estimate of Maximum Acceleration in Rock in the Contiguous United States" - U. S. Geological Survey, Open File Report 76-416, 1976.

of 0.04g. In a very detailed seismic study, Greensfelder (1976)[3] indicated that the site is at a location where the 100-year earthquake could produce a rock acceleration of 0.03g. The Corps of Engineers[4] have estimated peak accelerations in the area of 0.02g to 0.03g.

Although it would appear that earthquake loading is not a serious consideration in the design of the tailings embankment, the effect of an 0.03g rock acceleration has been included in our study analysis. The ground acceleration has been assumed to be 0.045g at the surface of the tailings pond. This is a reasonable value based on an amplication factor of 1.5 from bedrock to unconsolidated soils of the thickness encountered at the site.

POND 1

The Pond 1 starter dam was constructed in 1965 to Elevation 3002 to 3006 feet. The dam height ranged from five feet at the northeast extremity to 18 feet along the southwest embankment. A 10 to 14 foot extension was built in 1972 to Elevation 3015 to 3016 feet, and crest width 14 to 16 feet. Upstream slopes were constructed at 1.0 to 1.4:1 (horizontal:vertical) with a flatter section near the toe of approximately 2.5:1. Downstream slopes were built at 1.25 to 1.6:1. Dike profiles are presented on Plates 4 to 6.

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3. Greensfelder R. W., "Maximum Probable Earthquake Acceleration on Bedrock in the State of Idaho" - Idaho Department of Transportation Division of Highways, Research Project No. 79, August 1976.

4. The Corps of Engineers, "Seismic Zone Map of Contiguous States" - Federal Register, Vol. 39, No. 168, August 28, 1974.

Pond 1 has not received tailings for several years. It is filled to near capacity with 0 to 4 feet of freeboard. Decant water from recent tailings deposition at Pond 4 has recently been retained over the southern half of Pond 1. Ultimate discharge of this water was achieved through a decant tower located near the midpoint of the southeast embankment. A second existing decant tower is located near the midpoint of the northwest embankment. There is presently no water storage in Pond 1.

There are no evident signs of slumping or distress in the Pond 1 embankment. The upper slopes are partly grown over with Douglas Fir and Ponderosa Pine shrubs.

On the basis of the four borings drilled, the tailings backfill in the vicinity of the embankments consists mostly of grey slimes with occasional layers of light grey sand. No extensive sand zones were encountered. Pond 1 slimes were more plastic than those encountered in the other ponds. The northern part of the pond surface provided adequate bearing capacity for light truck traffic.

POND 2

The Pond 2 starter dam was constructed in 1965 to Elevation 2888 to 2993 feet, immediately downstream of the Pond 1 embankment. The dam height ranged from eight feet at the Pond 1 abutments to 20 feet along the southwest embankment. Tailings deposition into the pond commenced in 1968. A seven to 13 foot extension was built in 1972 to Elevation 2999 to 3002 feet, and crest width 13 to 20 feet. Upstream slopes were constructed at 1.3 to 1.7:1 (horizontal:vertical) with a flatter section near the toe of approximately 2.5:1. Downstream slopes were built at 1.2 to 1.5:1. Dike profiles are presented on Plates 7 to 10.

Because Pond 2 has not received tailings for several years, seepage and consolidation have probably stabilized. Existing decant towers are located near the northeast extremities of the northwest and southeast embankments. The pond is almost filled to capacity with 0 to 7 feet of freeboard.

There are no evident signs of distress in the Pond 2 embankment. The slopes are partly covered with bunch grasses, wild legumes, and some golden rod, Ponderosa pine and mountain ash shrubs.

On the basis of the nine borings drilled, the tailings backfill of Pond 2 in the vicinity of the embankments consists mostly of grey slimes with occasional layers of light grey sand. Tailings sand was encountered to depths of 18 to 22 feet adjacent to the southwest embankment. The pond surface provides adequate bearing capacity for heavy drilling equipment.

POND 3

The Pond 3 starter dam was constructed in 1970 to Elevation 3029 to 3039 feet, immediately upstream of Pond 1. The dam height ranged from 11 feet at the northeast extremity to 22 feet along the southwest embankment. An 8 to 13 foot extension was built in 1972 to Elevation 3042 to 3046 feet, and crest width 8 to 25 feet. The starter dam contains numerous large boulders. From an inspection of the downstream slopes, we estimate that the starter dam fill contains 20 percent by weight larger than 24 inches in size, 40 percent between 12 and 24 inches, and 40 percent less than 12 inches. Upstream and downstream slopes were constructed at 1.2 to 2.0:1 (horizontal:vertical) and 1.1 to 1.6:1, respectively. The southeast embankment is as steep as 1.1:1. The other embankments are flatter. Dike profiles are presented on Plates 11 to 13.

Pond 3 has not received tailings for several years. It is almost filled to capacity with two to five feet of freeboard. However, decant water from recent tailings deposition in Pond 4 was retained in Pond 3 before being decanted to Pond 1. During this time the pond was almost completely inundated. Existing decant towers are located near the midpoints of the northwest, southeast and southwest embankments.

Some seepage was observed emerging from a wet area at the toe near the western corner of the embankment. The presence of tailings in this area is due to an earlier pipe break and accidental overflow from the pond. Discolorization is due to the precipitation of zinc from the underlying "jig" tailings. There are no other signs of distress evident in the Pond 3 embankment. Grass and shrub growth are sparse.

On the basis of the four borings drilled, the tailings backfill in the vicinity of the embankments consists mostly of grey slimes with occasional layers of light grey sand. A zone of tailings sand exists for a thickness of about 15 feet at the north corner of the pond.

POND 4

The Pond 4 starter dam was constructed in 1974 to Elevation 3063 to 3071 feet, immediately upstream of Pond 3. The dam height ranged from 12 feet at the northeast extremity to 30 feet along the southwest embankment. Crest grade was sloped to parallel the road grade. A four to 12 foot extension was built in 1977 to Elevation 3074 to 3079 feet, and crest width 8 to 18 feet. Upstream and downstream slopes were constructed at 1.1 to 1.5:1 (horizontal: vertical) and 1.25 to 1.6:1, respectively. Dike profiles are presented on Plates 14 to 18.

Deposition of tailings into Pond 4 terminated in December 1979, after completion of the extension to Pond 5. The pond is effectively filled to capacity with 0 to five feet of freeboard. During recent deposition the pond was almost completely inundated. Existing decant towers are located near the north corner, and midpoints of the northwest and southwest embankments.

There are numerous signs of stress in the northwest embankment. From borings drilled along the northwest side of the pond, it is evident that the 1977 dike extension was actively slumping into the soft tailings deposit as it was being built. Tension cracks along the embankment crest verify that

some slumping continued after construction was completed. Older cracks and crest depressions have been infilled with mine waste. Existing tension cracks, of widths 6 to 18 inches, extend to depths greater than 9 inches. A scour on the southwest embankment was caused by an accidental overflow of tailings. The northwest and southwest slopes are well grassed. The southeast slope is barren of vegetation.

On the basis of the six borings drilled, the tailings backfill in the vicinity of the embankment consists mostly of grey slimes with occasional layers of light grey sand. A sand zone of thickness 30 feet exists adjacent to the southeast embankment.

Pond 4 has been abandoned with no intention of future embankment raises.

POND 5

Pond 5 site conditions were discussed in our July 26, 1979 report. The starter dam was constructed in 1975 to Elevation 2976 to 2979 feet, downstream of the access road at the toe of Pond 2. The dam height ranged from 12 to 28 feet. An 11 to 12 foot extension was completed in 1979 to Elevation 2987 to 2993 feet, and crest width 13 to 18 feet. The downstream slope of the extension is a continuation of the downstream slope of the starter dam, which was constructed to approximately 1.35 to 1.5:1 (horizontal:vertical). The upstream slope of the extension varies from approximately 1.3 to 1.35:1. Dike profiles are presented on Plates 19 to 21.

Tailings had not been deposited in Pond 5, since the embankment was raised, until February 20, 1980 when the lower portion of Pond 6 had been filled. At present the pond has 13 to 16 feet of freeboard. Two new decant towers were constructed in September 1979, on gravel causeways built towards the center of the pond. They were connected to existing towers located near the midpoints of the northeast and southwest embankments. Other towers located near the midpoints of the northwest and southeast embankments were plugged and abandoned. The new towers were located 200 and 150 feet in from the midpoints of the northeast and southwest embankments, respectively.

There are no evident signs of distress in the Pond 5 embankment. The slopes are void of vegetation.

On the basis of the borings drilled, the tailings backfill in the vicinity of the embankments consists mostly of grey slimes with occasional layers of light grey sand. No extensive sand zones were encountered. The pond surface provided adequate bearing capacity for decant construction equipment.

TAILINGS IMPOUNDMENT SYSTEM

GENERAL

Topography and land ownership impose severe limitations on site selection for tailings ponds in the entire Coeur d'Alene District. Therefore it is advantageous to extend the life of the existing ponds by using the "upstream construction" technique. We understand that Hecla Mining Company proposes to pair off the Star ponds. The northern pair, Ponds 3 and 4 would ultimately form one pond when Pond 3 is raised to the Pond 4 level. However, Pond 4 would neither be raised nor used in the future, so that this pair would be abandoned after the Pond 4 level is reached. Similarly the raising of Pond 2 to the Pond 1 level would unite the center ponds, and raising of new Pond 6 to the Pond 5 level would unite the southern pair of ponds. Consequently, Ponds 1 and 5 would be raised jointly with Ponds 2 and 6, respectively. To maximize retention time, tailings water from each pond would be decanted to a downstream pond prior to being decanted from the system.

Star mill tailings and mine water presently flow under gravity from the concentrator to the ponds through a 10-inch diameter polyethylene pipe, which is positioned along the crest of the northwest embankments. The vertical drop to the crests of the extensions would be about 1000 feet, over a distance of about 5.5 miles. The tailings would flow to the crest of each raised dike section at the middle of the northwestern embankment. From this position the tailings would be fed by gravity to a series of spigot discharge points along the embankment length.

Volumes of tailings slurry discharged to the site would generally be about 1800 gpm, peaking occasionally to over 2000 gpm. The variation in volume is caused by the seasonal variation in mine water which is pumped from a sump with level controls, and by the Star Mine requirement of sand backfill. During the time which sand is used, over 90 percent of mill operating time, total tailings are cycloned at the mill and sand is pumped underground. The coarse fraction is used for underground backfill, and the fine fraction is pumped to the tailings impoundment area. During the remaining mill operating time, total tailings are pumped to the impoundment area.

Decant water is presently removed from the tailings pond by decant towers leading to horizontal pipes discharging to ditches. The ditches discharge to Canyon Creek which flows into the Coeur d'Alene River. Existing decant towers are located adjacent to the embankments and consist of 12-inch diameter fiberglass sections installed in 1 to 2-foot incremental rises. New decant towers would be centrally located and connected to the existing system. They would consist of 10-inch diameter PVC pipe sections fitted onto a 12-inch diameter steel pipe stub and protected by exterior stoplog towers. Discharge of the decant water would be via existing 10-inch diameter, dipped and wrapped steel pipe connected by a concreted elbow to each decant tower. The centrally located towers would ensure that ponded water be kept as far as possible from the perimeter embankments. New decants have already been installed in Pond 5.

POND LOCATIONS AND CONFIGURATIONS

The location and layout of the existing dikes and proposed extensions are shown on Plate 1 and a longitudinal embankment profile is shown on Plate 3. As discussed in the Dike Design Section of this report the upstream and downstream slopes on the dike extensions can be constructed to 1.5 to 1 (horizontal:vertical). The downstream toe of the first extensions should be set 12 feet back from the outer edge of the existing embankment crests. Similar 12-foot wide benches should be provided at the downstream toe of the subsequent extensions. A minimum crest width of 16 feet is recommended for each extension to permit vehicle access along the crest. Each extension would be 10 feet in height as shown on the longitudinal section of Plate 3 and the dike profiles of Plates 4 through 21.

The first 10-foot extension of Pond 2 would back into the southwest embankment of Pond 1 at Elevation 3010 feet. The second Pond 2 lift, at Elevation 3020 feet, would extend to a 5-foot lift over Pond 1. Subsequent lifts to Elevations 3030, 3040 and 3050 feet would back into the southwest embankment of Pond 3.

The three proposed lifts of Pond 3, to Elevation 3055, 3065 and 3075 feet, would all back into the southwest embankment of Pond 4. The last of these lifts would raise Pond 3 to the Pond 4 level.

Successive lifts to Elevations 2958, 2968 and 2978 feet would be required to raise the newly built Pond 6 to the existing Pond 5 tailings level. Details of these proposed build ups have been discussed in our May 29, 1979 report. The next Pond 6 extension, herein designated as the first extension, to Elevation 2990 feet, would raise the Pond 6 embankment to the newly built Pond 5 extension crest. Successive lifts to Elevations 3000, 3010, 3020 and 3030 feet would raise the joint ponds.

For construction of dike extensions, stability and safety would be satisfied with the use of tailings sands or a mixture of sands, Star Mine waste and hillside borrow material. The decision as to which fill material to use should be based on economics. However, based on boring logs and the previous methods of tailings placement, we consider it unlikely that sufficient clean sand can be excavated from within the pond to make this borrow source feasibile.

IMPOUNDMENT RESERVOIRS

Total storage volumes of about 472,000, 113,000 and 773,000 cubic yards of tailings would be realized in the Pond 1 and 2, Pond 3 and 4, and Pond 5 and 6 combination ponds, respectively. Volumes, presented in our May 29, 1979 report, below the Pond 5 starter dam crest at Elevation 2978 feet, are not included herein in the joint pond analysis. Therefore above Elevation 2978 feet, a total storage volume of about 1,358,000 cubic yards would be realized. Based on our annual tailings production of 110,000 "in-place" cubic yards, we estimate total lives of about 4.29, 1.03 and 7.03, years, respectively,

for the combination ponds for a total life of about 12.35 years.

Design heights, construction fill and tailings storage volumes, surface areas and lifetimes of the combination pond dike extensions are summarized on Table 1. For each dike lift, the volume ratio of available storage to dike fill has been computed to illustrate the effect of decreasing surface area with increasing elevation. Storage volumes versus tailings levels for the Pond 1 and 2, 3 and 4, and 5 and 6 combination ponds are presented on Plate 22, 23 and 24, respectively.

We understand that the decant towers would be adjusted so that ponded water would be kept about 18 inches deep at the towers. The tailings should be kept at least one foot below the dike crest. Based on the spacing of decant towers and the slope formed by the tailings flowing from the dike crest to the towers, we have assumed that the average level of the tailings would be two feet below dike level.

It is apparent from Table 1 that the most efficient utilization of fill versus resulting tailings storage volume would be in the areas of Ponds 5 and 6 and the first few lifts of Ponds 1 and 2. For economic considerations it may be desireable to develop a Pond 7, across the creek from Ponds 1 to 6, rather than extending Pond 3 and the last two lifts of Ponds 1 and 2.

TABLE 1

CONSTRUCTION AND STORAGE DETAILS

	1st Lift	2nd Lift	3rd Lift	4th Lift	5th Lift	Ultimate
Ponds 1 and 2						
Embankment						
Crest Length (feet)	1,730	3,100	3,080	3,040	3,005	3,005
Crest Level (feet)	3,010	3,020	3,030	3,040	3,050	3,050
Fill Volume (cu. yds)	22,600	28,100	40,200	39,600	39,200	169,700
Tailings						
Design Level (feet	3,008	3,018	3,028	3,038	3,048	3,048
Maximum Height (feet)	37	46	56	65	75	75
Pond Area (acres)	5.82	9.41	7.49	5.56	3.63	3.63
Storage Volume (cu.yds)	43,900	108,100	120,800	89,700	58,600	471,700
Lifetime (years)	0.85	0.99	1.09	0.82	0.53	4.29
Ratio of Storage to Fill Volumes	4.2	3.9	3.0	2.3	1.5	2.8

DAMES & MOORE

TABLE 1 Con't

CONSTRUCTION AND STORAGE DETAILS

	1st Lift	2nd Lift	3rd Lift	4th Lift	5th Lift	Ultimate
Ponds 3 and 4						
Embankment						
Crest Length (feet)	1,690	1,600	1,550			1,550
Crest Level (feet)	3,055	3,065	3,075			3,075
Fill Volume (cu.yds)	22,000	20,900	20,100			63,000
Tailings						
Design Level (feet)	3,053	3,063	3,073			3,073
Maximum Height (feet)	47	56	65			65
Pond Area (acres)	3.32	2.33	1.36			1.36
Storage Volume (cu.yds)	53,600	37,600	21,900			113,100
Lifetime (years)	0.49	0.34	0.19			1.02
Ratio of Storage to Fill Volumes	2.4	1.8	1.1			1.80

DAMES & MOORE

TABLE 1 Con't

CONSTRUCTION AND STORAGE DETAILS

	1st Lift	2nd Lift	3rd Lift	4th Lift	5th Lift	Ultimate
Ponds 5 and 6						
Embankment						
Crest Length (feet)	4,350	3,640	2,970	2,680	2,380	2,550
Crest Level (feet)	2,990	3,000	3,010	3,020	3,030	3,030
Fill Volume (cu. yds)	73,500	47,500	38,700	34,900	31,000	225,600
Tailings						
Design Level (feet)	2,988	2,998	3,008	3,018	3,028	3,028
Maximum Height (feet)	60	66	72	75.5	84.5	80
Pond Area (acres)	12.95	10.97	8.83	7.23	5.37	5.37
Storage Volume (cu.yds)	250,700	177,000	142,500	116,600	86,600	773.400
Lifetime (years)	2.28	1.61	1.29	1.06	0.79	7.03
Ratio of Storage to Fill Volume	3.4	3.7	3.7	3.3	2.8	3.4

DAMES & MOORE

DIKE DESIGN

GENERAL

On the basis of our field investigations, laboratory testing and engineering analyses, we conclude that construction of tailings dike extensions for Star Ponds 1, 2, 3 and 5 is feasible. The design of Pond 6 extensions formed the basis for a previous Dames & Moore report. Upstream and downstream slopes should be constructed at 1.5 (horizontal) to 1 (vertical) and mine waste or hillside borrow should be used for dam construction. Each extension should be constructed with the downstream toe beginning 12 feet back from the previous crest, with the exception of the southwest embankment of Pond 5, which would be set back to 12 to 200 feet. A minimum crest width of 16 feet is recommended for each extension.

We recommend against future raising of Pond 4 because part of the existing embankment has been slumping into the underlying soft tailings, and the narrow pond area would result in a small storage to fill volume ratio. Concern over future raising of this pond has been expressed by Hecla Mining Company.

CONSTRUCTION MATERIAL

The most suitable fill materials for construction of the dike extensions are hillside borrow and Star mine waste. These materials are well graded sandy gravels, with some silt. To be used as compacted fill, cobbles and boulders greater than six inches in diameter should be broken up or removed. The recommended gradation range for the construction material is shown on Plate 25.

The quantity of material required for extension of the Pond 1 and 2, 3 and 4, and 5 and 6 combination ponds is estimated to be approximately 169,700, 163,000 and 225,600 cubic yards, respectively, to the ultimate design elevations. A total of about 458,300 cubic yards of construction

fill would be required. This does not include fill material required to raise Pond 6 to the existing Pond 5 starter dam crest level.

STABILITY

Stability of the existing and proposed embankments was determined using the Simplified Bishop Effective Stress Method of Analysis. The factor of safety is obtained by comparing the soil strength necessary to maintain equilibrium with the estimated soil parameters. Within the assumed circular failure surface, the area is divided into a number of vertical slices. For each slice, the factor of safety is defined as the ratio of available shear strength to the shear strength required to maintain equilibrium.

Embankment construction materials and impounded tailings were assumed to have total unit weights of 130 pounds per cubic foot and 115 pounds per cubic foot, respectively. Effective angles of internal friction used were 35 degrees and 27.5 degrees, respectively. The construction material properties are considered to be typical of compacted hillside borrow while the tailings parameters were based on laboratory tests. Using these soil parameters for the embankment fill and tailings, the geometry of the slopes and the phreatic surface were varied to determine critical stability conditions. Steady state seepage conditions were assumed.

Analyses were performed under static and seismic loading conditions. For seismic loading, an equivalent horizontal rock acceleration of 0.03g was used which is equivalent to a soil acceleration of 0.04g. An additional analysis was carried out where a pore pressure build up was assumed, under seismic loading equivalent to that observed in laboratory liquefaction tests under the design earthquake load, and used to further reduce effective stresses in the seismic stability analysis. The extended dikes, as designed on Plates 4 to 21, would be stable under all potential loading conditions including construction activities, steady stage seepage and earthquake loading. If the water level rises above the lines shown, the factors of safety would drop and slope flattening and/or remedial drainage treatment might be required. If the phreatic surface rose to inundate the entire pond for a prolonged period

of time, the factors of safety could drop to less than unity. A summary of the stability analyses are presented on Plate 26.

LIQUEFACTION

The liquefaction potential of the loose tailings sands and the very soft tailings slimes were investigated by performing a series of cyclic shear triaxial tests on remolded samples. Only slimes from Star Pond 2 were tested. Liquefaction potential of sands were determined by utilizing cyclic shear triaxial test data from the Lucky Friday Tailings Pond No. 1 investigation. Results from tests completed on Star slimes were similar to tests on Lucky Friday slimes. Hence, we concluded that the relationships established for Lucky Friday sands and slimes could be applied to the Star ponds, without the necessity of performing a full series of additional tests. In addition, tests performed for the Sunshine tailings pond, a few miles away, indicate similar liquefaction properties.

Laboratory test data, summarized in Appendix A, indicate that even at a slimes dry density of 75 pounds per cubic foot (relative density of about 23 percent), liquefaction of the sample only occurred when the soil was subjected to 81 stress reversal cycles at a stress level of 0.091g. The tests on sands, performed for the Lucky Friday Tailings Impoundment No. 1 investigation, indicated an even higher required earthquake loading, to cause liquefaction in 75 cycles, of 0.096g at a similar relative density of about 22 percent.

The susceptibility of the materials to liquefaction was analysed on the basis of techniques developed by Seed and Idriss (1971)[5], and modified by Valera and Donovan (1977)[6], where a series of uniform cyclic stresses are assumed to be equivalent to the irregular stress sequence produced by an earthquake. The equivalent uniform cyclic shear stress, τ , induced at any point

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5. Seed H. B. and Idriss I. M., "Simplified Procedure for Evaluating Soil Liquefaction Potential" - Journal of the Soil Mechanics and Foundations Division, ASCE, Vol. 97, No. SM9, September 1971.

6. Valera, J. E. and Donovan, N. C., "Soil Liquefaction Procedures - A Review" - Journal of the Soil Mechanics and Foundation Division, ASCE, Vol. 103, No. SM 9, June 1977.

in a soil deposit was computed using the following relationship:

$$\tau = 0.65 . \gamma h . a . r_d$$

where a = average maximum horizontal tailings acceleration
γ = total unit weight of soil
h = depth below ground surface
r_d = depth reduction factor for deformable soil

and the 0.65 factor assumes that the equivalent uniform shear stress is 65 percent of the maximum shear stress. The average maximum acceleration, a = 0.04g, was obtained by averaging the design rock acceleration of 0.03g and the estimated tailings pond surface acceleration of 0.045g. The r_d value was obtained from the average relationship presented by Seed & Idriss.

Having computed the induced shear stress during an earthquake, the cyclic shear stress that could cause liquefaction in the slimes and sands was evaluated from the equation:

$$\tau = 0.55 . p . s$$

where p = initial effective overburden pressure
s = laboratory test ratio of cyclic shear stress to initial effective overburden pressure

and the 0.55 factor is used to reduce the laboratory cyclic triaxial test data to the actual field conditions. This factor is a function of the coefficient of earth pressure at rest existing in the soil deposit. The s value was obtained from laboratory test data using 10 cycles of stress, which represent a reasonable duration for maximum earthquake loading based on the location and design acceleration.

Comparison of the cyclic shear stresses developed with those that would cause liquefaction provides an indication of the liquefaction potential for different groundwater levels and relative densities. The results of this comparison are presented on Plate 27 and indicate that the tailings are not likely to liquefy under the design earthquake loading. The dashed lines show the stress levels that would cause liquefaction at various depths for 10 cycles

of stress for different levels of groundwater and different insitu relative densities. They indicate that liquefaction will not occur for relative densities of 20 percent or more even with the groundwater table at the tailings surface. Our design specifies that the phreatic surface is to be maintained below the tailings surface for a horizontal distance of at least 50 feet from the dam crest. Consolidation tests on remolded samples indicate that the slimes would consolidate to a relative density of about 30 percent at a depth of 10 feet. Hence, the dashed curves shown on Plate 27 reflect "most probable" insitu densities and indicate the inherent safety against liquefaction.

SETTLEMENT

Settlements induced by the proposed dike extensions were computed utilizing consolidation test data and subsurface boring profiles. It was assumed that tailings forming the foundation of each proposed extension, after the first, would consist mainly of the coarser fraction. A virgin compression index of 0.12 was used for the tailings in our analyses. The maximum settlement induced on existing tailings backfill by an additional five, 10-foot lifts was computed to be about 21 inches. However, for most of the proposed ponds, the number of lifts and, consequently, the total settlements would be less. Settlements should occur relatively quickly with much of the consolidation taking place during fill placement. Consolidation of the foundation gravels were estimated to be negligible.

SEEPAGE

Most seepage from the tailings ponds is expected to flow vertically through the tailings backfill and into the permeable foundation gravels. Minor seepage is expected through the dikes. It is anticipated that if the ponded water is kept 50 feet back from the innter edge of the crest of each dike extension, and a tailings beach established above pond level, then the phreatic surface would be maintained below the lines shown on Plates 4 to 21.

Seepage analyses were completed using laboratory permeability test data for tailings sands and slimes, and assumed permeability characteristics for the foundation materials and embankment fill. The latter were based on gradation ranges and judgement, and on our experience with the existing ponds and other similar projects. Variations in permeabilities were averaged, as tabulated:

Material	Range of Permeability (cm/sec)	Design Permeability (cm/sec)
Tailings Slimes	$4.2 \times 10^{-6} - 3.3 \times 10^{-6}$	4×10^{-6}
Tailings Sand	$4.8 \times 10^{-3} - 8.3 \times 10^{-3}$	6×10^{-3}
Compacted Mine Waste	$2.5 \times 10^{-3} - 3.0 \times 10^{-6}$	1×10^{-4}
Compacted River Gravels	$2.5 \times 10^{-4} - 1.5 \times 10^{-2}$	1×10^{-3}
Foundation River Gravels	$1.0 \times 10^{-4} - 5.0 \times 10^{-2}$	1×10^{-2}

A flow net was utilized to model anticipated conditions in the tailings impoundment.

Seepage quantities were estimated for various tailings levels at the perimeter of the ponds at crest elevations with benches sloping back at one percent to the decants. Ponded water was assumed to be 50 feet back from the impoundment perimeters, and to have an average depth of one foot. Seepage ranging from 50 gallons per minute to nearly zero were computed for the various levels of tailings deposition in the different ponds. The maximum value was computed for the large Pond 5 area, while the negligible values were computed for the small, utltimate Pond 1 and 2, and 3 and 4 areas.

It must be cautioned that these are estimated flows based on assumed soil parameters. The extent of silt zones at the existing ground surface, actual fill materials utilized, horizontal layering of the tailings and depth of water would affect the actual seepage that takes place. However, we estimate that these volumes should not vary from actual values by more than a factor of about four.

To maintain the water level within the embankments at, or below, the lines shown on Plates 4 to 21, we recommend that the decant towers be relocated near the center of the ponds and that ponded water be maintained at least 50 feet from the crest of the dike extensions. This would also ensure that a maximum amount of sand is deposited adjacent to the dikes. Spigotting should be completed from the crest of each dike extension at intervals around the full dike perimeter.

FILTER REQUIREMENTS

If the dike extensions are constructed from mine waste, or hillside borrow, graded within the range presented on Plate 25, we do not anticipate piping of tailings slimes into the dike fill. However, if alluvial gravels or material graded coarser than the design range are utilized as fill, tailings slimes could migrate into the embankment. Therefore a filter of tailings sand or suitably graded hillside borrow or mine waste would be required as a liner on the upstream face of the embankment built from coarser materials.

PONDS 1 and 2

On the basis of our investigations and engineering analyses, we conclude that Pond 2 could be raised in five, 10-foot increments from existing Elevation 3000 feet to proposed final Elevation 3050 feet. The first extension, to Elevation 3010 feet, would back into the southwest embankment of Pond 1. The second extension, to Elevation 3020 feet, would extend to a 5-foot lift over Pond 1, thereby uniting the two ponds. Subsequent lifts to Elevations 3030, 3040 and 3050 feet would back into the southwest embankment of Pond 3. The recommended slope configuration has been discussed above.

The recommended design shown on Plates 1 and 3 to 10 provides adequate stability provided that the phreatic surface remains below the lines shown. Under normal static loading conditions the ultimate embankment would have a factor of safety of 1.3. The corresponding factor of safety under a rock

acceleration of 0.03g, and a seismic induced pore pressure build up proportional to the effective stress would be 1.2 and 1.1, respectively.

We compute that the maximum foundation settlements induced by the five dike extensions would be in the order of 10, 5, 3, 2 and 1 inches, respectively for the maximum depth of each raised pond.

We have estimated that seepage quantities for tailings levels at the crest of the five dike extensions would be about 25, 35, 25, 15 and 2 gallons per minute, respectively.

Tailings storage to dike fill volume ratios for the five extensions were computed to be 4.2, 3.9, 3.0, 2.3 and 1.5, respectively. Therefore the final extensions will yield storage volumes of only 2.3 and 1.5 times the volume of fill required for construction. Economics may dictate that these stages be eliminated.

PONDS 3 and 4

On the basis of our investigations and engineering analyses, we conclude that Pond 3 could be raised in three, 10-foot increments from existing Elevation 3045 feet to proposed final Elevation 3075 feet. Each extension would back into the southwest embankment of Pond 4. The final lift would raise Pond 3 to the Pond 4 level, thereby uniting the two ponds. We do not recommend future raising of Pond 4. The slope configuration of the Pond 3 extensions should conform to those discussed above.

The recommended design shown on Plates 1, 3 and 11 to 18 provides adequate stability provided that the phreatic surface remains below the lines shown. Under normal static loading conditions the ultimate embankment would have a factor of safety of 1.4. The corresponding factors of safety under a rock acceleration of 0.03g and a seismic induced pore pressure build up proportional to the effective stress would be 1.3 and 1.1, respectively.

We compute that the maximum foundation settlements induced by the three dike extensions would be in the order of 12, 6 and 4 inches, respectively for the maximum depth of each raised pond.

We have estimated that seepage quantities for tailings level at the crest of the three dike extensions would be about 10, 5 and 1 gallons per minute, respectively.

Tailings storage to dike fill volume ratios for the three extensions were computed to be 2.4, 1.8 and 1.1, respectively. Therefore the final extensions will yield storage volumes only 1.8 and 1.1 times the volume of fill required for construction. Economics may dictate that these stages be eliminated.

POND 5

On the basis of our investigations and engineering analyses, we conclude that Pond 5, in conjunction with the newly constructed Pond 6, could be raised in five, 10 to 12-foot increments from existing Elevation 2978 feet to final Elevation 3030 feet. The northwest, northeast and southeast embankments should be raised with slope configurations discussed above. However, the three southwest embankment extensions should be set back 150, 150 and 200 feet, respectively, from the previous dike crest. These setbacks over Pond 6 are necessary since the impoundment area pinches out to the southwest. These setbacks are discussed in more detail in our Pond 6 design report.

The recommended design shown on Plates 1, 3 and 19 to 21 provides adequate stability provided that the phreatic surface remains below the lines shown. Under normal static loading conditions the ultimate embankment would have a factor of safety of 1.3. The corresponding factors of safety under a rock acceleration of 0.03g and a seismic induced pore pressure build up proportional to the effective stress would be 1.2 and 1.1, respectively.

We compute that the maximum foundation settlements induced by the five dike extensions would be in the order of 10, 5, 3, 2 and 1 inches, respectively for the maximum depth of each raised pond.

We have estimated that seepage quantities for tailings levels at the crest of the five dike extensions would be about 50, 45, 35, 25 and 15 gallons per minute, respectively.

Tailings storage to dike fill volume ratios for the five dike extensions were computed to be 3.4, 3.7, 3.7, 3.3 and 2.7, respectively. These figures illustrate that it is more economical to continue raising Ponds 5 and 6 than to place an initial lift on Pond 3. Further raising of Ponds 5 and 6, could be considered. However, additional evaluations should be completed to assess a suitable higher cross-section.

DECANT SYSTEM

GENERAL

The decant system in existing Ponds 1 to 4 consists of a 10-inch diameter pipeline connected to 12-inch diameter decant towers, which are located adjacent to the embankments. The decant system at Pond 5 was similar, but is now modified with the recent installation of two centrally located decant towers which are connected to the former system. Decant water is discharged into ditches at the toe of the embankments from where the ditches flow into Canyon Creek. Existing records and our observations indicate that the capacity of this system is adequate. Therefore our recommendations for the decant system of the raised ponds incorporate similar pipe sections. Each pond receives only the precipitation that falls directly on it, because each pond is completely surrounded by dikes, and is not fed by any other catchment area.

While the computed factors of safety indicate adequate stability of the existing embankment structures, we are concerned about the past practise of constructing decant towers adjacent to the embankments and ponding of water against the dikes. We recommend that decant towers be constructed toward the center of the basins to maintain the decant pond as far as possible from the dikes. We understand that the retention time required for clarification and chemical neutralization of the decant water necessitates placing decant towers as far as possible from the tailings discharge points. Based on experience with beach slopes and clarification problems, it may be necessary to restrict pond raises when the distance between the discharge spigots and the decant tower does not provide for adequate pond depth at the tower.

To conform with the design beach development and pond setback, we recommend that two new decant towers be centrally located in each of Ponds 1, 2 and 3. Causeways of mine waste or hillside borrow should be built over dried tailings surface to the proposed locations. Decant line extensions should be built into the causeways to connect the new towers with the existing system. This arrangement would permit better control of pond level and tailings deposition than the existing system and would allow continued

tailings deposition during construction of embankment extensions. Proposed decant tower and decant line extension locations are shown on Plate 1. Recommended decant system designs are shown on Plates 28 and 29.

Decant tower construction would not be necessary at Pond 4 since the pond will not be raised. Two centrally located decant towers were installed in Pond 5 in 1979 during construction of Pond 6.

DECANT TOWERS

Centrally located decant towers were constructed in Pond 5 with 12-inch diameter steel pipe stubs set in a concrete base. A reduction section was installed at the top of the stubs to mate with 10-inch diameter Polyvinyl chloride (PVC) pipe, which is rated for 160 pounds per square inch. A square stoplog tower was constructed around each of the 12-inch diameter stubs and was bolted to the concrete base. The exterior towers consist of a ¼-inch thick sheet metal frame in which cedar stoplogs will be inserted into the open side. The riser section of the base of the tower including the 12-inch steel pipe, the reduction section and the lower end of the first PVC section were encased in concrete. Construction details are shown on Plate 28.

Flow into the towers will be by free overflow controlled by the stoplogs, which will be kept above the level of the inner riser pipe. The stoplog tower extensions will be connected by bolted flanges at the ends of the sections. The inner riser pipe will be raised by connecting increments with sleeve-joints. Both the PVC pipe and the exterior stoplog towers will be raised in 5-foot increments. Intermediate water level control will be provided by the stoplogs.

We recommend that two similarly designed decant towers be constructed at each of Ponds 1, 2 and 3, at locations shown on Plate 1. Decant towers should be installed as truly vertical as possible. The ultimate height of the towers will be over 30 feet, and any initial deviation from plumb would be magnified when the height increases.

We recommend that the towers be constructed on gravel causeways to be built out from existing towers and outfalls adjacent to the existing dike crests. The proposed extended decant lines would connect to the existing towers and outfalls by means of a T-section. These towers could be maintained for emergency pond control. All other existing towers should be plugged and abandoned.

DECANT LINES

Decant lines in Ponds 1 to 5 consist of 10-inch diameter, dipped and wrapped steel pipelines. They are connected by elbows to the decant towers and pass through the embankment limbs.

The decant extensions built into Pond 5 were laid in the causeways and manifolded into existing outfalls. The decant lines consisted of 12-inch diameter, No. 10 gauge, dipped and wrapped steel pipe. The lines were sloped at about one percent to 12 feet from the existing towers. These pipe sections were end welded and joints sealed with tar. Short sections of pipe, joined with Dresser couplings, comprised the 12-foot section connecting the decant lines to the T-sections and existing outfalls. The flexible section and the increased invert elevations were included to compensate for the estimated tower and pipeline settlement of 21 inches expected from future tailings buildup. All elbows, and one pipeline kink were sealed with tar and embedded in concrete blocks. Upon the completion of pipeline installation, all trenches were backfilled and covered with mine waste. A minimum cover of two feet was provided to prevent uplift of the pipelines. Construction details are shown on Plate 29.

We recommend that similarly designed decant lines be constructed at Ponds 1, 2 and 3 to connect the proposed towers to the existing system.

PONDS 1 and 2

We recommend that the perimeter decant towers be replaced with two centrally located towers in each pond. The towers should be constructed on causeways built out from the northwest and southeast embankment limbs, as shown on Plate 1. The towers in each pond would be built 250 feet northeast of the southwest pond embankment, and 100 feet southwest of the northeast pond perimeter. The four towers would be 350 to 400 feet apart, and all would be connected by causeways and decant line extensions to existing towers and outfalls. All four existing towers should be maintained for emergency pond control.

Causeway lengths required for the four towers from northeast to southwest would be about 300, 200, 200 and 300 feet respectively. Anticipated settlements of up to 21 inches for the new towers and pipelines should be accounted for in the constructed pipeline grades.

PONDS 3 and 4

We recommend that the three perimeter decant towers of Pond 3 be replaced with two centrally located towers. The new towers should be constructed on causeways built out from the southeast and southwest embankment limbs, as shown on Plate 1. The new towers would be built 250 feet northeast of the southwest embankment and 100 feet southwest of the northeast pond perimeter. The towers would be 400 feet apart and would be connected by causeways and decant line extensions to existing towers and outfalls. The southwest outfall discharges into Pond 2. We recommend that decant water continue to be discharged in this manner to maximize retention time. The Pond 3 surface area is less than that of the other ponds, and additional retention space for some of its decant water will be needed. The southeast and southwest decant towers should be maintained for emergency pond control. The northwest towers and all Pond 4 towers should be plugged and abandoned.

Causeway lengths required for the northeast and southwest towers would be about 275 and 250 feet, respectively. Anticipated settlements of up to 18 inches should be accounted for in the constructed pipeline grades.

POND 5

During the summer of 1979, the perimeter decant towers were replaced with two centrally located towers as discussed above. Construction of the towers and pipelines adhered to the design recommendations of our July 26, 1979 report, along with subsequent communications. We consider the decant tower design, performed by Hecla Mining Company, to be satisfactory. Dames & Moore provided part-time services to Hecla Mining Company during construction of the causeway, decant towers and pipelines.

FREEBOARD

We recommend that an average minimum freeboard of two feet be maintained over the pond areas. Assuming a beach slope of one percent, the level of tailings at the pond perimeter would not reach within one foot of the dike crest levels. Since the ponds are isolated basins, changes in pond water levels due to storm precipitation would be due solely to the amount of water falling in the pond itself. The maximum one-hour precipitation recorded for this area was 4.4 inches in January 1974. With the proposed 2-foot freeboard, the 1-in-50 and 1-in-100 year events can readily be accommodated within the ponds.

CONSTRUCTION

GENERAL

Full time inspection by a qualified engineer familiar with site conditions and design of the dike extensions should be provided during construction. The engineer can interpret and adjust construction methods and design criteria if conditions observed during construction vary from those assumed in design. Field density equipment should be maintained on site during construction so that spot tests can be carried out for control purposes. Laboratory gradation and moisture content tests could be completed in the Hecla Mining Company laboratory. Otherwise suitable field equipment should be provided on site.

We understand that construction would be performed by a local contractor on a time and material basis. Therefore, it should only be necessary to have a survey crew provide accurate stationing and layout prior to construction. Additional control points should be provided from time to time to assist the contractor in establishing the appropriate slopes and final dam shape.

STRIPPING

The surface of the existing embankment crests and tailings backfill should be stripped of any vegetation, organic material and other deleterious matter. We estimate that a few inches or less of stripping would be required. Stripped material should be wasted in disposal areas convenient to Hecla Mining Company.

FILL PLACEMENT

We recommend that, if the surface of the foundation tailings is wet, the first lift placed over the unconsolidated tailings be to a thickness sufficient to provide a stabilizing cushion on top of the existing loose and saturated tailings backfill. If the surface of the tailings is dry, then the first lift placed should be 12 inches thick. Subsequent lifts to complete each dike extension should be limited to 12 inches in thickness before compaction. Each lift should be compacted to 90 percent of Modified Proctor maximum dry density as determined by the Modified AASHTO T-180-57 Method of Compaction.

All particles over six inches in size should be removed from fill prior to compaction. Fill may have a moisture content above or below optimum depending upon the location of the stockpile and weather conditions. However, because of the granular nature of the fill we expect little difficulty in compaction. Some wetting or drying may be required. During periods of heavy precipitation it may be necessary to stop construction and allow the surface material to dry out, or to rework it, before continuing with fill placement and compaction.

FIELD TESTING

We recommend that during the first week of each construction stage, at least one insitu density test be performed for each 1000 cubic yards of compacted fill. After the first week, one insitu density test per day should be adequate. A single point Modified Proctor dry density is recommended to be performed with each insitu density test rather than developing full curves because of the expected variability of gradation of the fill. In addition, a gradation determination is recommended for each insitu density test.

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The actual number of tests completed could be reduced, at our suggestion, if uniformly superior compaction is obtained relative to our design recommendations. Consequently we may recommend during construction that only spot density checks be completed but continuous observations be made to verify sufficient passes by the compactor, to ensure that pumping does not occur and to limit lift thicknesses to design values.

CONSTRUCTION COSTS

As part of this study, we have estimated costs for constructing the embankment extensions of Ponds 1 to 5. The calculated values are based on estimated unit prices provided by Mr. Ken Thomas of Zanetti Brothers Incorporated, and reflect the costs of completing the work during 1979. For purposes of our estimate, we have assumed the cost of haulage, placement and compaction of mine waste or hillside borrow to be $2.10 per cubic yard.

At these rates, the cost in 1979 dollars to construct the dike extensions as proposed in this report would be:

	Ponds 1 & 2	Ponds 3 & 4	Ponds 5 & 6
Extension 1	$ 48,000	$ 46,000	$ 155,000
Extension 2	59,000	44,000	100,000
Extension 3	85,000	42,000	81,000
Extension 4	83,000	-	73,000
Extension 5	83,000	-	65,000

The cost of dike extensions may be reduced if mine waste production from the Star Mine is routinely hauled to the site for construction fill. In the cost estimate, we have not included the costs for installing the new decant towers and lines.

OPERATION AND SURVEILLANCE

TAILINGS DISCHARGE

Tailings discharge will be accomplished by spigots attached at intervals along the tailings slurry pipeline which would be run along the dike crests. Behind the dike extensions, the slurry would segregate into a coarser fraction adjacent to the embankment, and the finest slimes and water closest to the decant towers. To achieve the build-up of the coarsest beach possible adjacent to the embankment, which is important, frequent changes in the locations of the discharge points would be required, particularly during the early stages of operation at each pond. As soon as a beach sloping 50 feet to the ponded water has developed, the frequency of spigot relocation could be relaxed somewhat.

Proper maintenance of the of the tailings discharge would probably result in about a one percent sloped beach on the tailings surface. To maximize storage volumes for a given dike height we suggest that spigots be spaced at 75-foot centers around the perimeter of the dike.

FUTURE MONITORING

The long-term stability of tailings dams is dependent upon pore water pressures and the position of the phreatic surface both within the dike and in the tailings deposited adjacent to the dike. Piezometers should be kept operative in the dikes and in the tailings backfill to monitor subsurface water levels and to verify our design assumptions.

As shown on the sections, Plates 4 to 21, at least one piezometer has already been installed at each section of each pond. Also shown on the sections are proposed future piezometers to be placed prior to future pond raises. As the ponds are raised each existing piezometer must be raised and protected from damage. Piezometers should be open-standpipes with properly graded filters placed around the open-end or well point.

Piezometers should be observed once a week for the first three months of discharge into each pond, then monthly, and the readings tabulated in graph form. The results should be forwarded to our office every six months for review. Should water levels rise abruptly or reach the levels shown on Plates 4 to 21, we should be notified immediately. Based on initial observations it may be determined that additional piezometers should be installed sooner than discussed above, and remedial drainage measures may have to be implemented.

A designated member of the Hecla Mining Company staff should inspect the ponds on a daily basis to assess potential problems such as abruptly rising pond level, plugged discharge lines, seepage at the face of the dike, breaks in the discharge lines, and anything of a suspicious or unusual nature such as embankment cracking and differential settlements. The details of inspections and methods of reporting information are included in our December 4, 1979 Operations Manual for the Star ponds.

o 0 o

The following plates and appendices complete this report.

Plate 1	Site Plan - Layout of Tailings Impoundment Facility
Plate 2	Site Plan - Field Exploration Program
Plate 3	Longitudinal Profile - Ponds 1 to 6
Plate 4	Dike Profile - Pond 1 (Section AA)
Plate 5	Dike Profile - Pond 1 (Section BB)
Plate 6	Dike Profile - Pond 1 (Section CC)
Plate 7	Dike Profile - Pond 2 (Section DD)
Plate 8	Dike Profile - Pond 2 (Section EE)
Plate 9	Dike Profile - Pond 2 (Section FF)
Plate 10	Dike Profile - Pond 2 (Section GG)
Plate 11	Dike Profile - Pond 3 (Section HH)
Plate 12	Dike Profile - Pond 3 (Section II)

Plate 13	Dike Profile - Pond 3 (Section JJ)
Plate 14	Dike Profile - Pond 4 (Section KK)
Plate 15	Dike Profile - Pond 4 (Section LL)
Plate 16	Dike Profile - Pond 4 (Section MM)
Plate 17	Dike Profile - Pond 4 (Section NN)
Plate 18	Dike Profile - Pond 4 (Section OO)
Plate 19	Dike Profile - Pond 5 (Section PP)
Plate 20	Dike Profile - Pond 5 (Section QQ)
Plate 21	Dike Profile - Pond 5 (Section RR)
Plate 22	Storage Capacity - Ponds 1 and 2
Plate 23	Storage Capacity - Ponds 3 and 4
Plate 24	Storage Capacity - Ponds 5 and 6
Plate 25	Gradation Range - Construction Materials & Tailings
Plate 26	Summary of Stability Analyses
Plate 27	Liquefaction Potential
Plate 28	Decant Tower
Plate 29	Decant Line
APPENDIX	FIELD AND LABORATORY INVESTIGATION

Respectfully Submitted,

DAMES & MOORE

K. E. Robinson

K. E. Robinson P. Eng.
Partner

C. M. Urlich

C. M. Urlich P. Eng.
Project Manager

George C. Toland

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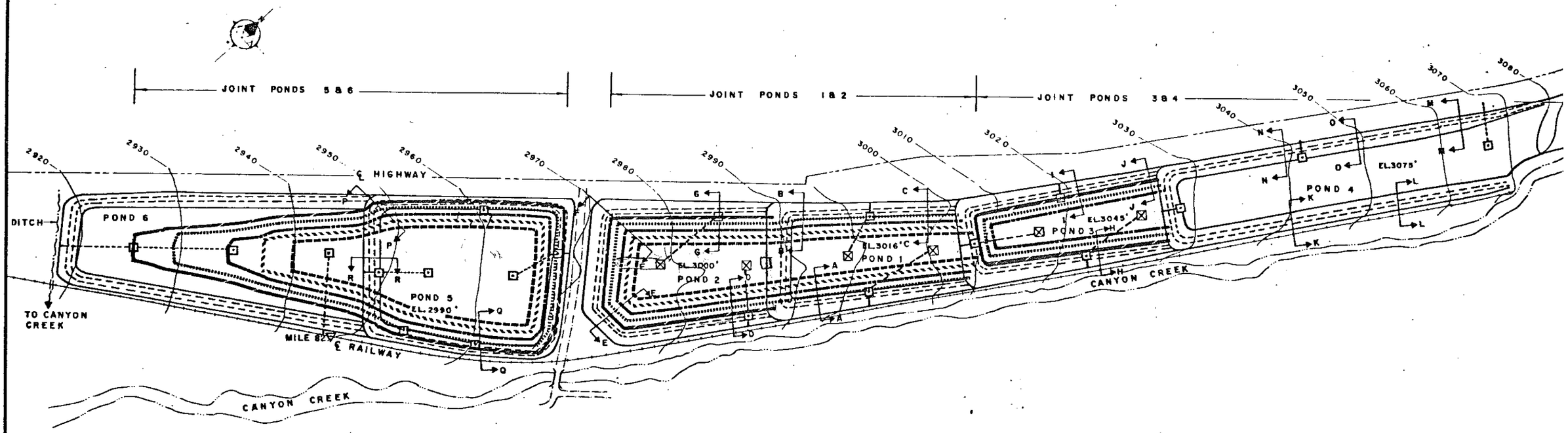


LEGEND:

PROPOSED 1ST. EXTENSION CREST (JOINT POND 1&2, ELEV. 3010 FT.
(JOINT POND 3&4, ELEV. 3055 FT.
(JOINT POND 5&6, ELEV. 2990 FT.

PROPOSED 2ND. EXTENSION CREST (JOINT POND 1&2, ELEV. 3020 FT.
(JOINT POND 3&4, ELEV. 3065 FT.
(JOINT POND 5&6, ELEV. 3000 FT.

PROPOSED 3RD. EXTENSION CREST (JOINT POND 1&2, ELEV. 3030 FT.
(JOINT POND 3&4, ELEV. 3075 FT.
(JOINT POND 5&6, ELEV. 3010 FT.

PROPOSED 4TH. EXTENSION CREST (JOINT POND 1&2, ELEV. 3040 FT.
(JOINT POND 5&6, ELEV. 3020 FT.

PROPOSED 5TH. EXTENSION CREST (JOINT POND 1&2, ELEV. 3050 FT.
(JOINT POND 5&6, ELEV. 3030 FT.

SECTION LINES (SEE PLATES 4 TO 21)

EXISTING DECANT TOWER

PROPOSED DECANT TOWER

PROPOSED DECANT LINE AND CAUSEWAY

REFERENCES:

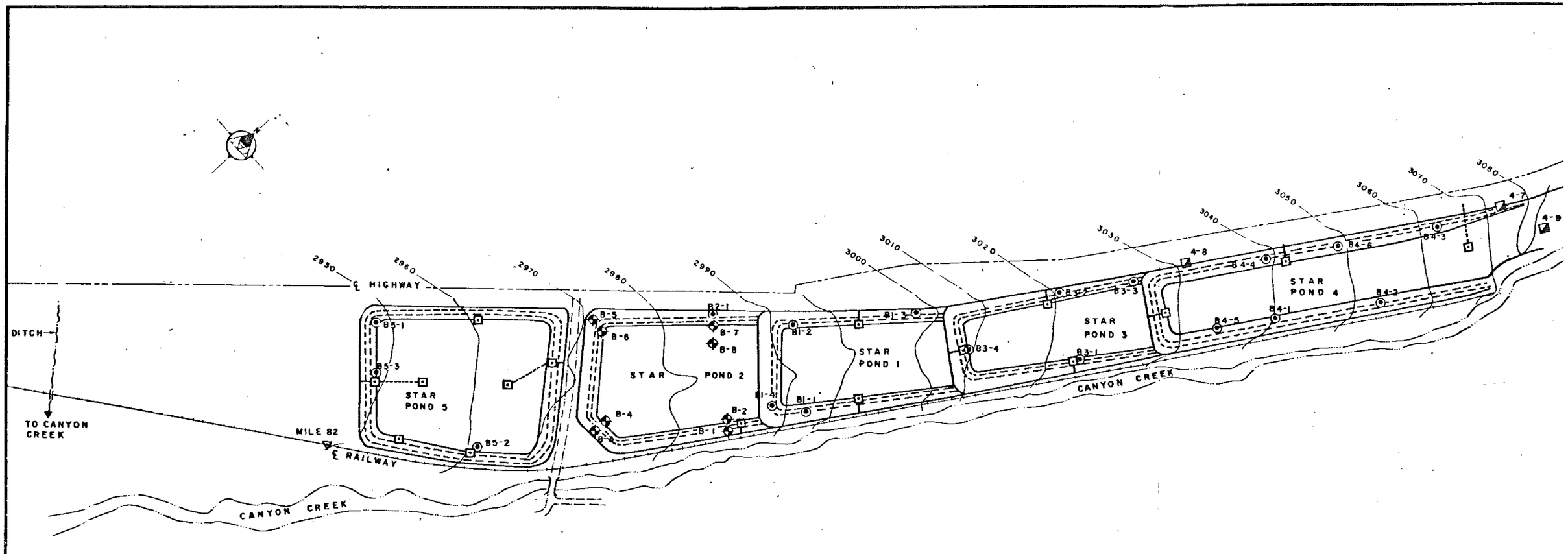
1. DRAWING C-7e HECLA DTD. 9-2-'66
2. DRAWING 2469-3 HECLA.
3. MAP VALLEYS OF CANYON CREEK AND SOUTH FORK COEUR D'ALENE RIVER, HECLA.

FEET
100 0 100 200 300 400 500

SITE PLAN
LAYOUT OF TAILINGS IMPOUNDMENT FACILITY

DAMES & MOORE

PLATE 1



LEGEND:

- BORING DRILLED UNDER DAMES & MOORE SUPERVISION IN 1977.
- BORING DRILLED UNDER DAMES & MOORE SUPERVISION IN 1979.
- WATER WELL DRILLED AND LOGGED BY BRAND-X IN 1979.
- EXISTING DECANT TOWERS

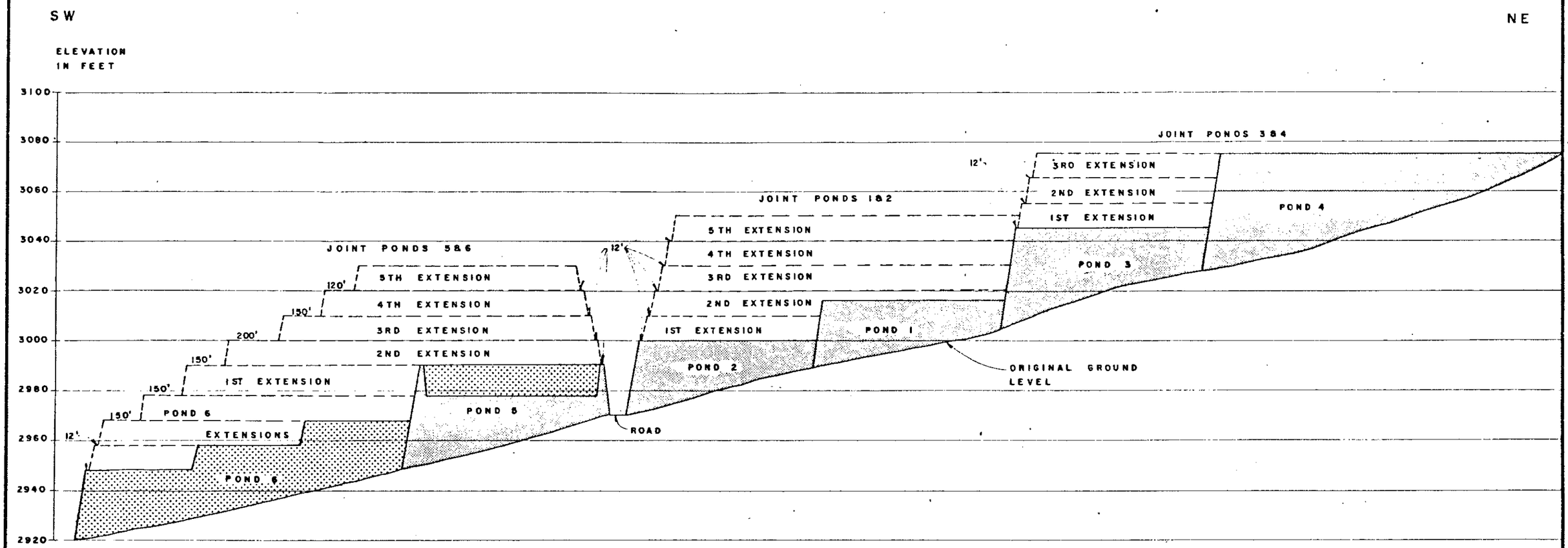
SITE PLAN
FIELD EXPLORATION LOCATION

REFERENCES:

1. DRAWING C-7e HECLA DTD. 9-2-'66
2. DRAWING 2469-3 HECLA.
3. MAP VALLEYS OF CANYON CREEK AND SOUTH FORK COEUR D'ALENE RIVER, HECLA.

FEET
100 0 100 200 300 400 500

DAMES & MOORE



VERTICAL SCALE 1" = 20'
HORIZONTAL " 1" = 200'
EXAGGERATION x 10

LEGEND:

- EXISTING TAILINGS DEPOSIT
- EXISTING STORAGE VOLUME
- FUTURE STORAGE VOLUME

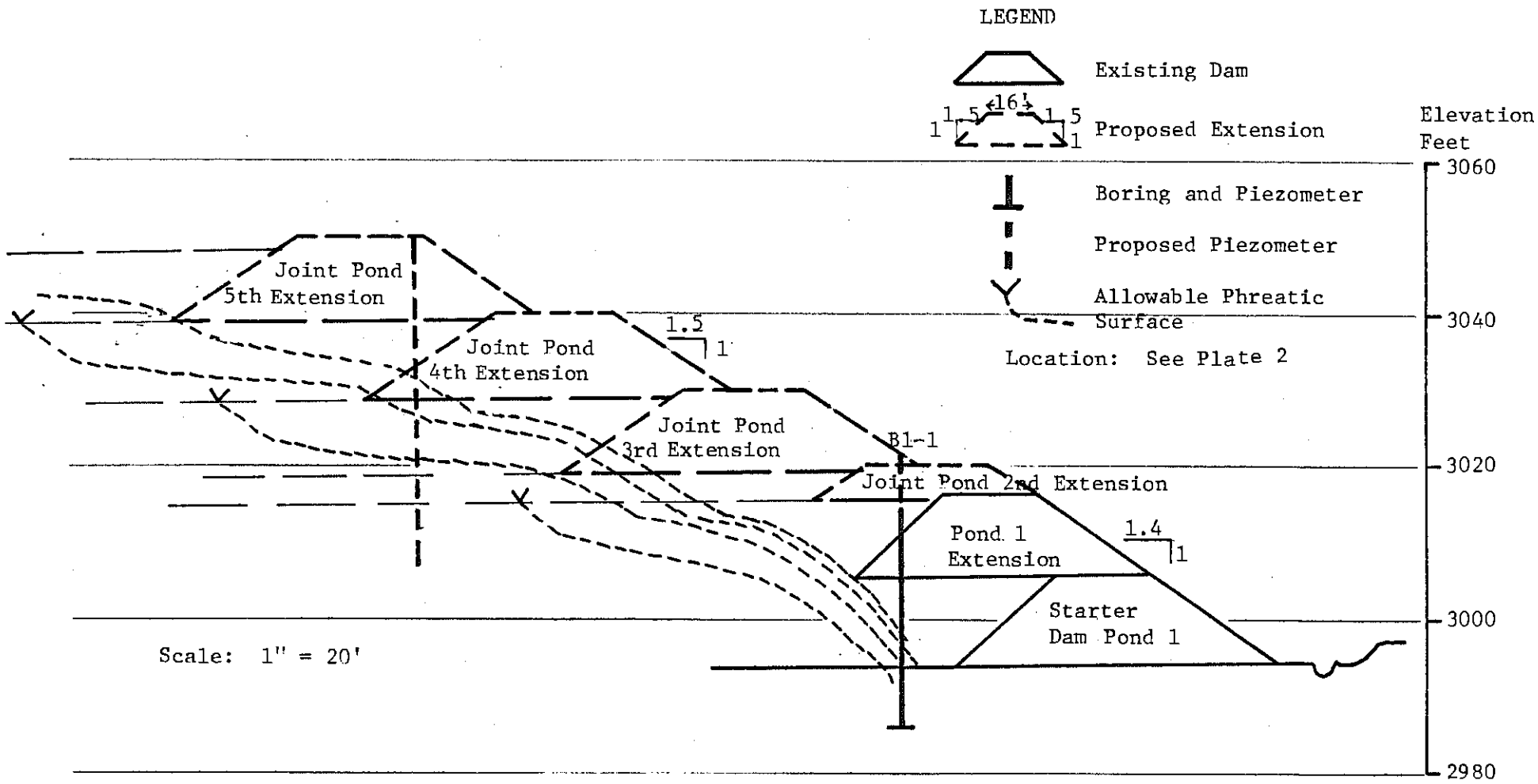
LONGITUDINAL PROFILE

PONDS 1 TO 6

DAMES & MOORE

BY _____ DATE _____
CHECKED BY _____ FILE 05457-012-32

REVISIONS
BY CMU DATE Feb 4,80



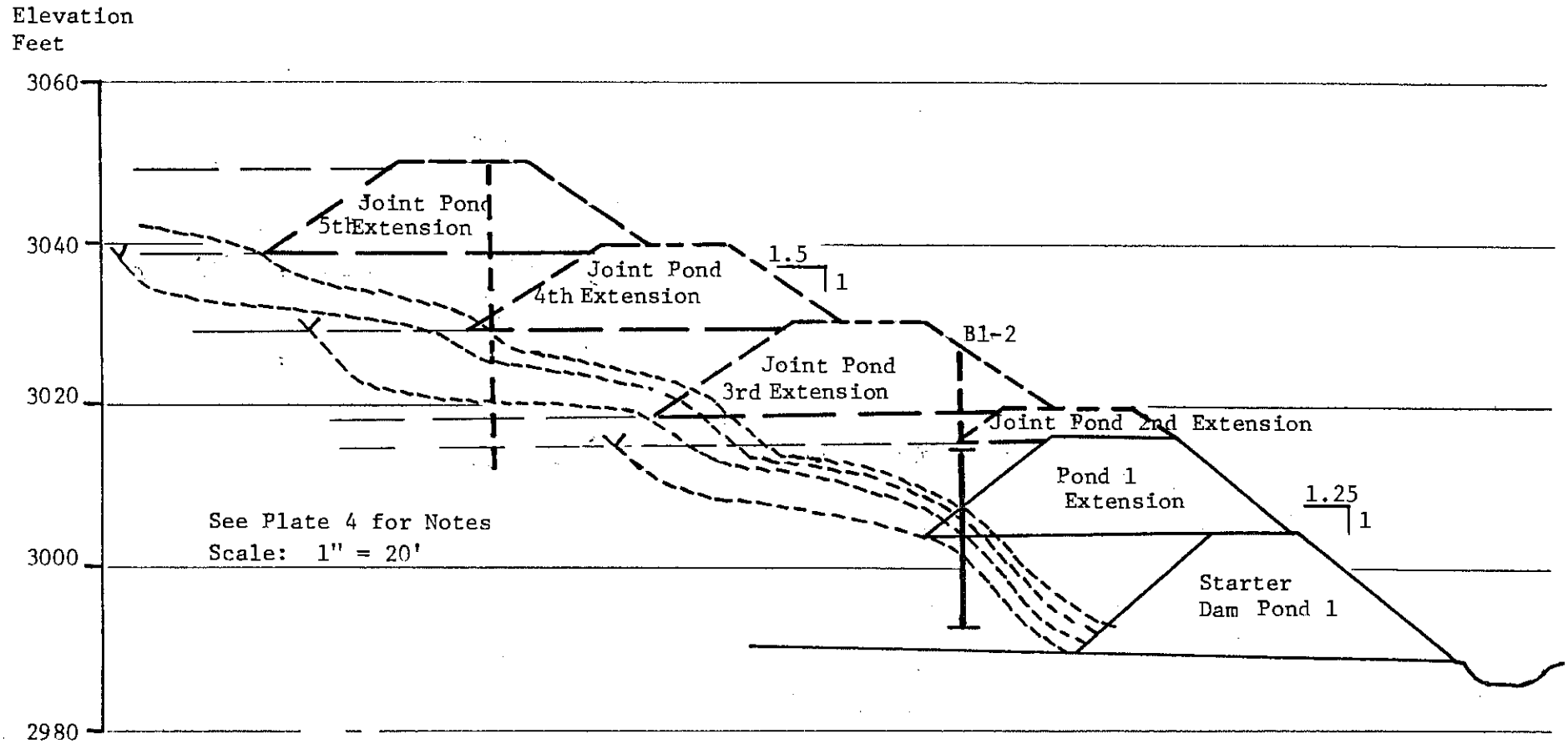
DIKE PROFILE – POND I (SECTION A-A)

DAMES & MOORE

PLATE 7

BY _____ DATE _____
CHECKED BY _____ FILE 11457-012-32

REVISIONS
BY C.MU DATE Feb 4, 80



DIKE PROFILE — POND I (SECTION B-B)

DAMES & MOORE

PLATE 5

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CHECKED BY _____ FILE 05457-012-32

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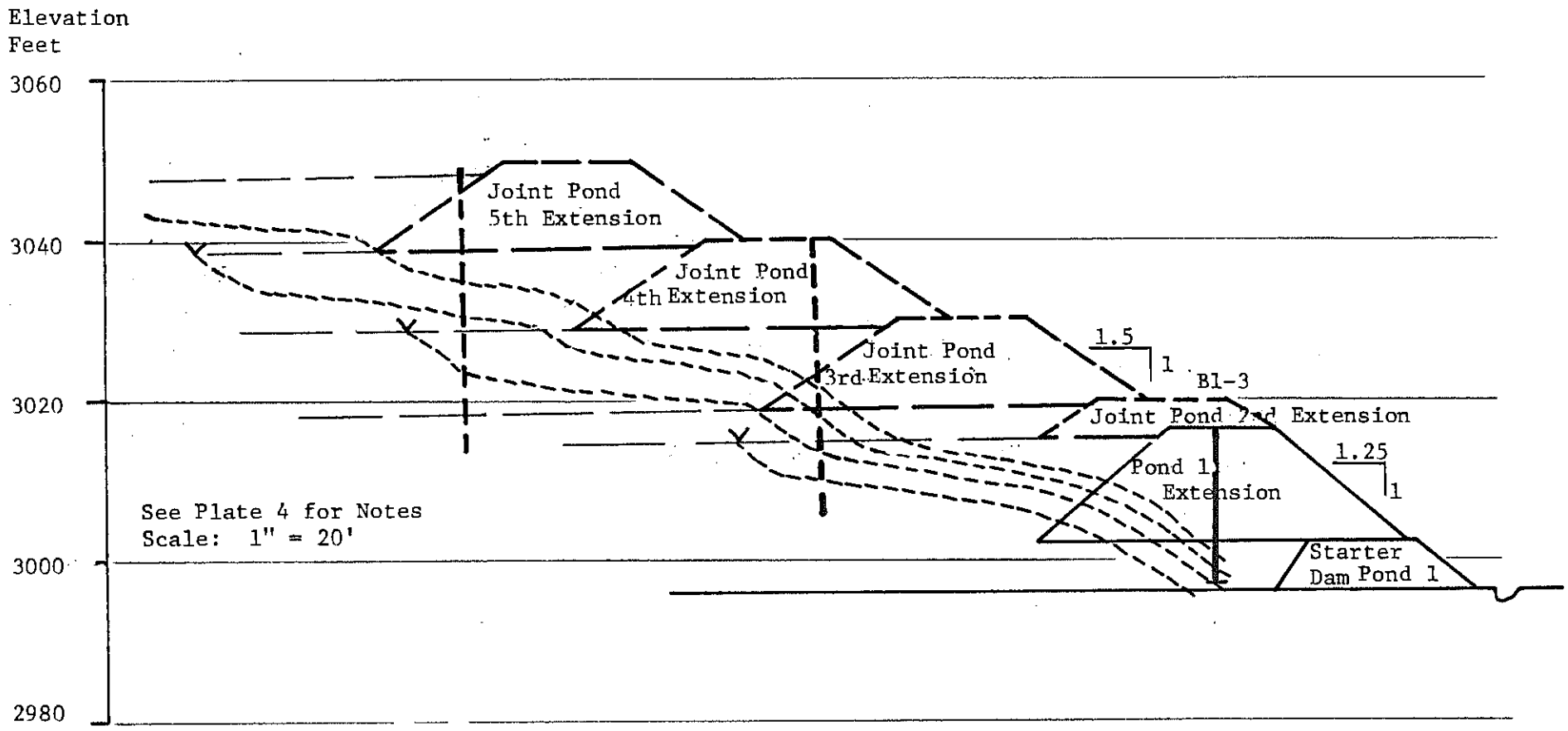
BY CMLL DATE Feb 4, 80



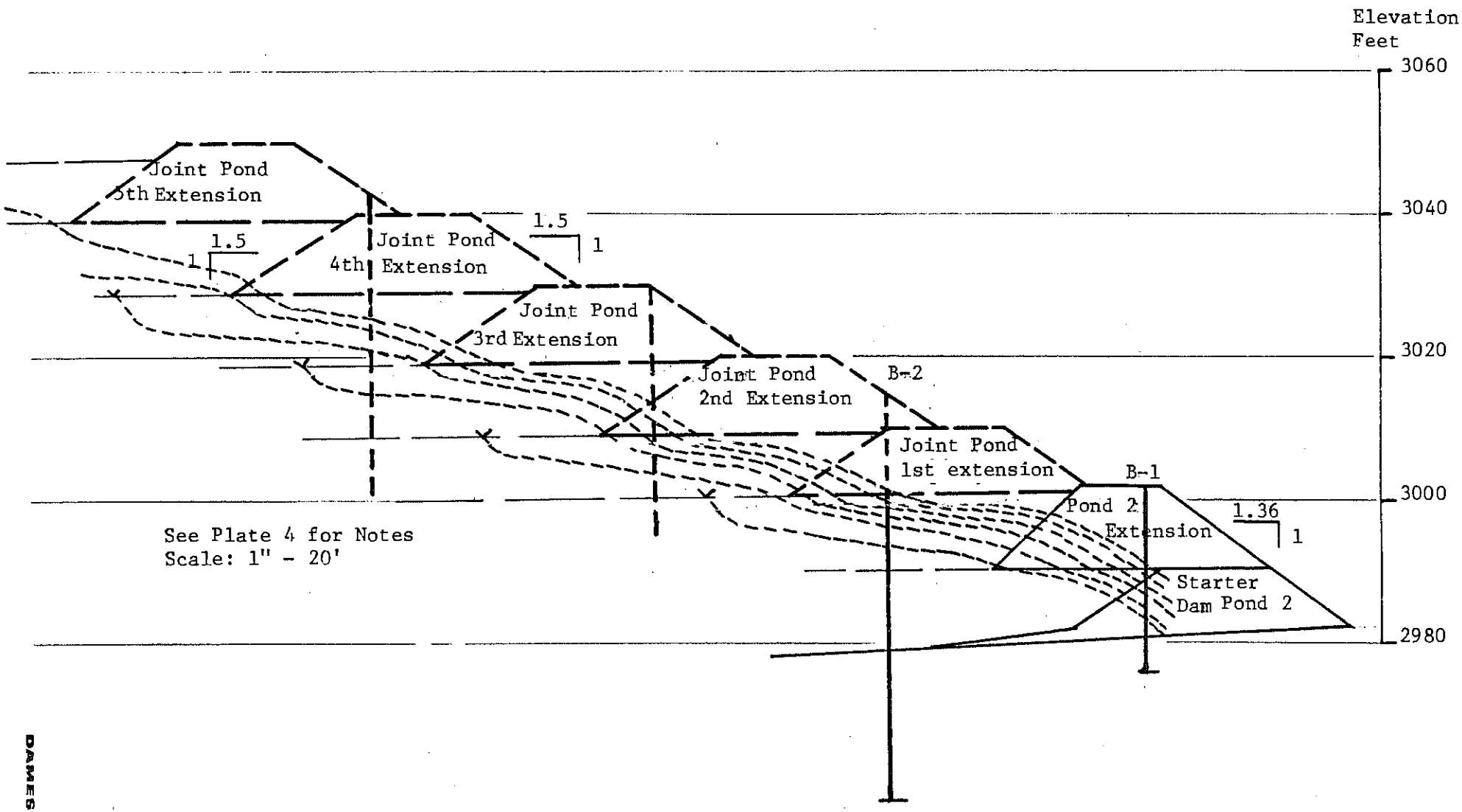
DIKE PROFILE – POND I (SECTION C-C)

DAMES & MOORE

PLATE 6

BY _____ DATE _____
CHECKED BY _____ FILE 05457-012-32

REVISIONS
BY CMU DATE Feb 4, 80



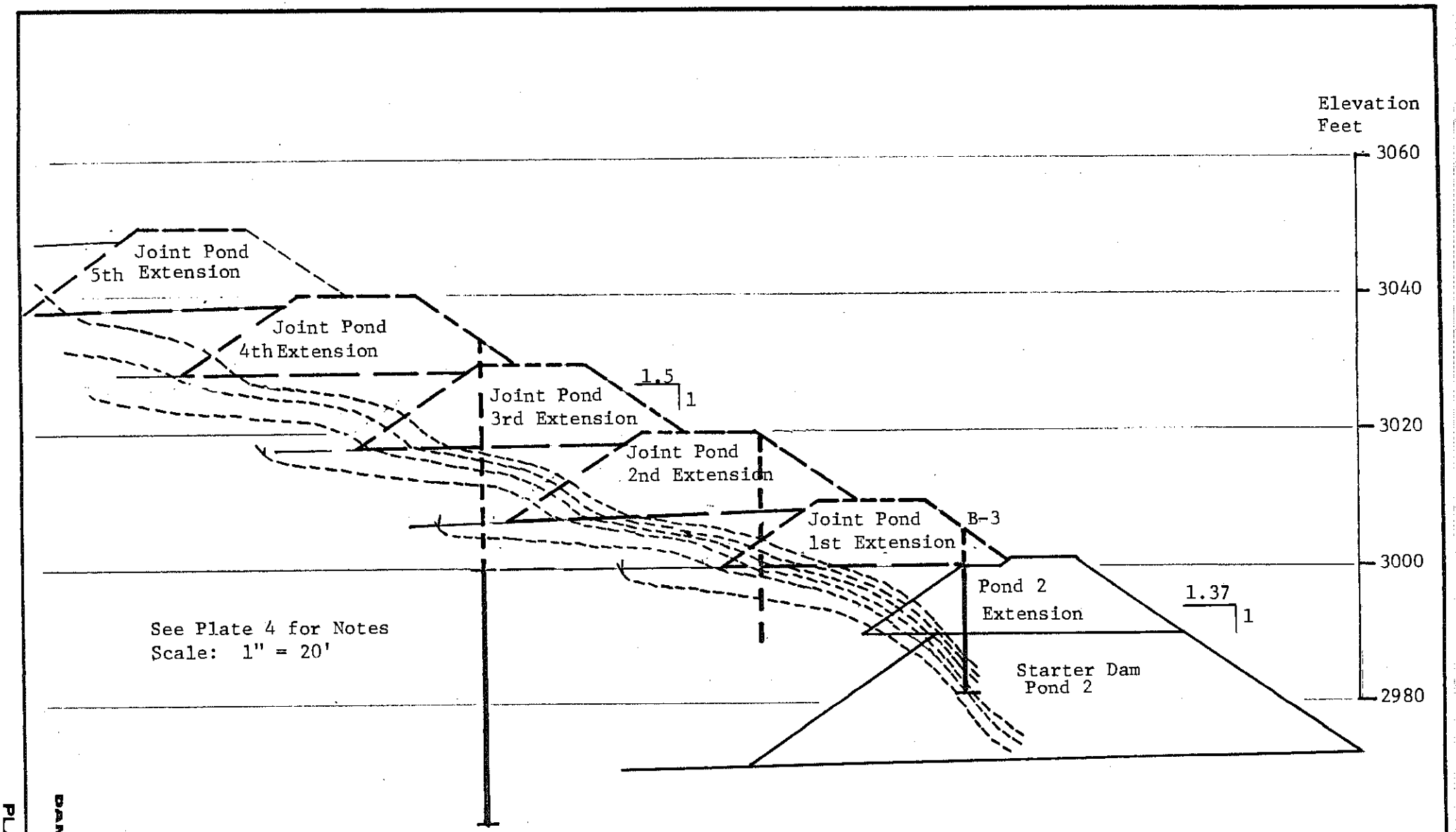
DIKE PROFILE — POND 2 (SECTION D-D)

DAMES & MOORE

PLATE 7

BY _____ DATE _____
CHECKED BY _____ FILE 05457-012-32

REVISIONS
BY CMU DATE FEB 4, 80



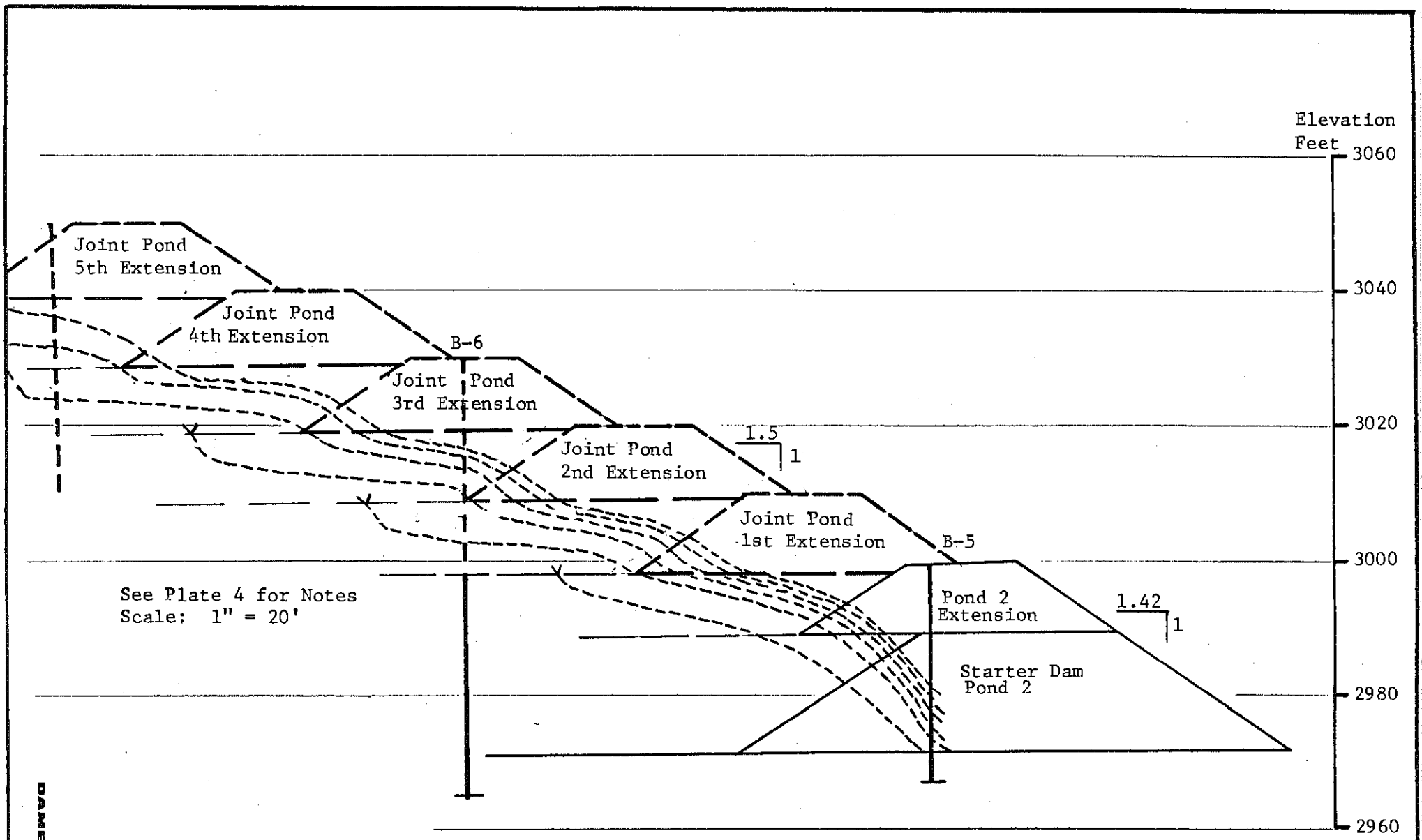
DIKE PROFILE — POND 2 (SECTION E-E)

DAMES & MOORE

PLATE 8

BY _____ DATE _____
CHECKED BY _____ FILE 05457-012-32

REVISIONS
BY CMU DATE Feb 4, 80



DIKE PROFILE—POND 2 (SECTION F-F)

DAMES & MOORE

PLATE 9

BY _____ DATE _____
CHECKED BY _____ FILE 05457-012-32

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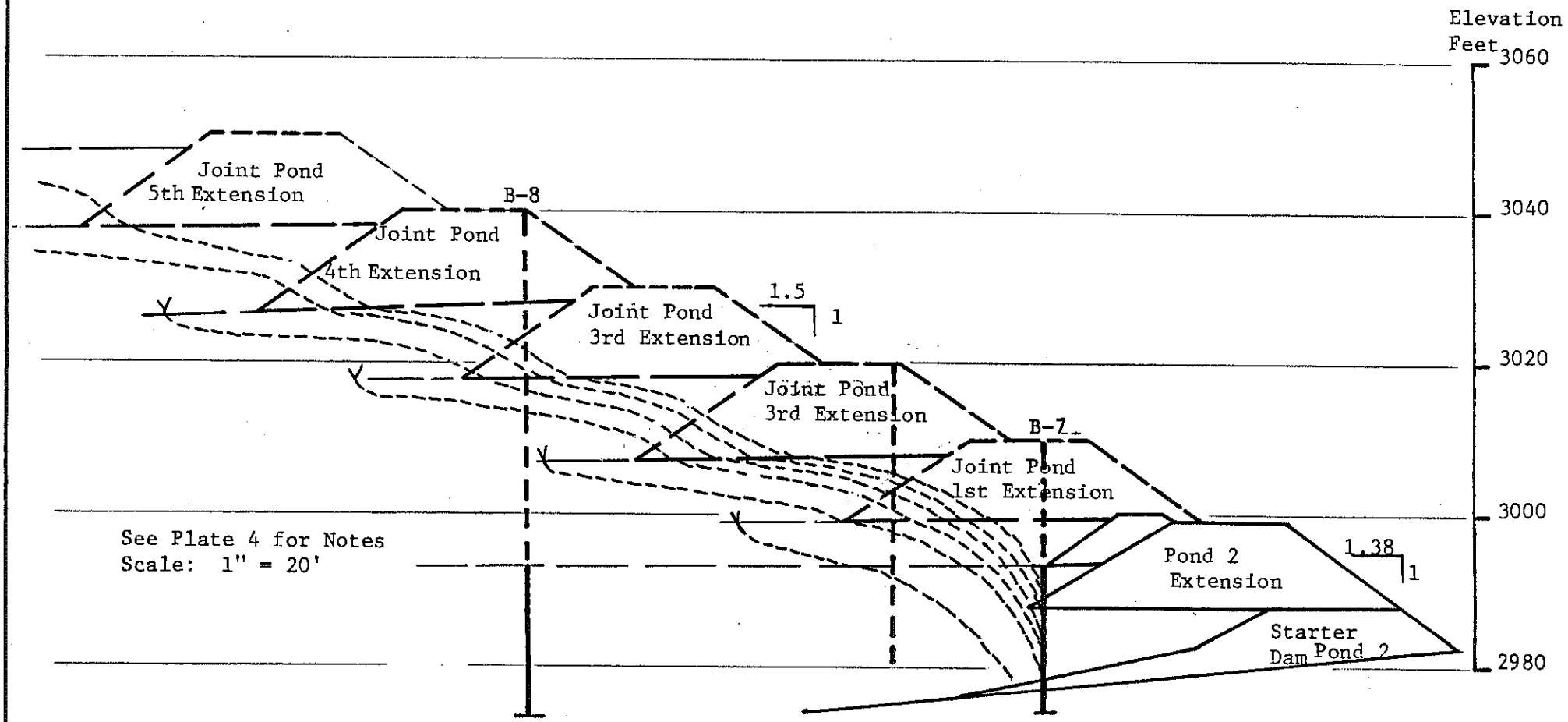
BY CMU DATE Feb 4, 80



DIKE PROFILE—POND 2 (SECTION G-G)

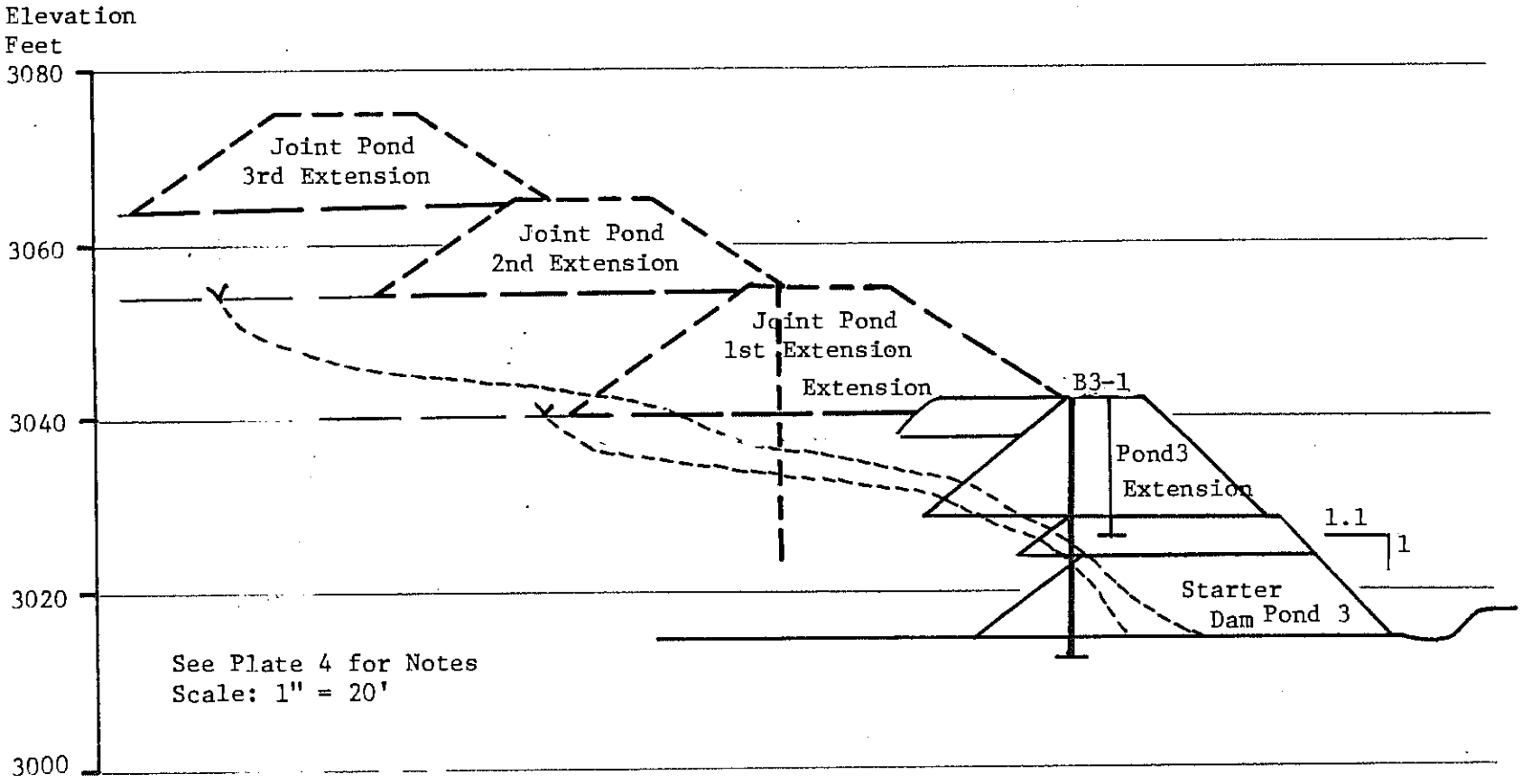
DAMES & MOORE

PLATE 10

BY _____ DATE _____
CHECKED BY _____

FILE 05457-012-32

REVISIONS
BY CMU DATE Feb 4 80



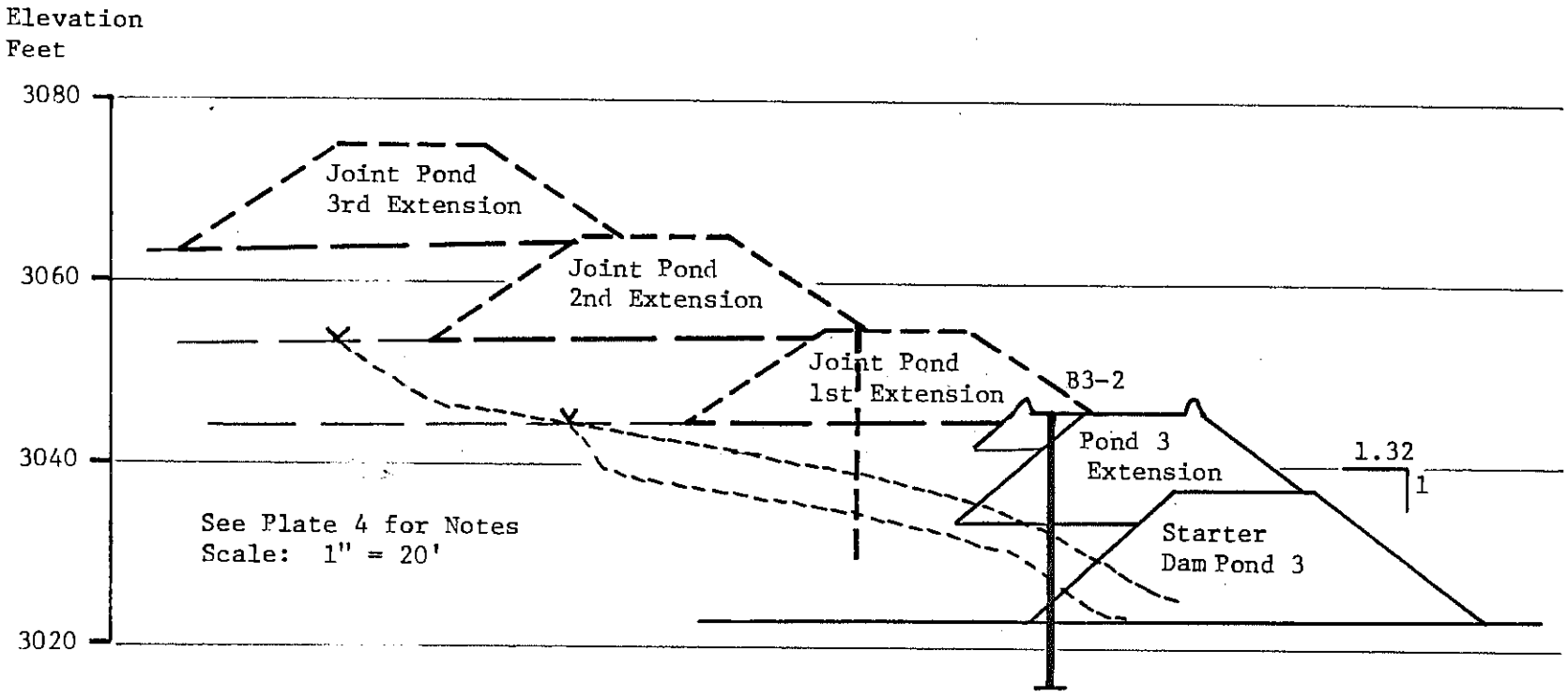
DIKE PROFILE — POND 3 (SECTION H-H)

DAMES & MOORE

PLATE 11

BY _____ DATE _____
CHECKED BY _____ FILE 05457-012-32

REVISIONS
BY CMU DATE Feb 4 80

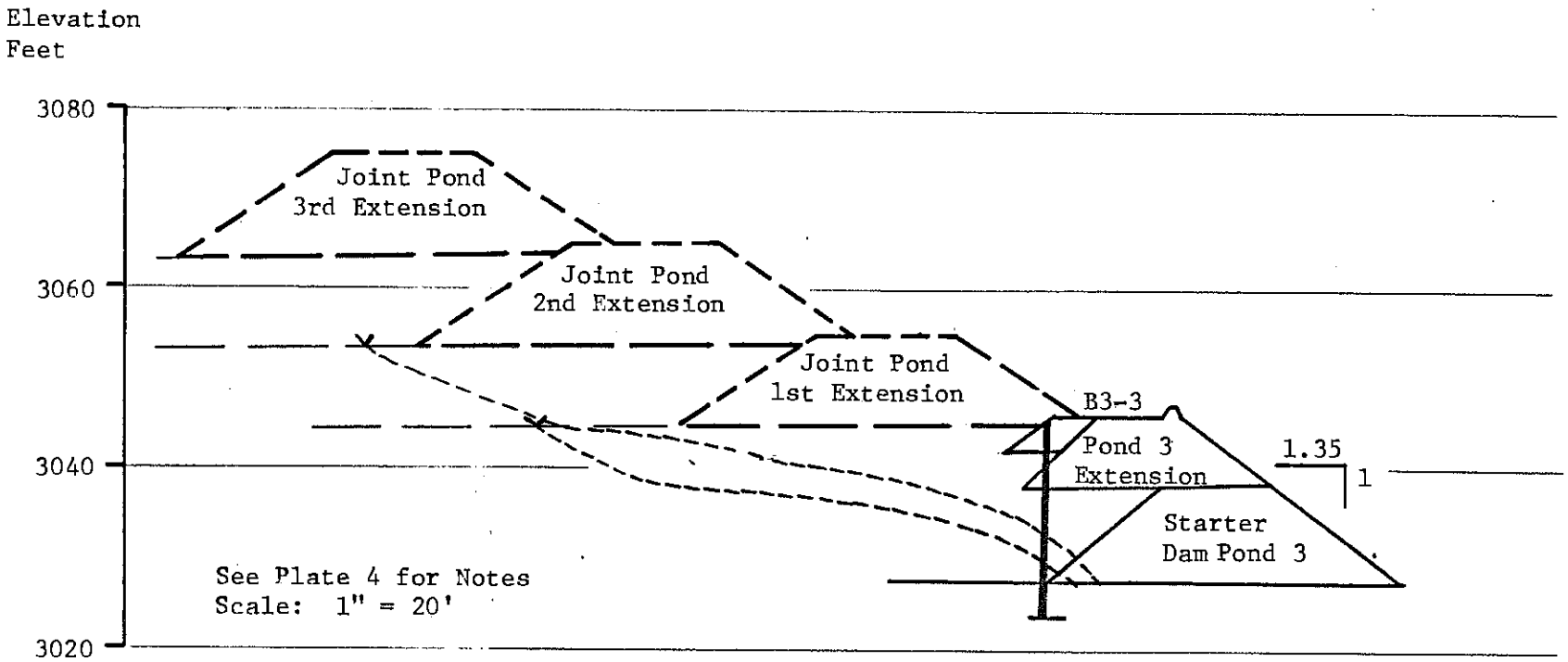


DIKE PROFILE – POND 3 (SECTION 1-1)

DAMES & MOORE

BY _____ DATE _____
CHECKED BY _____ FILE 05457-012-32

REVISIONS
BY CMU DATE Feb 4 80



DIKE PROFILE - POND 3 (SECTION J-J)

DAMES & MOORE

PLATE 13

BY _____ DATE _____
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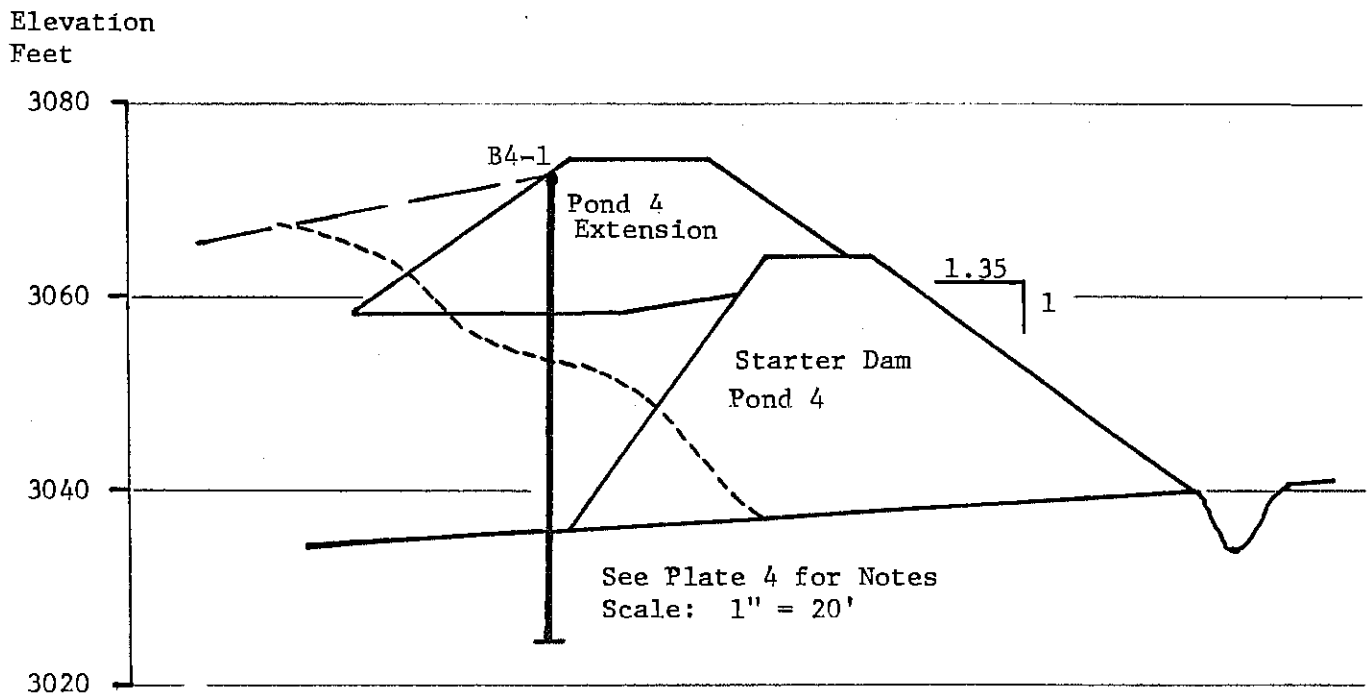
REVISIONS
BY CMU DATE Feb 4, 80

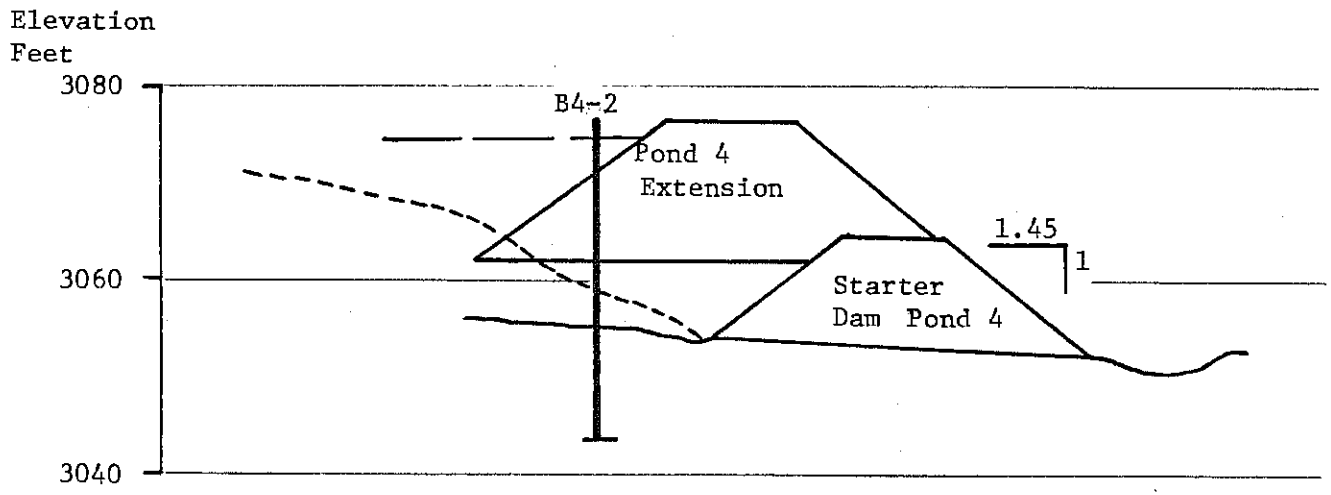


DIKE PROFILE — POND 4 (SECTION K-K)

DAMES & MOORE

BY _____ DATE _____
CHECKED BY _____ FILE 05457-012-32

REVISIONS
BY CMU DATE Feb 4, 80



See Plate 4 for Notes
Scale: 1" = 20'

DIKE PROFILE — POND 4 (SECTION L-L)

DAMES & MOORE

PLATE 15

BY _____ DATE _____
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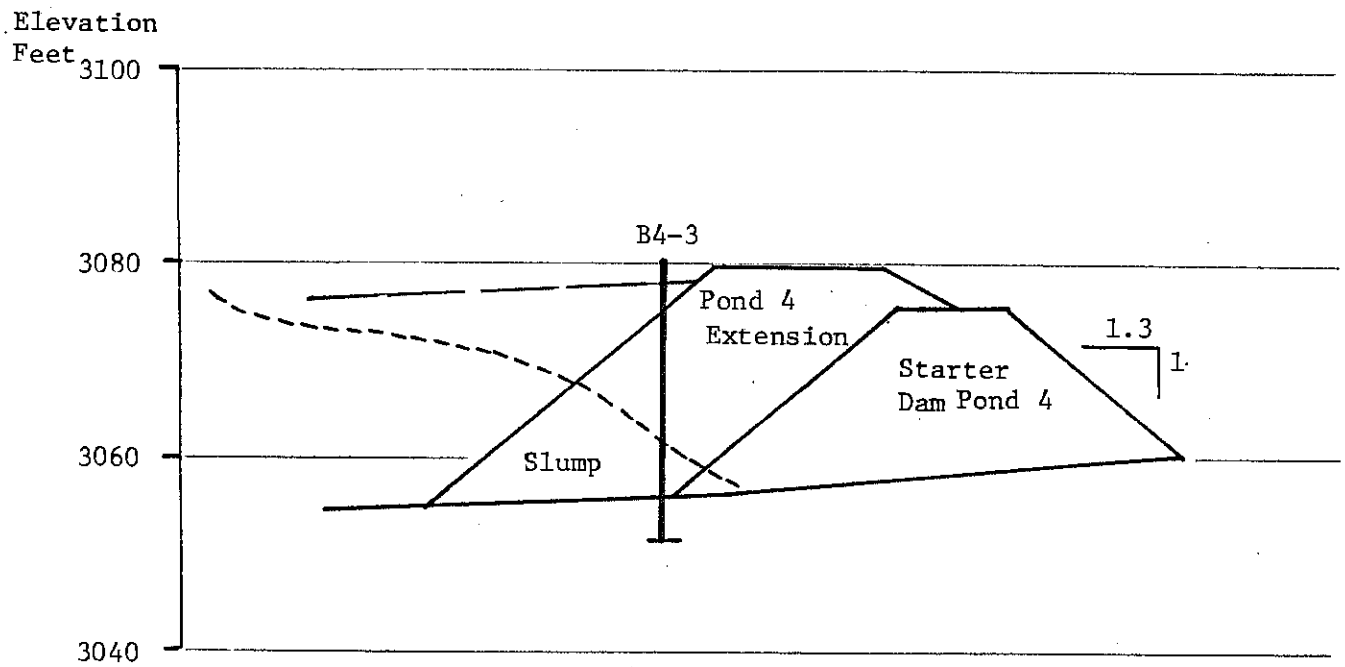
REVISIONS
BY CMM DATE Feb 80



See Plate 4 for Notes
Scale: 1" = 20'

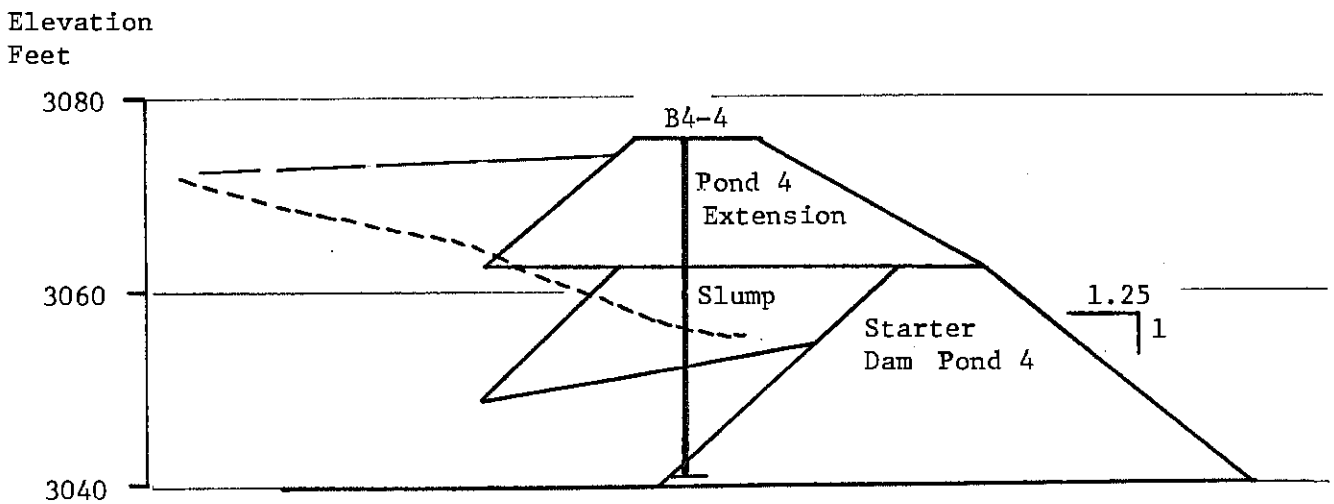
DIKE PROFILE — POND 4 (SECTION M-M)

DAMES & MOORE

PLATE 16

BY _____ DATE _____ REVISIONS

CHECKED BY _____ FILE 05457-012-32 BY CMU DATE Feb 4 80



See Plate 4 for Notes
Scale: 1" = 20'

DIKE PROFILE—POND 4 (SECTION N-N)

DAMES & MOORE

PLATE 17

BY _____ DATE _____
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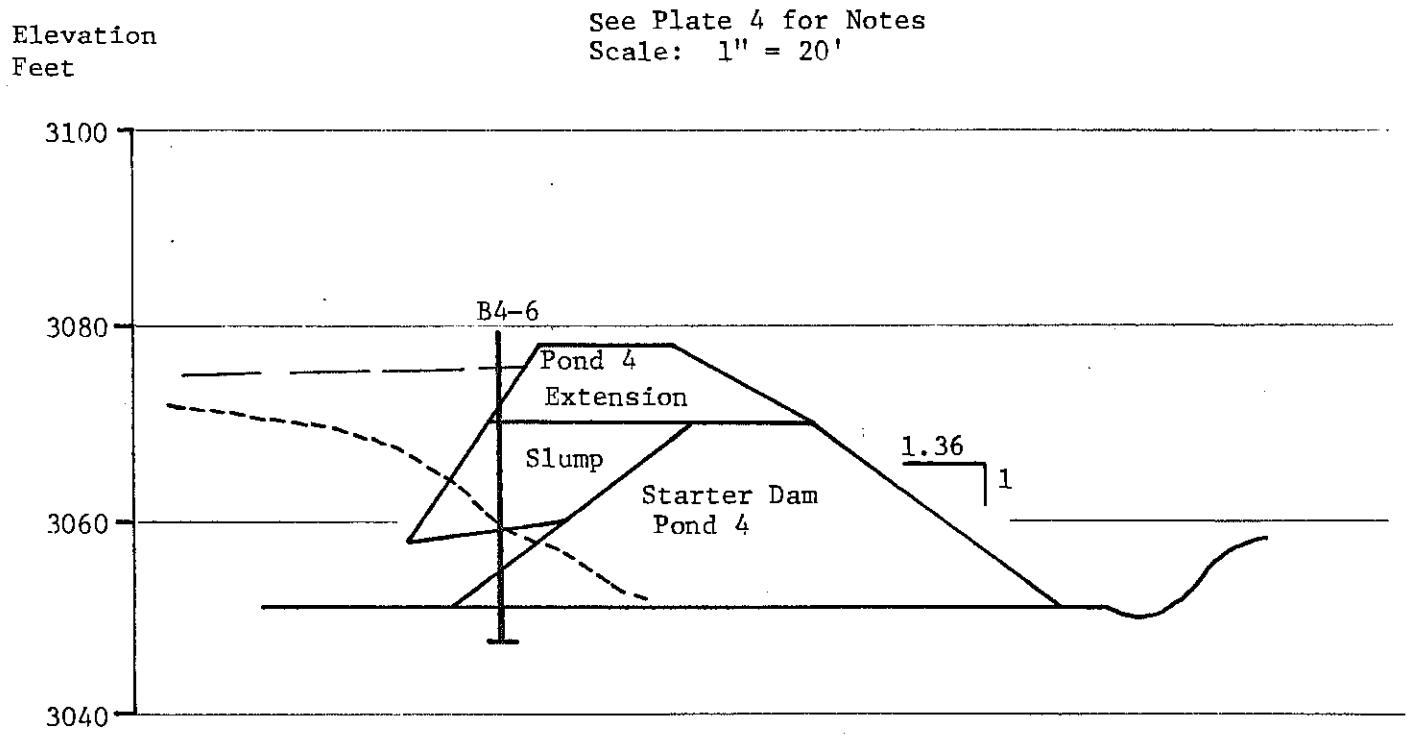
REVISIONS
BY CMU DATE Feb 4, 80

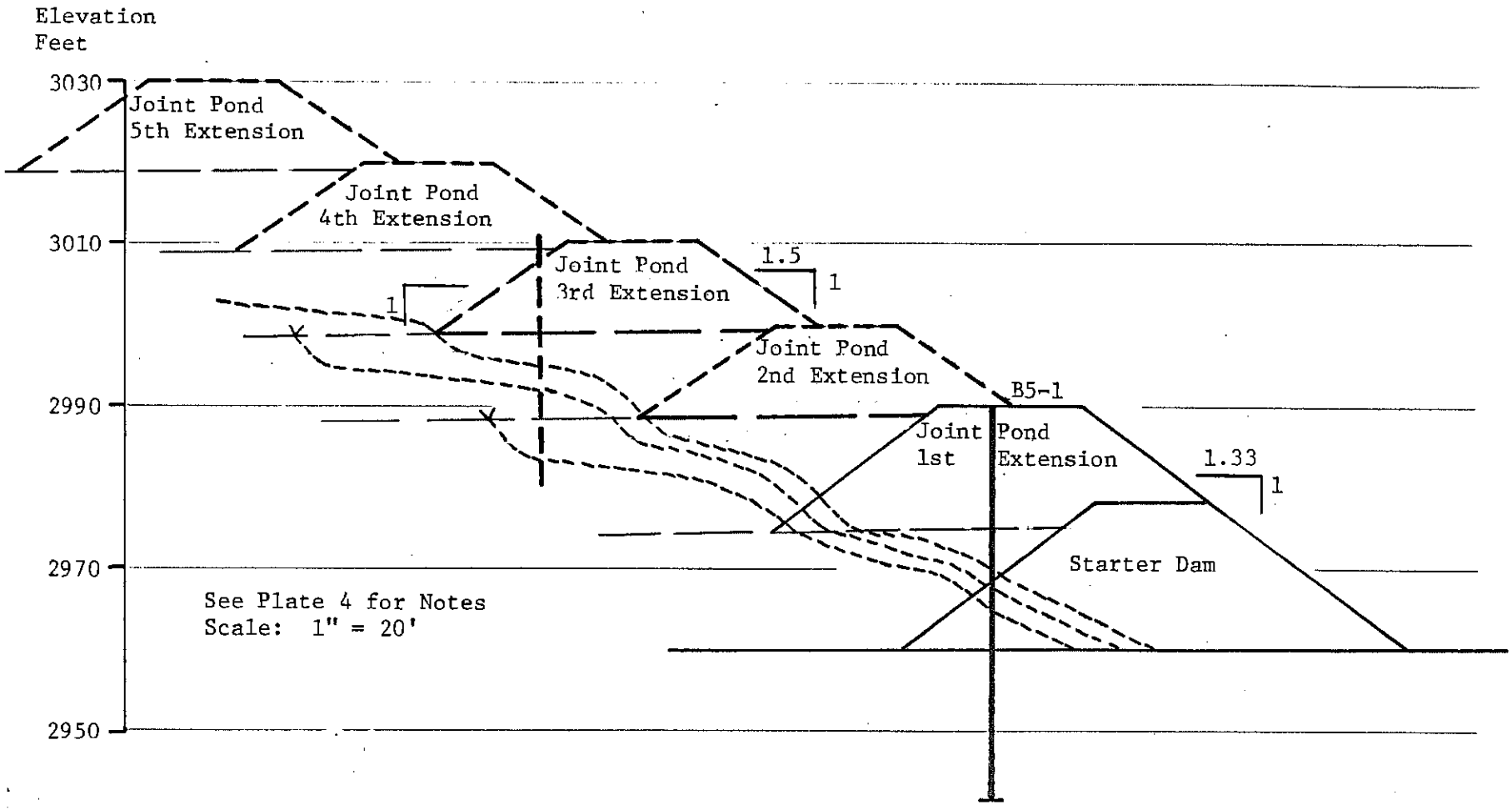


DIKE PROFILE – POND 4 (SECTION O-O)

DAMES & MOORE

BY _____ DATE _____
CHECKED BY _____ FILE 05457-012-32

REVISIONS
BY CMU DATE Feb 4 80



DIKE PROFILE — POND 5 (SECTION P-P)

DAMES & MOORE

BY _____ DATE _____
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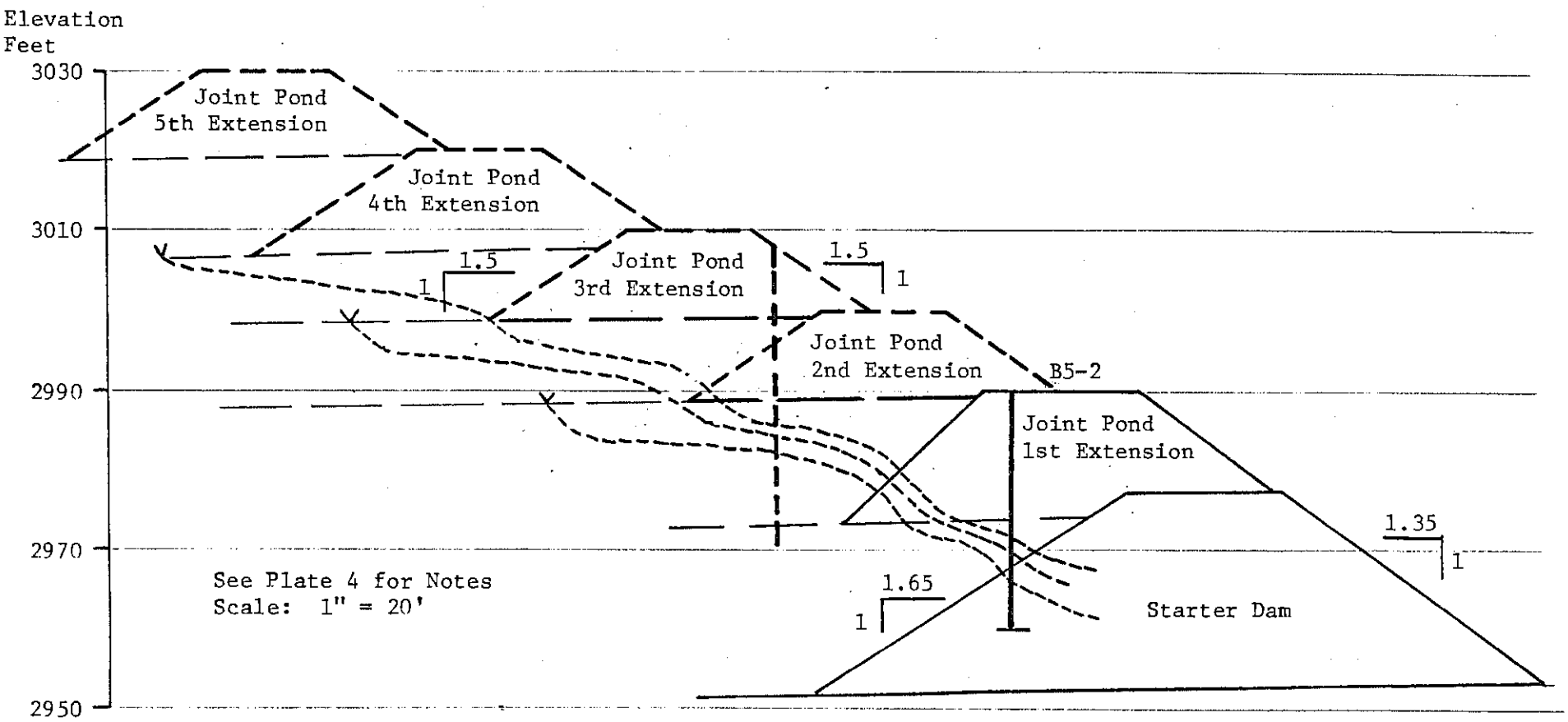
REVISIONS
BY CMU DATE Feb 4 80



DIKE PROFILE — POND 5 (SECTION Q-Q)

DAMES & MOORE

BY _____ DATE _____
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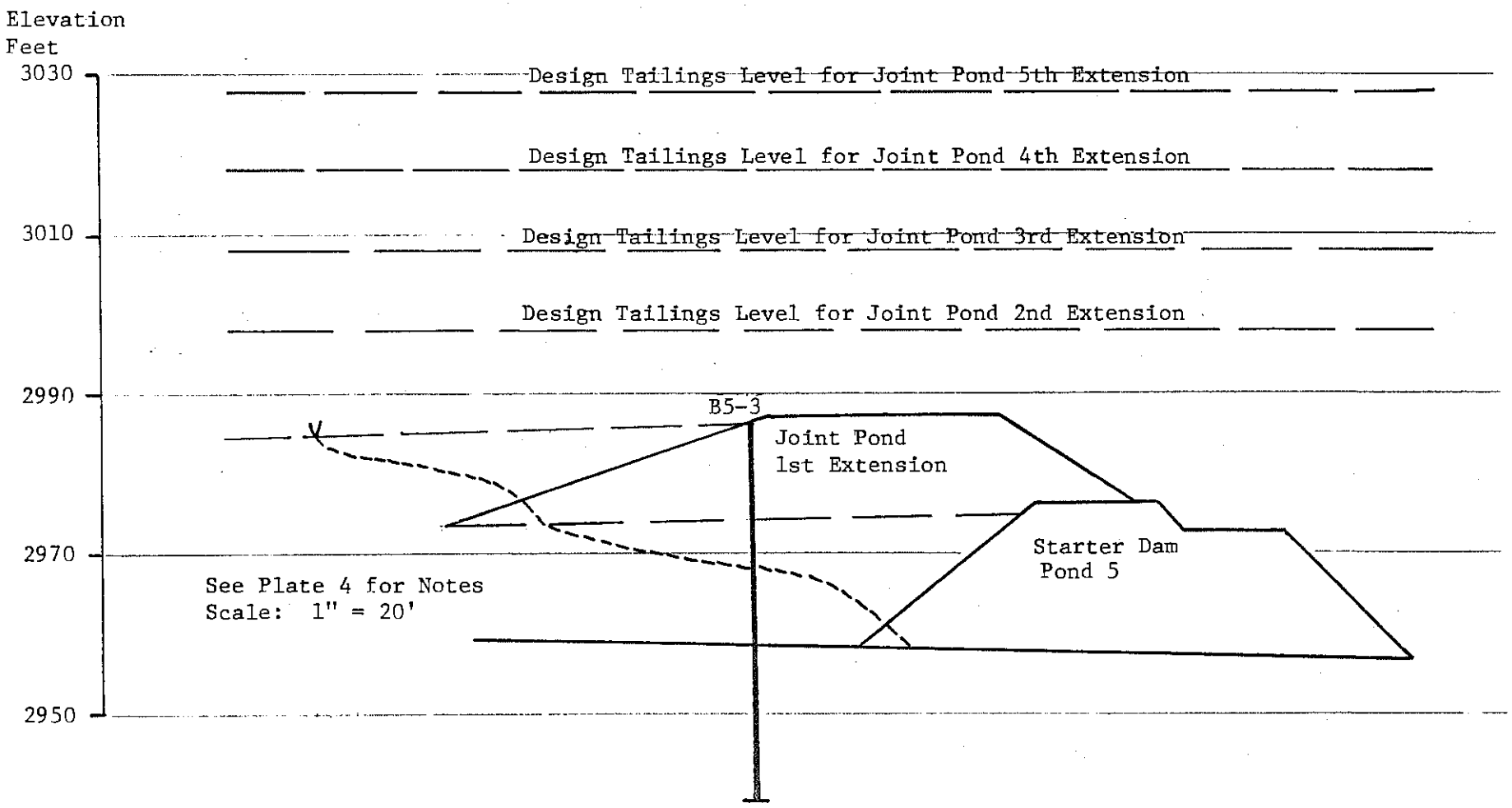
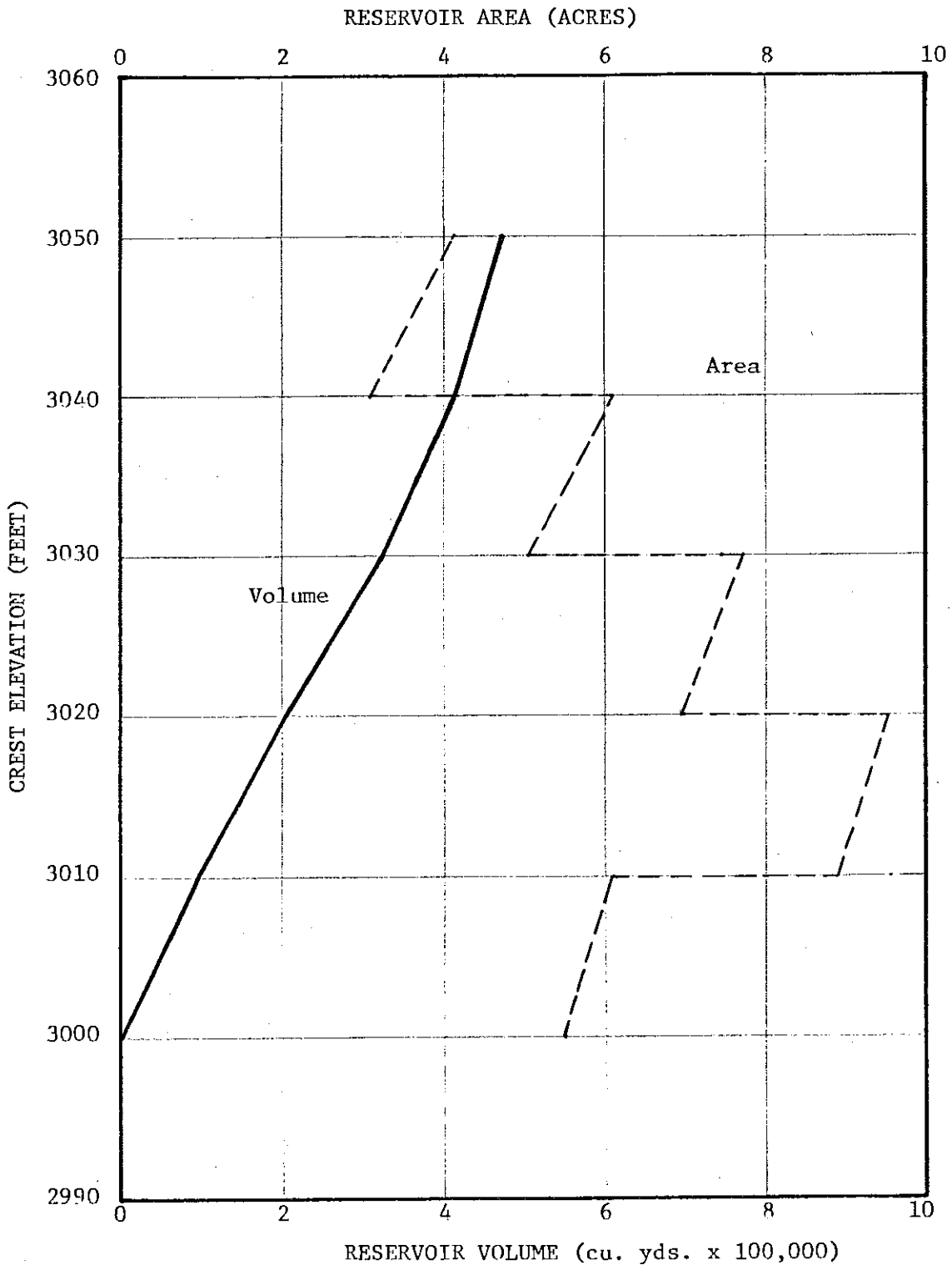
REVISIONS
BY CMU DATE Feb 4, 80



DIKE PROFILE — POND 5 (SECTION R-R)

DAMES & MOORE

PLATE 21



STORAGE CAPACITY
PONDS 1&2

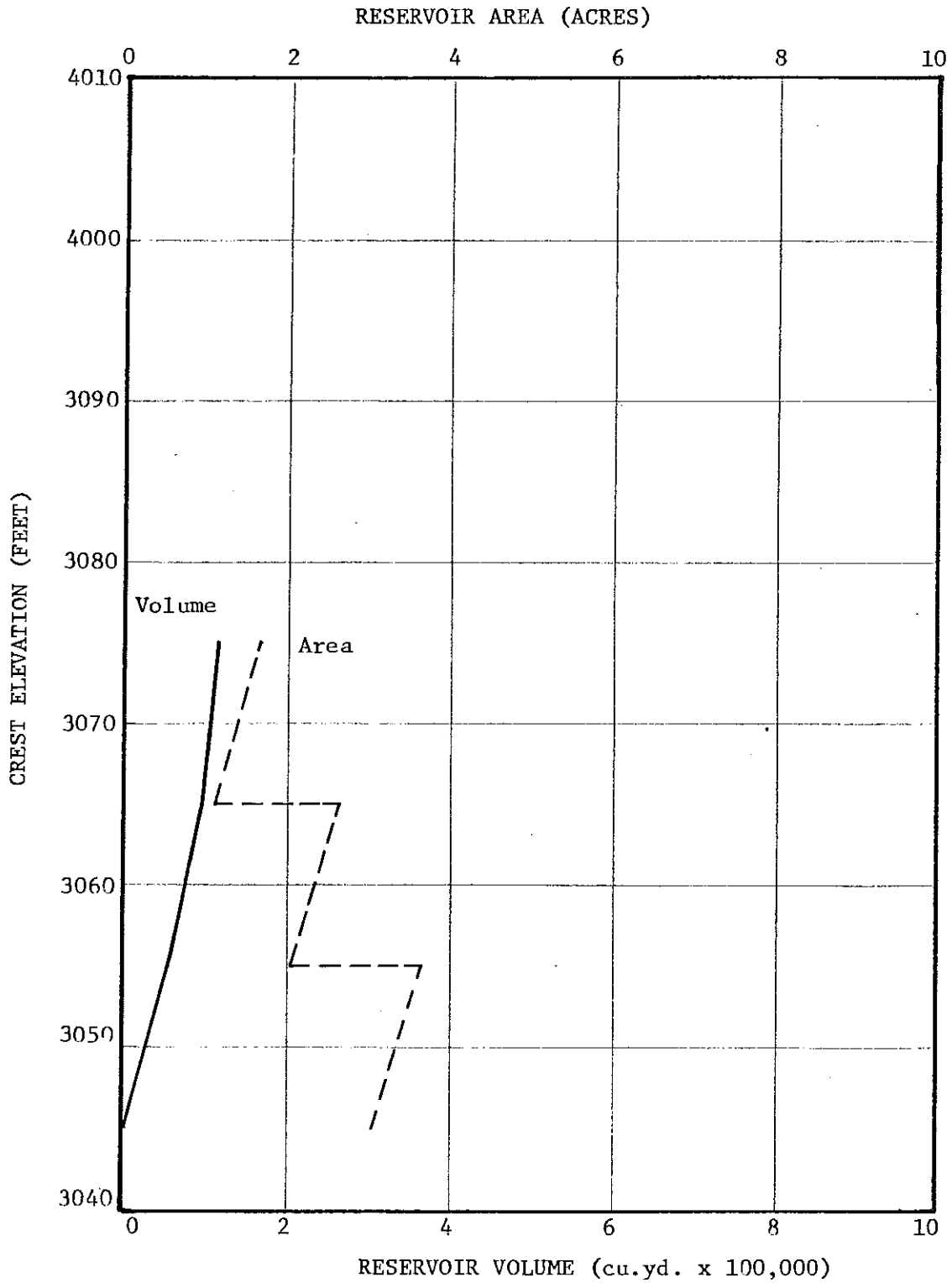
DAMES & MOORE

PLATE 22

REVISIONS BY DATE

FILE 05457-012-32

BY LL DATE 2/3/80
CHECKED BY



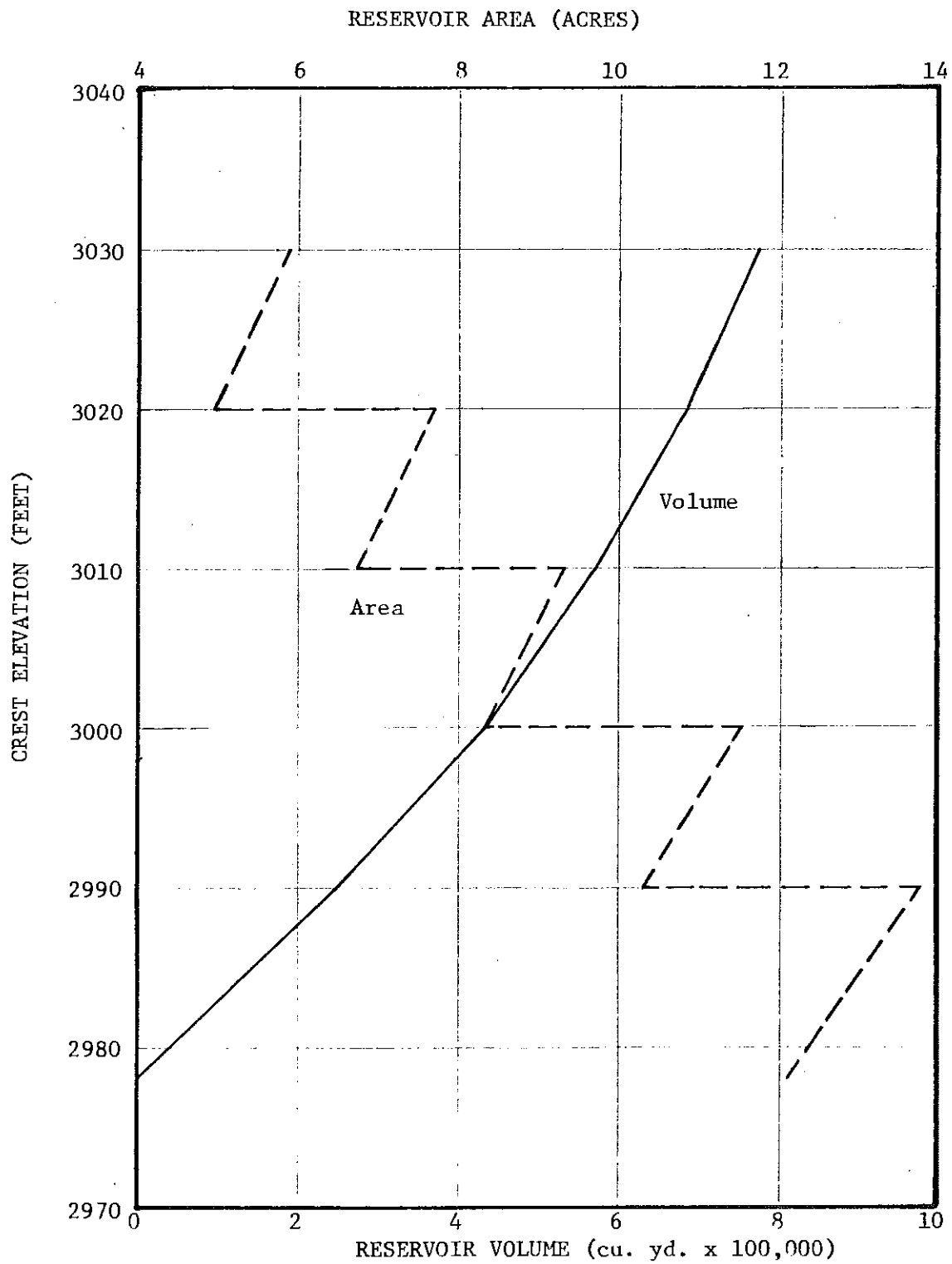
STORAGE CAPACITY
PONDS 3&4

DAMES & MOORE

REVISIONS BY ____ DATE ____

FILE 05457-012-32

BY LL DATE 2/4/80
CHECKED BY ____



STORAGE CAPACITY
PONDS 5&6

DAMES & MOORE

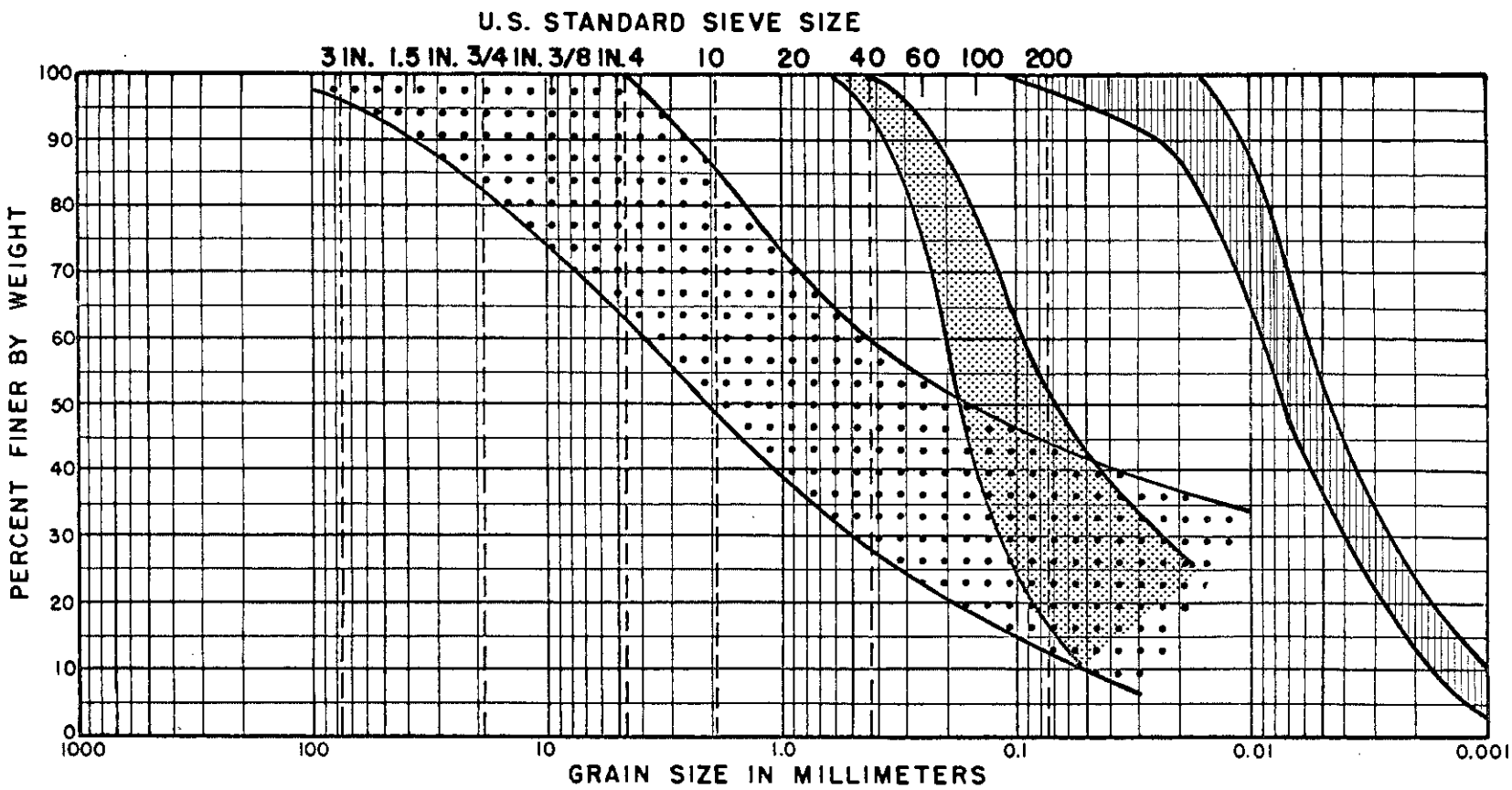
REVISIONS BY ____ DATE ____

FILE 05457-012-22

BY LL DATE 2/4/80
CHECKED BY ____

FILE 1545, 12-3
BY LL DATE 2/11/80
CHECKED BY ____ DATE ____

REVISIONS
BY ____ DATE ____
BY ____ DATE ____
PLATE ____ OF ____



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	
	Slimes	ML	Silt					Tailings Slimes
	Sands	SM	Silty fine sand					Tailings Sands
	Dike Material	GM	Silt, sand & gravel					Hillside Borrow

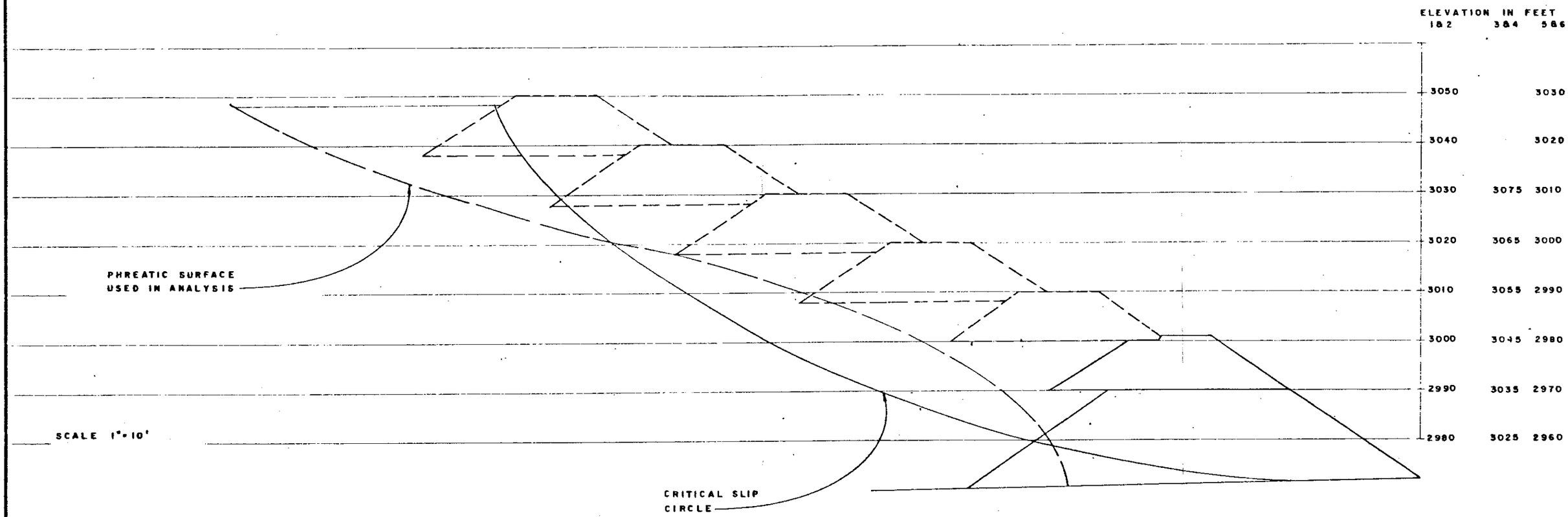
DAMES & MOORE

GRADATION CURVE
CONSTRUCTION MATERIALS & TAILINGS

757.2 (REV. 4-62)

JOINT PONDS		1&2	3 & 4	5&6
FACTOR OF SAFETY	STATIC LOADING CONDITION	1.3	1.4	1.3
	SEISMIC LOADING CONDITION— ROCK ACCELERATION OF 0.03g	1.2	1.3	1.2
	PORE PRESSURE BUILD UP PROPORTIONAL TO THE EFFECTIVE STRESS DURING SEISMIC LOADING	1.1	1.1	1.1

NOTE: STABILITY ANALYSES PERFORMED ON PONDS 3&4 FOR THREE EXTENSIONS ONLY.



EFFECTIVE STRESS SOIL PARAMETERS USED IN THE SIMPLIFIED BISHOP METHOD OF STABILITY ANALYSIS

COMPACTED FILL:

γ [illegible]

ϕ' [illegible] DEGREES

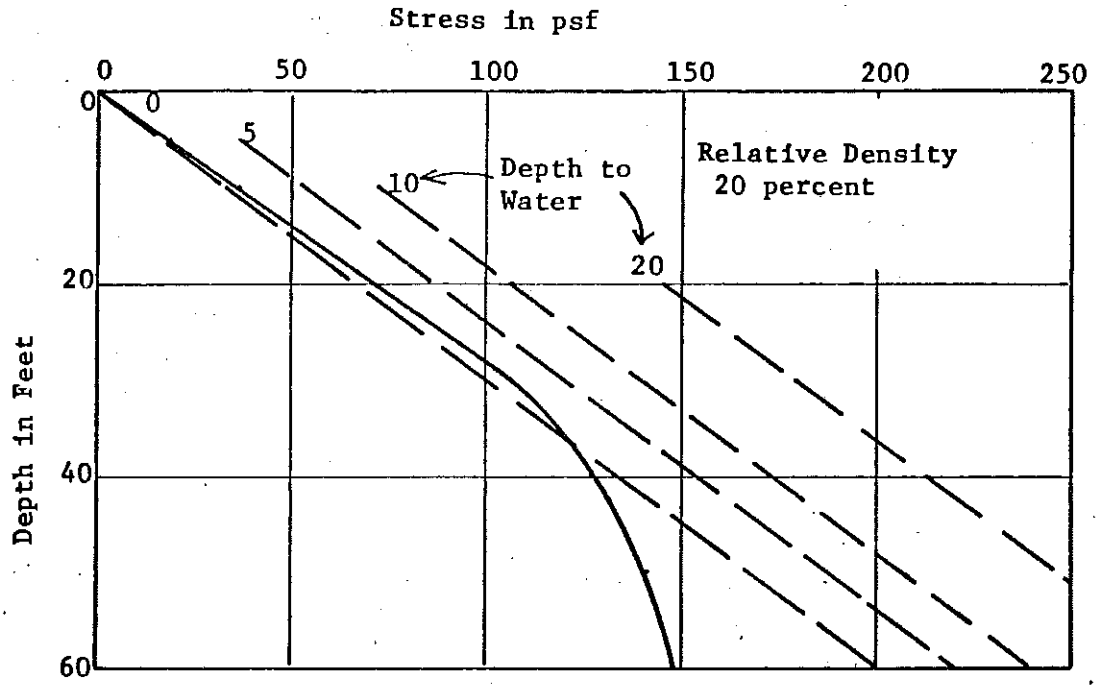
TAILINGS:

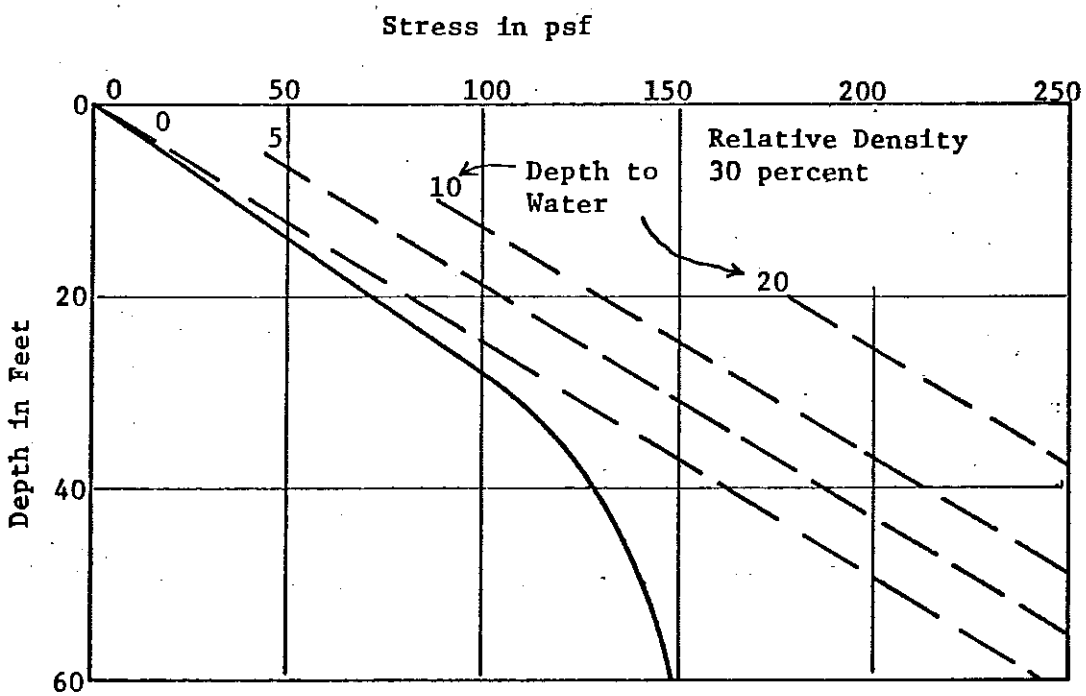
γ [illegible]

ϕ' [illegible] DEGREES

SUMMARY OF STABILITY ANALYSES

DAMES & MOORE





——— Cyclic stress developed by an earthquake oscillation of 0.05g

— — Cyclic stress causing liquefaction in 10 cycles (based on laboratory test data) for various depths of phreatic surface. Depth to water is shown for each curve.

LIQUEFACTION POTENTIAL

DAMES & MOORE

PLATE 27

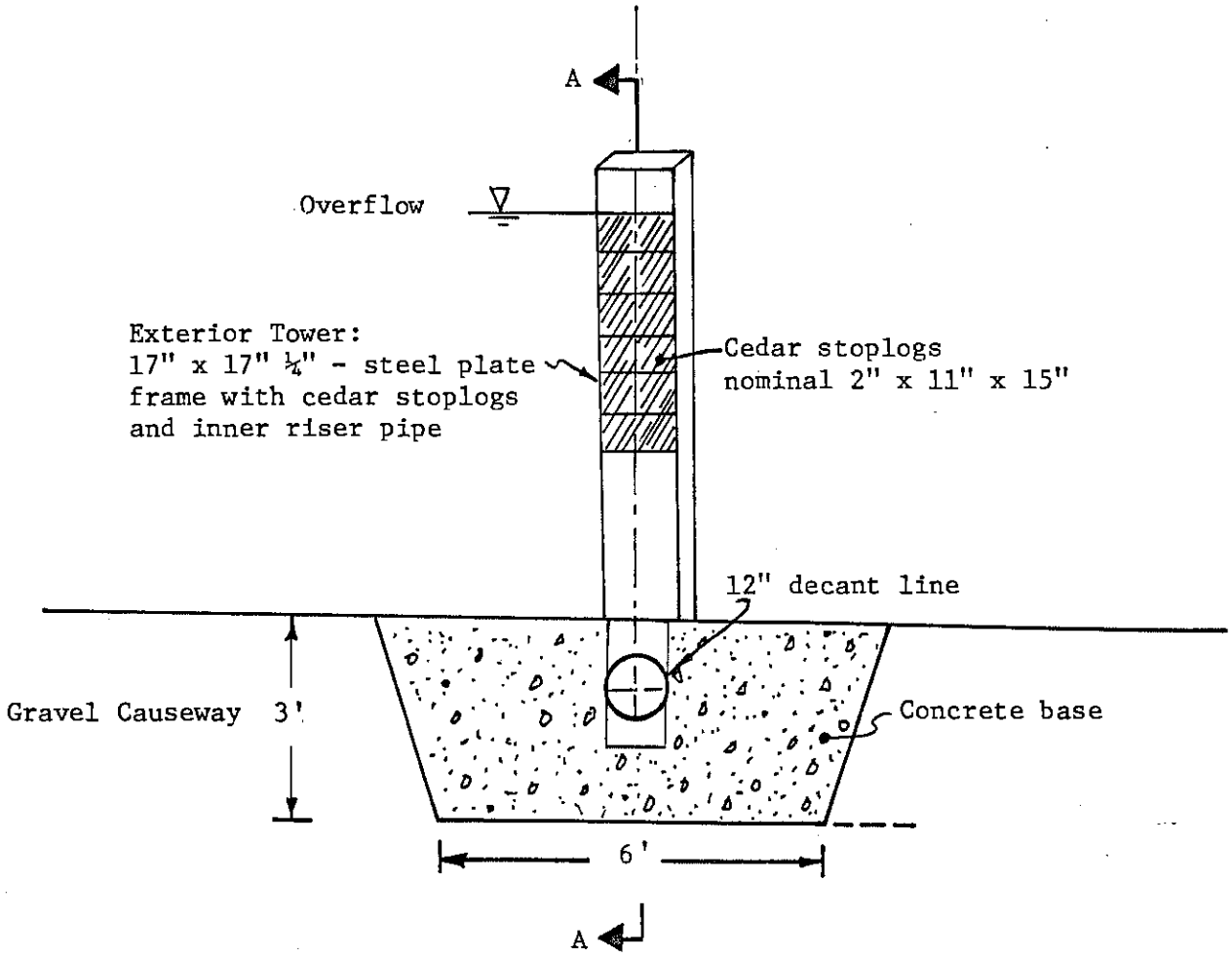
REVISIONS BY DATE

FILE 5457-008-32

CHECKED BY DATE

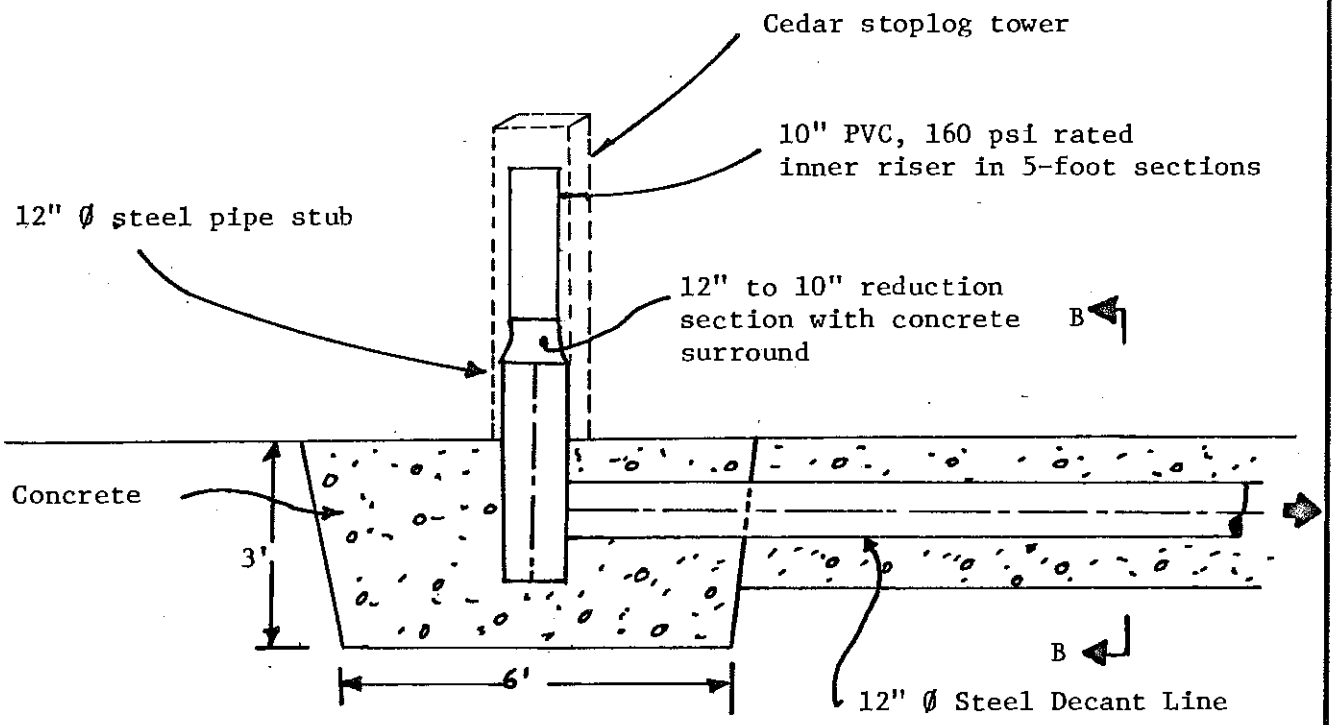
BY B/M DATE 11/20/79
CHECKED BY _____ FILE 05457-011-32

REVISIONS
BY _____ DATE _____



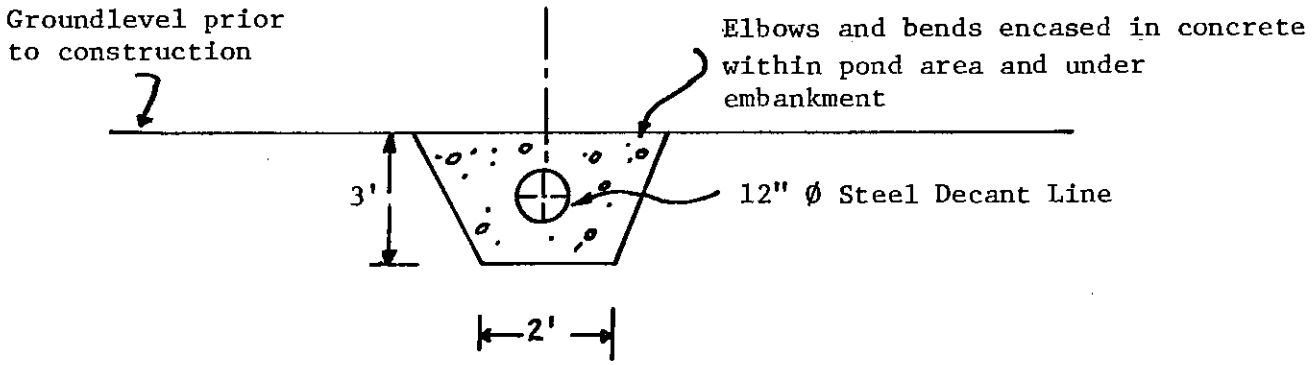
DECANT TOWER

DAMES & MOORE



Section A-A

Mine waste or hillside borrow backfill



Section B-B

Scale: 1" = 3'

DECANT LINE

DAMES & MOORE

REVISIONS BY ____ DATE ____

FILE 05457 010 32

BY BJT DATE 11/19/77

CHECKED BY ____

APPENDIX

FIELD AND LABORATORY INVESTIGATIONS

FIELD INVESTIGATIONS

General

The field exploration programs undertaken to investigate subsurface conditions in the tailings backfill and existing dikes of Star Tailings Ponds 1 to 5 were performed from August 8 through August 12, 1977 and September 28 through October 19, 1979. The earlier program was carried out at Pond 2 and was discussed in our "Report On Investigation and Design, Star No. 2 Tailings Impoundment Extension, Wallace, Idaho", dated December 14, 1977. The later program concentrated on the other ponds. For completeness the results of both investigations are reported herein.

The field programs included the drilling of 29 borings, completion of 17 insitu density tests and installation of 22 piezometers, as tabulated:

Pond No.	No. of Borings	Boring Depths (ft)	No. of Samples	Feet Drilled	No. of Piez.	Insitu Densities
1	4	18 to 30	30	100	3	4
2	9	18 to 41	80	244	8	3
3	4	24 to 30	28	105	3	4
4	9	29 to 100	11	497	5	3
5	3	29 to 49	6	126	3	3
TOTAL	29	18 to 100	155	1072	22	17

Eight of the Pond 2 borings were drilled in 1977 and labelled B-1 through B-8. All 1979 borings, piezometers and insitu density tests were labelled with the prefix denoting the pond numbers as shown on Tables A-1 and A-2.

Borings

A truck mounted hollow stem auger drill rig was utilized to complete the borings in Ponds 1, 2 and 3. The borings were advanced by augering and stopped at selected depths for sampling. Samples were obtained by lowering the sampler down the hollow auger stem to the bottom of the hole with the auger keeping the hole from caving. Samples were obtained in all borings at 2.5 to 5 foot intervals by driving a 2-inch standard split spoon sampler with a 140 pound hammer falling 30 inches. The blow counts for driving this sampler each foot are indicative of the relative consistency of the soil. Relatively undisturbed samples of soil were taken in Pond 2 tailings at 5- to 10-foot intervals with a 3-inch diameter Shelby sampler advanced by hydraulic pressure. Occasional undisturbed samples were taken in Pond 1 tailings.

Most borings were terminated when cobbles and boulders below the original ground level prevented further augering. One of the borings, B-3, had to be relocated 5 times before augering through boulders at a depth of about 10 feet could be achieved. Two borings, B-2 and B-4, were advanced beyond the auger limits in the foundation gravels by the rotary wash method. This involved using a tri-cone roller bit for drilling, mud for circulation of cuttings, and the auger for casing off the augered section of the hole. Caving gravels and the breaking and loss of drill equipment prevented additional deepending of these borings.

Because of the difficulties encountered with auger penetration of the foundation gravels, a truck mounted air rotary drill rig supplied by Brand-X of Rathdrum, Idaho, was mobilized to complete the drilling program. It deepened Pond 3 borings, B3-1 and B3-2, and completed all borings in Ponds 4 and 5. The rig had previously completed three water wells in the vicinity of Pond 4, to depths of 75 to 100 feet. The driller's logs of these wells are incorporated herein as Borings B4-7, B4-8, and B4-9. Since the rig was not initially equipped for soil sampling, grab samples of the cuttings were

obtained during drilling of most holes. Modifications to the drill rig enabled split spoon samples to be taken for some of the later borings at changes in soil strata. Most borings were terminated after penetrating several feet into the foundation gravels.

A Dames & Moore engineer supervized and inspected all drilling operations, obtained tube and bag samples for classification and laboratory testing, and prepared detailed logs of the subsurface conditions at each boring. The boring locations were estimated by Dames & Moore. Surface profiles which enabled boring elevations to be obtained, were established by a Hecla Mining Company survey crew. Boring locations are shown on Plate 1, Site Plan. Graphical representations of the soils encountered in all borings are shown on Plates A-1A through A-1Z, Log of Borings. The soils encountered were classified according to the Unified Soil Classification System described on Plate A-2.

Insitu Density Tests

Two insitu density tests were completed on the existing Pond 2 surface by Hecla Mining Company in 1977 using the water replacement technique. Dry densities were 83 and 72 pounds per cubic foot for the tailings sands and slimes, respectively. Fifteen undisturbed samples of tailings were obtained by Dames & Moore in 1979 from near the surface of the tailings ponds. A 1½-inch diameter plastic tube was gently pushed into the tailings and extracted by carefully digging around it. Dry densities ranged from 78 to 106 pounds per cubic foot. Insitu densities are tabulated on Table A-2.

Piezometers

Piezometers were installed in most boreholes upon completion of drilling as shown on the boring logs and Table A-1. They consist of ½- to 2-inch diameter Poly-vinyl chloride pipe (PVC), with the lower 10 to 20 feet slotted at 6-inch intervals. The piezometers were installed either inside a 2- to 4-inch diameter perforated pipe casing, or in an open hole and backfilled with sand.

Groundwater levels in all piezometers were measured at least 24 hours after installation and are shown on the boring logs. Recommended piezometer designations are shown on Table A-1.

LABORATORY TESTING

General

A detailed laboratory testing program was completed in 1977 on selected samples from the Pond 2 dike fill tailings backfill, and foundation materials. It included determination of moisture content and density, gradation, Atterberg Limits, specific gravity, consolidation characteristics, relative density, shear strength properties from torvane, direct shear and triaxial tests, liquefaction potential from cyclic triaxial tests, and permeability.

The 1979 laboratory program, performed on selected samples from the Pond 1 to 5 exploration program, was supplemental to the earlier program. It included determination of moisture content and density, gradation, and shear strength from torvane tests.

Moisture and Density

Moisture content and densities were determined for selected samples from the exploration borings. The data from these tests were used to correlate with other test results for identification and classification. The results of the tests are presented on the boring logs.

Gradation

Gradation tests were completed on a number of representative samples obtained from borings to aid in classifying the soils and determining their suitability for dike construction. The coarse gradation of these samples

was determined by shaking through Standard Sieve sizes. The fine gradation was determined by either an hydrometer analysis or by washing the samples through a No. 200 U. S. Standard Sieve. The results of gradation tests on foundation soils, dike fill material and tailings sands and slimes, are shown on Plate A-3A to A-3X.

Atterberg Limits

The plasticity of the slimes was determined by completing one liquid and plastic limit test. Both limits were found to occur at about the natural moisture content. The slimes were found to be very sensitive to water and to have no plasticity.

Specific Gravity

Specific gravity tests were completed on representative samples of tailings sand and slimes. The specific gravities were found to be 2.63 and 2.79, respectively.

Consolidation Tests

A consolidation test was performed on a relatively undisturbed sample of slimes. The test was completed to evaluate the compressibility characteristics of the tailings under the proposed embankment. One additional test was completed on a sample remolded to as loose a consistency as possible to try and establish a virgin compression curve. This curve was used to develop a relationship between relative density and depth below tailings surface for use in the liquefaction analyses. Test results are presented on Plate A-4. The method of performing consolidation tests is presented on Plate A-5.

Relative Density

The relative density of the tailings sands and slimes in Pond 2 was determined. The purposes of these tests, in conjunction with the remolded consolidation test, was to establish a relationship between confining pressure, dry density and relative density. Using this relationship the relative density can be estimated at various depths in the pond based on the confining pressure. Relative density is then used in the determination of liquefaction potential. The lower the relative density, the higher the probability of liquefaction under given loading conditions. Generally, insitu densities ranged from 10 to 50 percent relative density for the tailings sand and from 15 to 45 percent relative density for the tailings slimes. Test results are presented on Plate A-6. These test results were used to assess the behaviour of deposited tailings.

Torvane Tests

Torvane shear strength tests were performed on samples of slimes. Shear strengths varied from 200 to 600 pounds per square foot. Because of the lack of plasticity and clay in the slimes, these values are not indicative of long term shear strength but given an indication of relative consistency for materials having similar gradations.

Direct Shear Tests

Direct shear tests were completed on samples of tailings sands and slimes at low relative densities to determine the long term effective strength parameters of the tailings. The samples were saturated and tested at various normal loads. The test results are plotted on Plate A-7. The method of performing direct shear tests is presented on Plate A-8.

Triaxial Compression Tests

Two unconsolidated undrained triaxial tests were completed on reconstituted samples of slimes to determine strength parameters. The samples were formed by drying under room temperature and then pouring into a mold and tamping to the appropriate density. The samples were then flooded and held under a back pressure for several days until they were fully saturated. For testing, each sample was consolidated to a pre-determined confining pressure and sheared by increasing the vertical load. Test results are plotted on Plate A-9. The method of performing triaxial tests is presented on Plate A-10.

Cyclic Triaxial Tests

Several cyclic shear triaxial tests were conducted to determine the number of stress reversal cycles to cause liquefaction of samples of tailings sands and slimes remolded to approximate insitu densities when subjected to various simulated earthquake loadings. Two tests were performed on samples of Pond 2 slimes, and were supplemented by tests performed on sands and slimes from the Lucky Friday Pond. The tests were performed by one of Dr. Liam Finn's associates in the Department of Applied Sciences at the University of British Columbia. Samples of slimes were formed by drying under room temperature and then pouring into a mold and tamping to the appropriate density. Samples of sand were formed by drying in an oven and then pouring into a mold and vibrating to the appropriate density. The samples were saturated with a back pressure for a few days prior to testing. Pore pressures were then monitored electronically during testing so that the rate of build up of pore pressures could be determined in relation to the number of stress cycles. For each test, a specific stress was applied cyclically as a percentage of the confining pressure until liquefaction occurred. The number of stress cycles was recorded and is plotted on Plate A-11. Pore pressure increases during the tests are plotted on Plates A-12.

Variable Head Permeability Tests

Variable Head Permeability tests were performed on recompacted samples of tailings sands and slimes to provide permeability data for use in estimating the probable amount of seepage through the tailings backfill and into the foundation gravels. The results of the permeability tests are presented in tabular form below.

Boring	Depth (feet)	Soil Description	Density (pcf)	Permeability (cm/sec.)
B-6	17.5	Tailings Slimes	82.7	4.2×10^{-6}
B-8	7.5	Tailings Slimes	85.1	3.3×10^{-6}
B-6	7.5	Tailings Sands	88.8	6.2×10^{-3}
			92.3	5.6×10^{-3}
			94.2	4.8×10^{-3}
B-4	17.5	Tailings Sands	87.8	8.3×10^{-3}
			89.3	8.0×10^{-3}
			92.3	6.6×10^{-3}
			94.1	6.0×10^{-3}
			96.7	5.1×10^{-3}

o 0 o

The following tables and plates are attached to complete this Appendix:

Table A-1	Boring and Piezometer Designation
Table A-2	Insitu Density
Plate A-1A to A-1D	Log of Boring - Pond 1
Plate A-1E to A-1L	Log of Boring - Pond 2
Plate A-1M to A-1P	Log of Boring - Pond 3
Plate A-1Q to A-1W	Log of Boring - Pond 4
Plate A-1X to A-1Z	Log of Boring - Pond 5
Plate A-2	Unified Soil Classification System

Plate A-3A to A-3E	Gradation Curves - Pond 1
Plate A-3F to A-3J	Gradation Curves - Pond 2
Plate A-3K to A-3N	Gradation Curves - Pond 3
Plate A-3O to A-3T	Gradation Curves - Pond 4
Plate A-3U to A-3X	Gradation Curves - Pond 5
Plate A-4	Consolidation Test Data
Plate A-5	Method of Performing Consolidation Tests
Plate A-6	Relative Density Test Results
Plate A-7	Direct Shear Test Results
Plate A-8	Method of Performing Direct Shear and Friction Tests
Plate A-9	Triaxial Test Results
Plate A-10	Method of Performing Unconfined Compression and Triaxial Compression Tests
Plate A-11	Cyclic Triaxial Test Results
Plate A-12	Cyclic Triaxial Test Pore Pressure Data

TABLE A-1

BORING AND PIEZOMETER DESIGNATION

Tailings Pond	Boring Designation	Depth (ft)	Piezometer Designation
1	B1-1	27	P1EA1
	B1-2	25	P1WA1
	B1-3	18	P1WB1
	B1-4	30	-
2	B-1	25	P2EB1
	B-2	41	P2EB2
	B-3	19	P2EA1
	B-4	37	P2EA3
	B-5	31	P2WA1
	B-6	33	P2WA2
	B-7	18	-
	B-8	19	P2WB3
	B2-1	22	P2WB1
3	B3-1	24	P3EA1
	B3-2	30	P3WA1
	B3-3	24	P3WB1
	B3-4	27	-
4	B4-1	50	P4EA1
	B4-2	32	P4EB1
	B4-3	29	P4WC1
	B4-4	33	P4WA1
	B4-5	50	-
	B4-6	33	P4WB1
	B4-7	100	-
	B4-8	75	-
	B4-9	95	-
5	B5-1	29	P5WA1
	B5-2	49	P5EA1
	B5-3	48	P5SA1

TABLE A-2

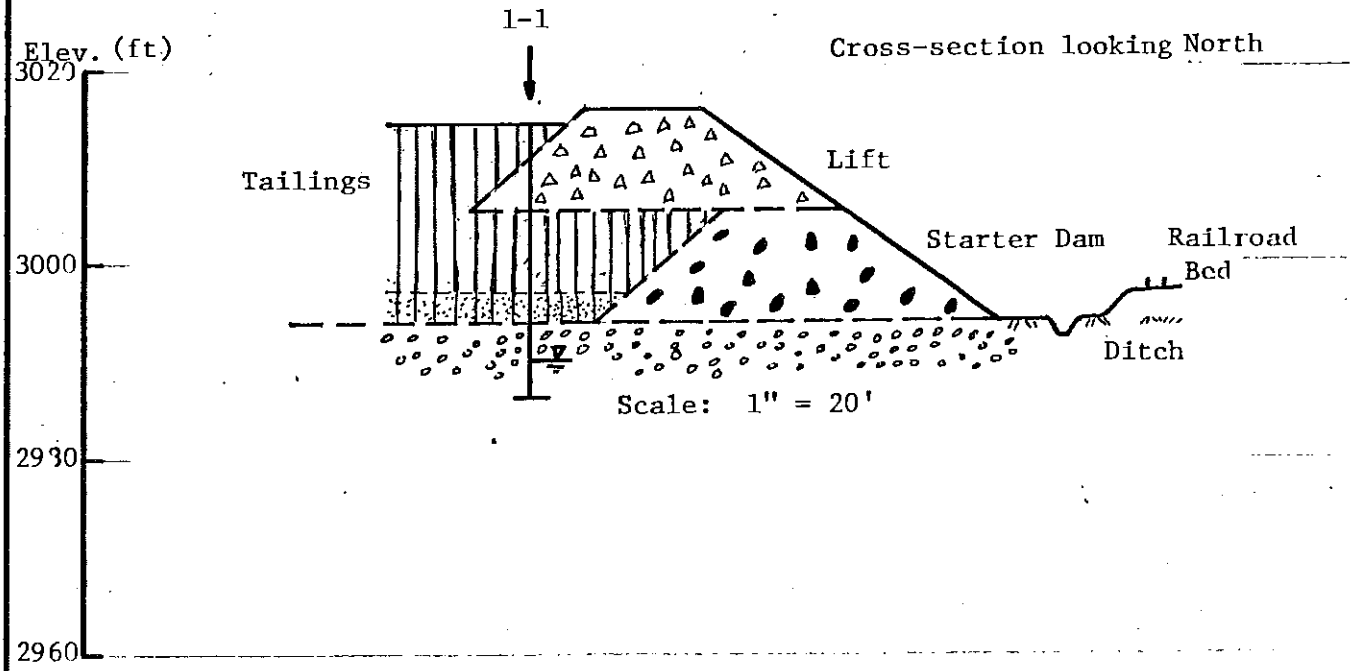
INSITU DENSITY

Tailings Pond	Depth (ft)	Sample Designation	Minus No. 200 (Percent)	Moisture Content (%)	Dry Density (pcf)
1	2.0	S1-1	74	34	85
	2.0	S1-2	98	35	84
	1.0	S1-3	93	29	86
	1.5	S1-4	40	27	94
2	0.0	Hecla 1	-	-	83
	0.0	Hecla 2	-	-	72
	1.0	S2-1	50	11	100
3	2.0	S3-1	85	37	78
	1.0	S3-2	71	25	85
	1.0	S3-3	95	41	81
	2.0	S3-4	50	16	83
4	0.0	S4-1	49	35	106
	0.0	S4-2	88	51	81
	0.0	S4-3	72	45	76
5	3.0	S5-1	78	26	94
	0.0	S5-2	25	14	88
	1.0	S5-3	90	36	85

Boring B1-1
Date Drilled Sept. 30, 1979
Collar Elevation 3014
Borehole Depth 27 feet

Depth (ft)	Sample	Lab Test	Moisture Content %	Blow Count	% Passing #200	Soil Strength TSF	Strength Test	Piezometer		
0									SM	Light brown silty fine sand - tailings (loose)
	◪		20	3	50				GM	Brown silty and sandy gravel - mine waste and hillside borrow (medium dense)
	◪		16	8	40					
	◪		10	15						
10									ML	Dark grey sandy silt with layers of light grey silty fine sand (very soft to soft) - tailings slimes
	◪		17	3	60					
			44							
	◪		25	2	92					
20	◪		31	9	84				SM	Dark grey silt and sand-tailings (loose)
	◪		14	11					GP	Brown sand, gravel, cobbles and boulders - river gravel (very dense)
	◪		10	100	18			1"in 2" PVC		
30										
40										
50										

For Notes and Key see Plate A-1E



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LOG OF BORING — POND I

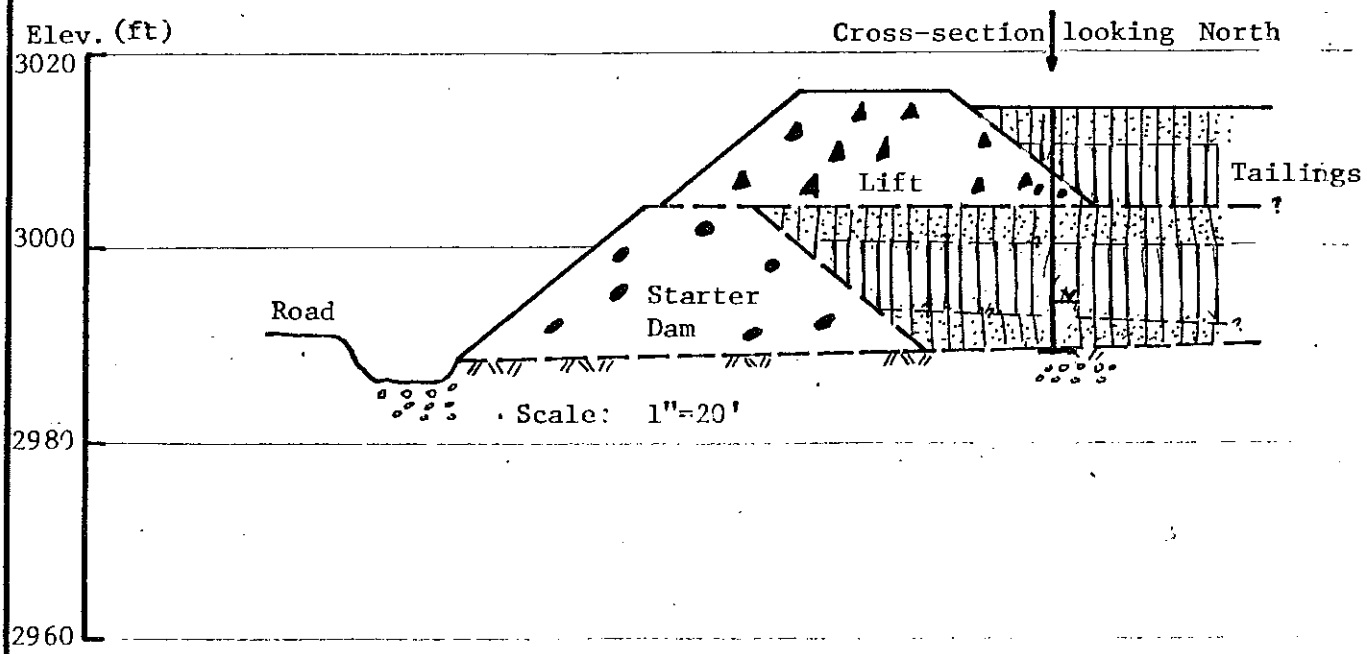
PLATE A-1A

FILE HECLA MINING CO. 05457-012-32 EV S BY DATE
CHECKED BY

Boring B1-2
Date Drilled September 28, 1979
Collar Elevation 3015
Borehole Depth 25 feet

Depth (ft)	Sample	Lab Test	Moisture Content %	Blow Count	% Passing #200	Soil Strength TSF	Strength Test	Piezometer		
0	◪	G	23	2	91				SM	Light brown silt and sand - tailings (very loose)
	◪		31	W					ML	Grey sandy silt - tailings (soft)
	◪	G	13	4	66				GM	Brown silty and sandy gravel - mine waste and hillside borrow (loose)
10	◪		17	10						
	◪	G	26	2	60				SM	Light brown and grey silty and gravelly sand - tailings and fill (very loose)
	■		36	P					ML	Dark grey sandy silt - tailings slimes
20	◪	G	16	2	30			1" PVC	SM	Grey silty fine sand - tailings (very loose)
									GP	Brown sand, gravel, cobbles and boulders - river gravel (very dense)
30										
40										
50										

For Notes and Key see Plate A-1E



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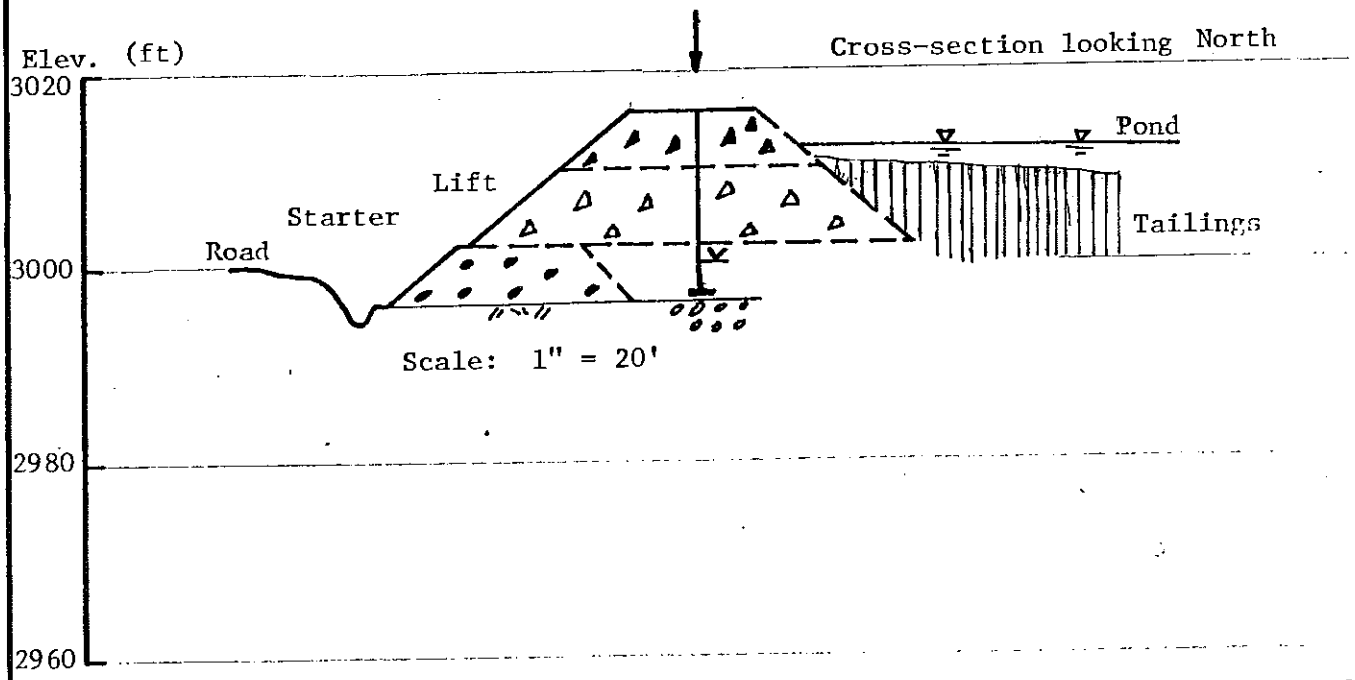
LOG OF BORING — POND I

FILE HECLA MINING CO. 05457-012-32 BY ____ DATE ____ CHECKED BY ____

Boring B1-3
Date Drilled September 29, 1979
Collar Elevation 3016
Borehole Depth 18 feet

Depth (ft)	Sample	Lab Test	Moisture Content %	Blow Count	% Passing #200	Soil Strength TSF	Strength Test	Piezometer		
0									GM	Brown silty and sandy gravel - hillside borrow (loose to medium dense)
			4	12						
		G	3	4	21				GM	Brown silty and sandy gravel - mine waste (very dense)
				100						
10										
		G	6		26					
		G	24	5	65				ML	Dark grey sandy silt - tailings slimes (soft)
			13	35						
									GP	Brown sand, gravel, cobbles and boulders - river gravel (dense)
20								1"in 2" PVC		
30										
40										
50										

For Notes and Key see Plate A-1E



DAMES & MOORE

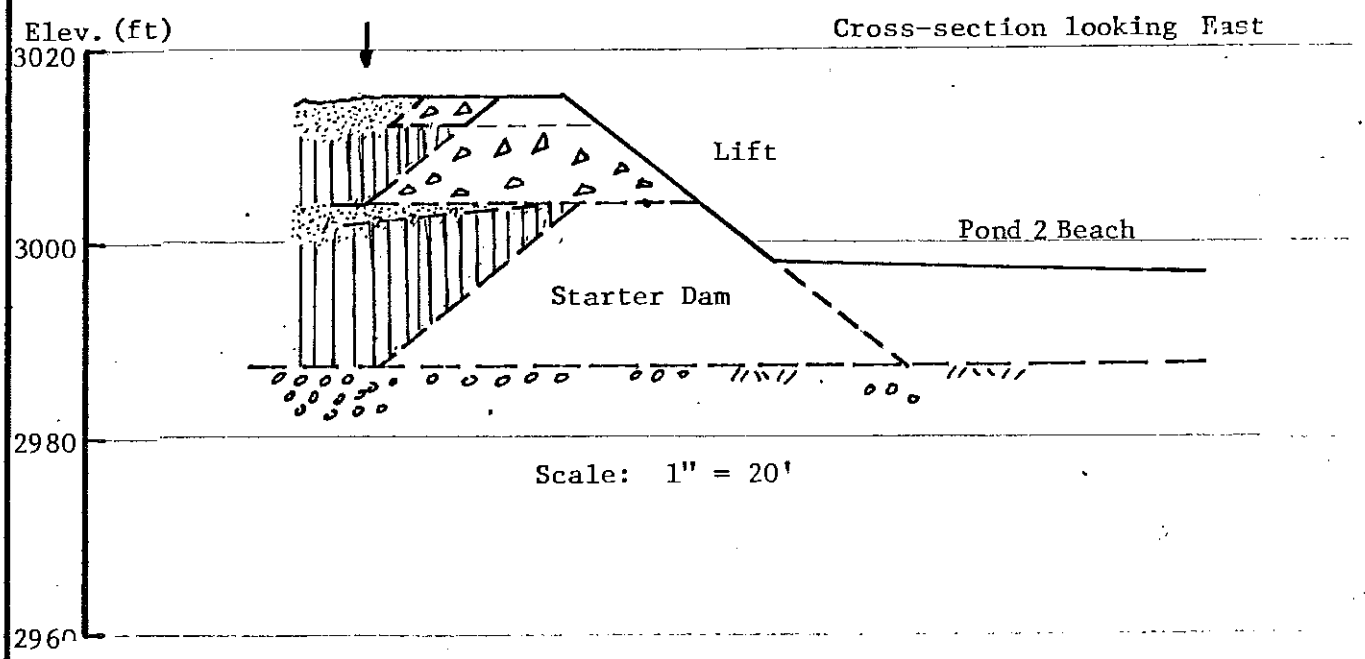
LOG OF BORING — POND I

FILE HECLA MINING CO. 05457-012-32 DATE
BY
CHECKED BY

Boring B1-4
Date Drilled September 29, 1979
Collar Elevation 3015
Borehole Depth 30 feet

Depth (ft)	Sample	Lab Test	Moisture Content %	Blow Count	% Passing #200	Soil Strength TSF	Strength Test	Piezometer		
0									SM	Light brown silty fine sand - tailings (very loose)
	◪		23	1						
	◪		44	W					ML	Dark grey sandy silt - tailings slimes (very soft)
	◪		41	W						
10	◪		38	1						
	◪		41	1						
									SM	Brown silty fine sand with some gravel - tailings (loose)
	◪		46	W					ML	Dark grey sandy silt - tailings slimes (very soft)
20										
	■		43	P						
	◪		42	W						
	◪		7	8					GP	Brown sand, gravel, cobbles and boulders (very dense)
30										
40										
50										

For Notes and Key See Plate A-1E



LOG OF BORING — POND I

DAMES & MOORE

FILE HECLA MINING CO. 05457-012-32 BY ____ DATE ____

CHECKED BY ____ DATE ____

Boring B-1

Elevation 3001.6
Drilled August 8, 1977
Depth 25 feet

Depth in Feet	Laboratory Tests	Dry Density (pcf)	Moisture Content (%)	Blow Count	Sample	Piezometer 2" PVC			
0									
	G		6	37				GM	Brown silty sand and gravel with some cobbles and boulders - Phase 2 fill (dense)
			7	59					
			7	35					
10			10	12				SM	Light gray silty fine sand and dark gray silt - tailings sand and slimes
				15				ML	
	G		14	11				GM	Dark brown gravelly sand with some silt and some wood debris - Phase 1 fill (loose to medium dense)
			9	8					
20				38				WD	Wood
			11	>100				GP	Brown gravel, cobbles and boulders - river gravel (very dense)
				>100					

NOTES

1. Blow count refers to the blows per foot in the Standard Penetration Test (SPT) using a 140 lb. hammer falling 30 inches.
2. P indicates the advance of a Shelby sampler using hydraulic pressure.
3. W indicates the advance of a sample under the weight of drill rods.

LEGEND

Depth at which undisturbed, disturbed and SPT samples were taken, respectively.

Depth at which water level was measured.

C	Consolidation Test	G	Gradation Test	D	Direct Shear Test
T	Triaxial Test	A	Atterberg Limit	S	Specific Gravity
V	Torvane Test	R	Relative Density	P	Permeability
Y	Cyclic Shear Test				

Slotted section of piezometer, annular space backfilled with sand.

LOG OF BORING — POND 2

DAMES & MOORE

REVISIONS BY CMU DATE Sep 2, 77

FILE 5457-009-32

BY CMU DATE Aug 19, 77

CHECKED BY

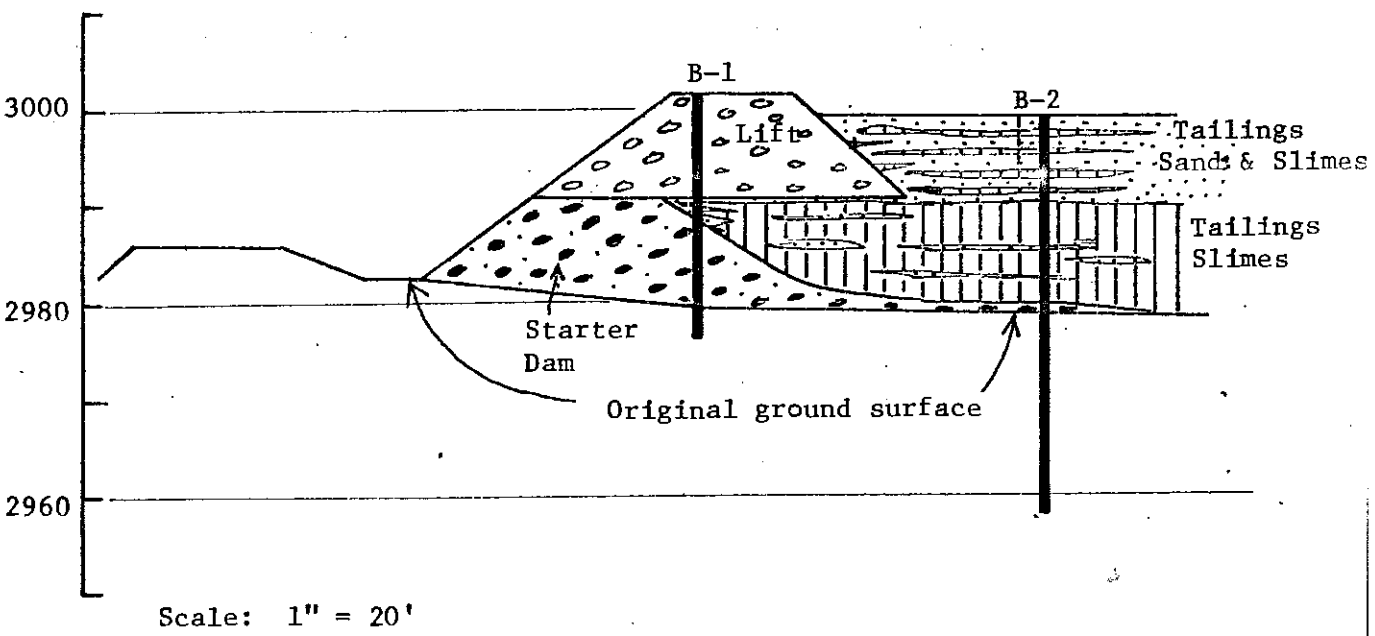
Boring B-2

Elevation 2999.3
Drilled August 9, 1977
Depth 41 feet

Depth in Feet	Laboratory Tests	Dry Density (pcf)	Moisture Content (%)	Blow Count	Sample	Piezometer 2" PVC		
0		85	11	P			SM	Interlayered light gray silty fine sand and dark gray and brown silt - tailings sand and slimes (loose and soft)
		90	7					
	G		12	4			ML	
			12	P				
10			35	2			ML	Dark gray silt with occasional layers of light gray silty fine sand - tailings slimes (very soft)
	G		21	P				
			38	1				
		85	38	P				
		81	53					
20			15	25			GM	Dark brown silt, sand and gravel with some wood debris - topsoil (medium dense)
				>100			GP	Brown gravel, cobbles and boulders with occasional layers of sand - river gravel (very dense)
			5	97				
30				>100				
40								

Drill rods and roller bit left stuck in hole.

For notes and Key see Plate A-1E



Scale: 1" = 20'

LOG OF BORING — POND 2

DAMES & MOORE

PLATE A-1F

REVISIONS BY ____ DATE ____

FILE 11108-001-32

BY CMH DATE Dec 21, 79

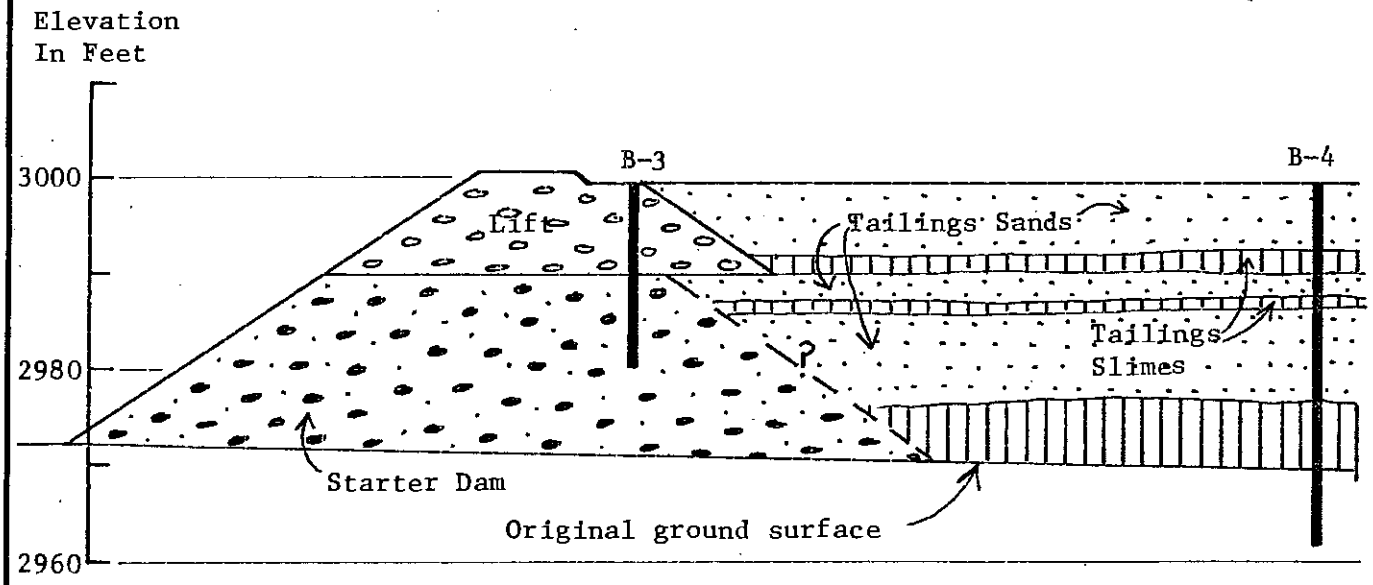
CHECKED BY ____

Boring B-3

Elevation 2999.6
Drilled August 9 & 10, 1977
Depth 19 feet

Depth in Feet	Laboratory Tests	Dry Density (pcf)	Moisture Content (%)	Blow Count	Sample	Piezometer 2" PVC		
0								
	G		8	13			GM	Brown silty sand and gravel with some cobbles and boulders - Phase 2 fill (medium dense)
			14	26				
			9	27				Boulder at 9 feet
10			6	33			GP	Brown cobbles and boulders with some gravel - Phase 1 fill (very dense)
				>100				
			4	33				
				>100				
20			7	>100				

For Notes and Key see Plate A-1E



Scale: 1: = 20'

LOG OF BORING — POND 2

DAMES & MOORE

PLATE A-1G

REVISIONS BY ____ DATE ____

FILE ____

CHECKED BY ____ DATE ____

Boring B-4

Elevation 2999.5
Drilled August 10, 1977
Depth 37.2 feet

Depth in Feet	Laboratory Tests	Dry Density (pcf)	Moisture Content (%)	Blow Count	Sample	Piezometer 2" PVC			
0								SM	Light gray and light brown silty fine sand - tailing sand (very loose)
		94	9	P					
			10	2					
		94	31	P				ML	Dark gray silt - tailing slimes(very soft)
		95	22						
10			9	9				SM	Light gray silty fine sand - tailing sand (loose)
		91	9	P				ML	Dark gray silt - tailing slimes (soft)
		96	6					SM	Light gray silty fine sand - tailing sand (loose)
	GS		7	7					
	DPR	88	5	P					
		86	11						
20			21	3					
			37	W				ML	Dark gray silt - tailing slimes (very soft)
	GR		36	W					
	V	87	36	W					
		86	37						
30	G		8	>100				GP	Brown gravel, cobbles and boulders - river gravel (very dense)
				>100					

For Notes and Key see Plate A-1E

REVISIONS BY ____ DATE ____

FILE ____

CHECKED BY ____ DATE ____

LOG OF BORING — POND 2

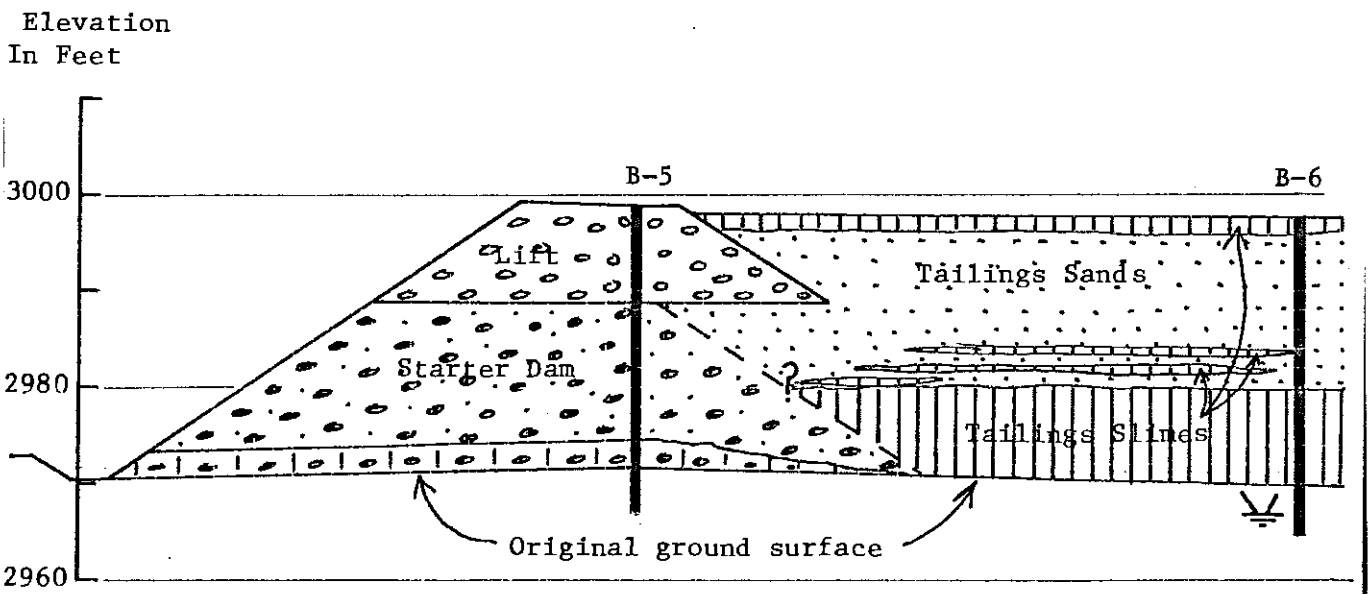
DAMES & MOORE

Boring B-5

Elevation 2998.7
Drilled August 11, 1977
Depth 30.5 feet

Depth in Feet	Laboratory Tests	Dry Density (pcf)	Moisture Content (%)	Blow Count	Sample	Piezometer 2" PVC		
0	G		6	6	◪		GM	Brown silty sand and gravel with some cobbles and boulders - Phase 2 fill (loose)
			7	8	◪			
			12	31	◪			- grades with boulders (medium dense to dense)
10	G		15	35	◪		GW	Brown gravel and sand with some cobbles and boulders, and occasional wood debris- Phase 1 fill (very dense)
			7	86	◪			
			7	74	◪			
			8	73	◪			- grades with numerous boulders
20				>100	◪			
							ML	Dark brown sandy silt with some gravel and some roots - topsoil
30				86 >100	◪		GP	Brown gravel, cobbles and boulders - river gravel(very dense)

For Notes and Key see Plate A-1E



Scale: 1" = 20'

LOG OF BORING — POND 2

DAMES & MOORE

REVISIONS BY ____ DATE ____

FILE ____

CHECKED BY ____ DATE ____

Boring B-6

Elevation 2997.5
Drilled August 11-12, 1977
Depth 33 feet

Depth in Feet	Laboratory Tests	Dry Density (pcf)	Moisture Content (%)	Blow Count	Sample	Piezometer 2" PVC		Description
0							ML	Light brown silt - tailing slime
	R	93	5	P				
		95	4				SM	Light gray silty fine sand - tailings sand (loose)
	S		4	5				
		90	3	P				
	DPR	90	3					
10	G		4	6				- grades with layers of dark gray silt
		97	2	P				
		94	16					
			20	3				
	VP	88	37	W				
20	TD	90	37				ML	Dark gray silt - tailing slimes (very soft to runny consistency)
			37	W				
	SGR		44	W				
			9	>100				
30							GP	Brown gravel, cobbles and boulders - river gravel (very dense)
	G			>100				

For Notes and Key see Plate A-1E

REVISIONS BY ____ DATE ____

FILE ____

CHECKED BY ____ DATE ____

BY ____

LOG OF BORING — POND 2

DAMES & MOORE

REVISIONS BY ____ DATE ____

FILE ____

CHECKED BY ____ DATE ____

Boring B-7

Elevation 2992.9
Drilled August 11, 1977
Depth 17.7 feet

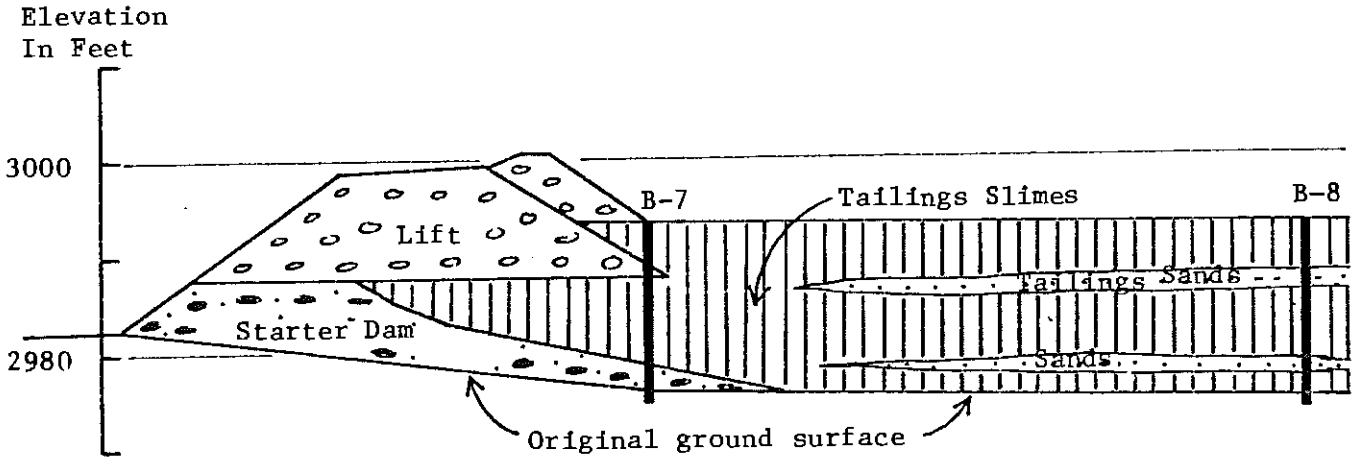
Depth in Feet	Laboratory Tests	Dry Density (pcf)	Moisture Content (%)	Blow Count	Sample	Piezometer 2" PVC		
0	V	80	44	P			ML	Dark gray silt - tailing slimes(very soft)
		81	44				GM	Brown sand, silt and gravel - Phase 2 fill
			16	8			ML	Dark gray silt - tailing slimes (very soft)
			24	2				
10	G		27	2				- grades with a trace of gravel
	V	95	32	W				
			6	50			GW	Brown sand and gravel - Phase 1 fill (dense to very dense)
			9	>100			GM	Dark brown silt, sand and gravel - topsoil (very dense)
20								

For Notes and Key see Plate A-1E

Boring B-8

Elevation 2993.4
Drilled August 11, 1977
Depth 19 feet

Depth in Feet	Laboratory Tests	Dry Density (pcf)	Moisture Content (%)	Blow Count	Sample	Piezometer 2" PVC		
0	VC	87	37	P			ML	Dark gray silt - tailing slimes (very soft)
		84	41					6 inch silty fine sand lens
			27	7				
	VC	86	33	P				
	DP	83	38					
10			26	2				
	V	82	39	P				
		87	36					
			29	2			SM	Light gray silty fine sand - tailings
			19	P			ML	Dark gray silt - tailings sand (loose) slimes (very soft)
			6	100			GP	Brown gravel, cobbles and boulders - river gravel (very dense)
20								



Scale: 1" = 20'

LOG OF BORING — POND 2

DAMES & MOORE

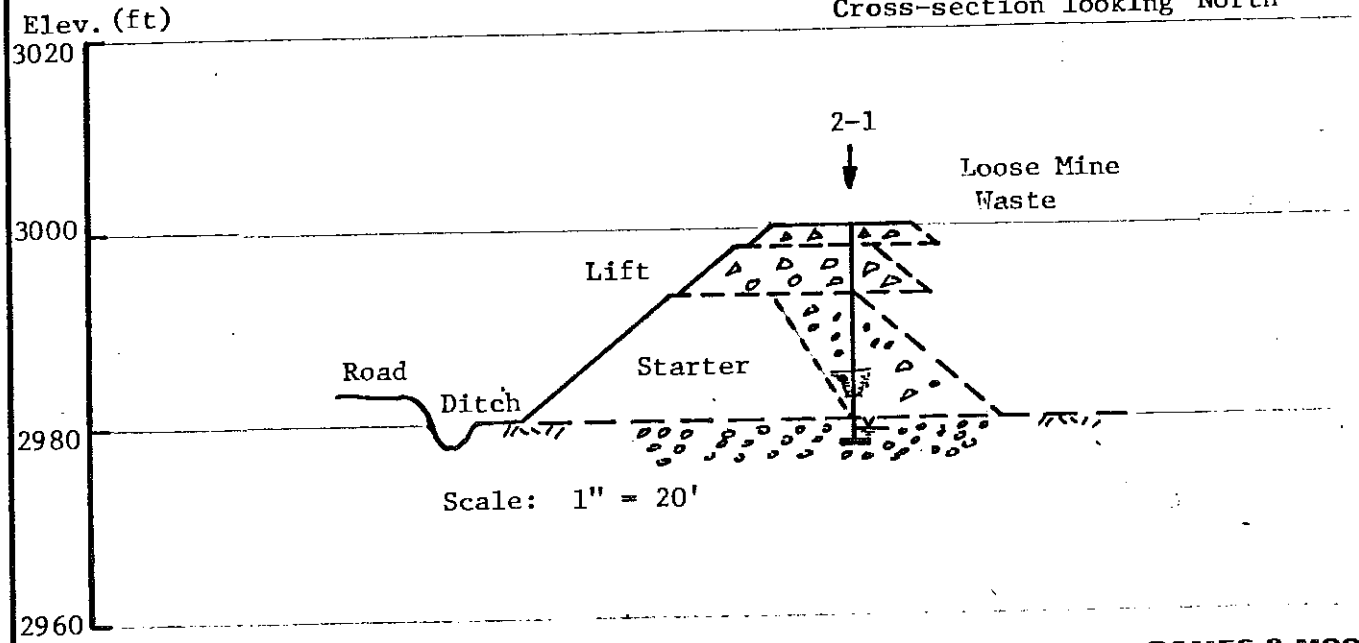
PLATE A-1K

Boring B2-1
Date Drilled October 1, 1979
Collar Elevation 3000
Borehole Depth 22 feet

Depth (ft)	Sample	Lab Test	Moisture Content %	Blow Count	% Passing #200	Soil Strength TSF	Strength Test	Piezometer		
0									GM	Brown silty sand and gravel - mine waste (loose)
									GM	Brown silty and sandy gravel - hillside borrow (dense)
10										
									SM	Grey sand and silt with trace of gravel - tailings (medium dense)
	◪		19	17					GM	Brown sand, gravel, cobbles and boulders with tailings odor - river gravel (medium dense)
20	◪	G	23	12	53					
30										
40										
50										

For Notes and Key see Plate A-1E

Cross-section looking North

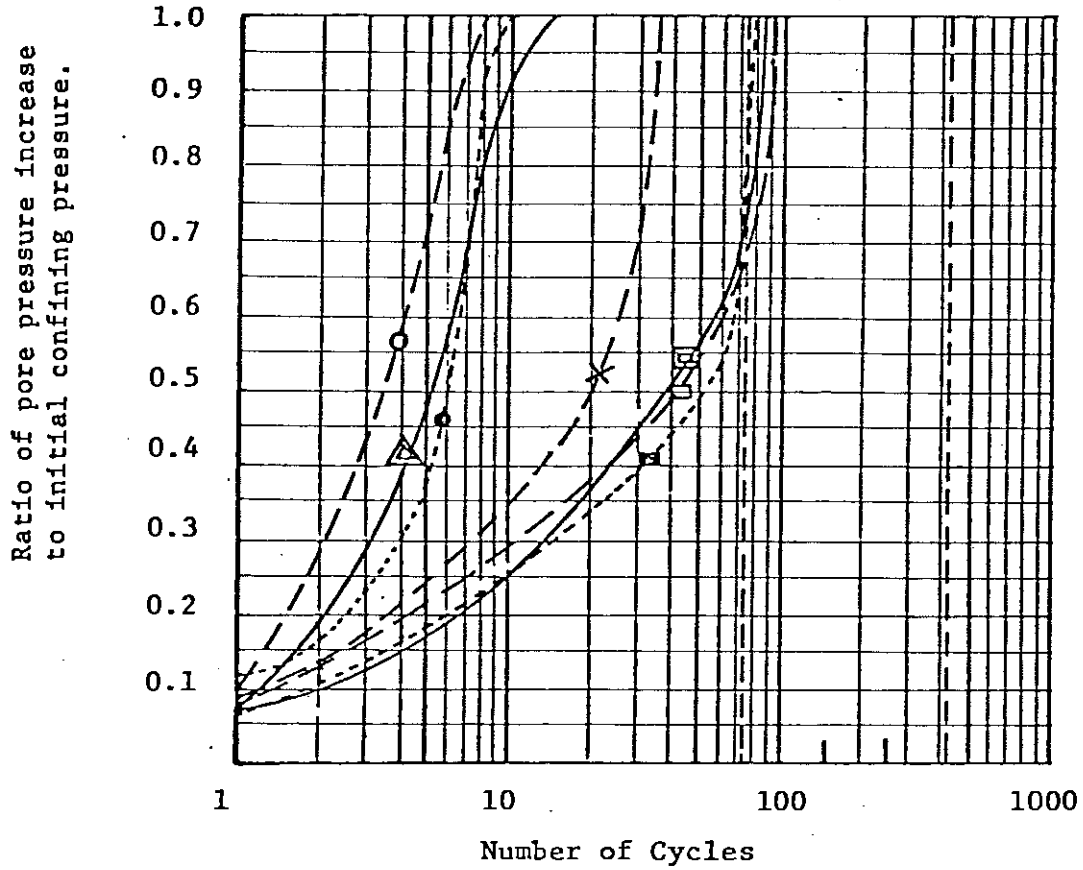


DAMES & MOORE

LOG OF BORING — POND 2

PLATE A-1L

FILE HECLA MINING CO. 05457-012-32 DATE ____ BY ____ CHECKED BY ____ E. ____



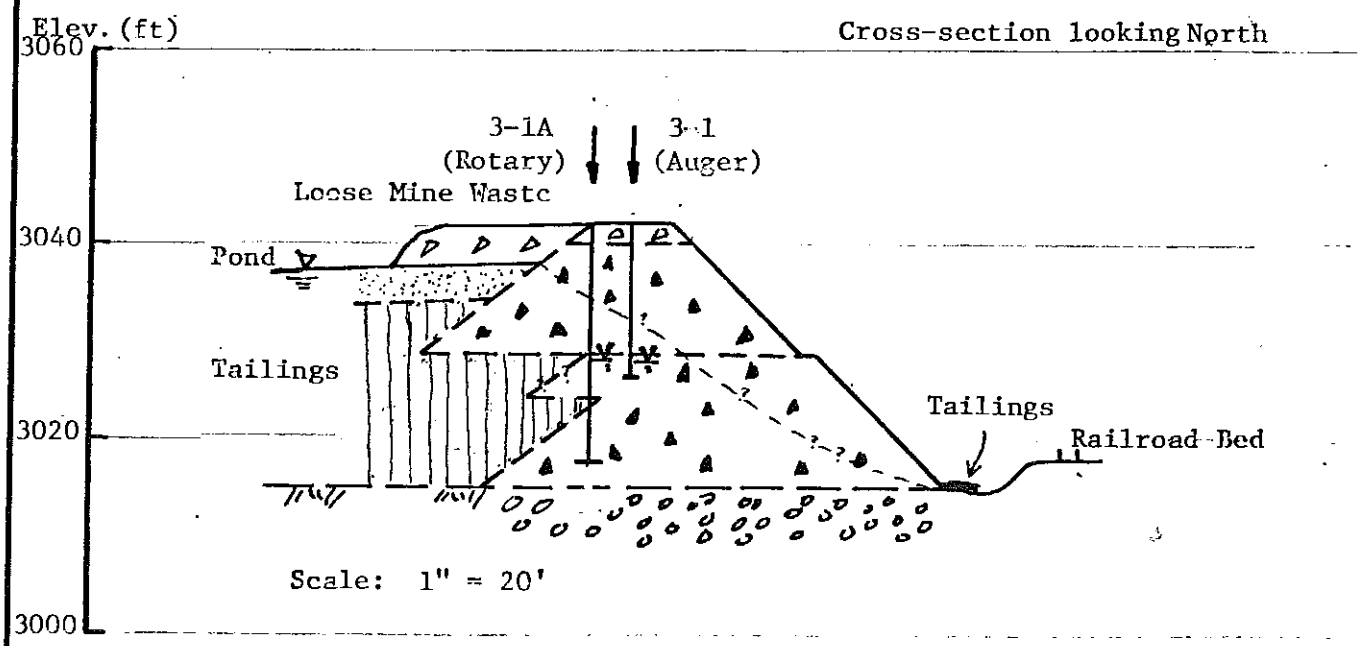
	Stress Ratio	Dry Density (pcf)	Relative Density	Soil Description	Soil Source
△	0.141	77.0	27	Tailings Slimes	Star Pond No. 2
▭	0.091	75.1	23	Tailings Slimes	Star Pond No. 2
●	0.151	93.7	28	Tailings Sands	Lucky Friday Pond No.1
■	0.098	91.6	22	Tailings Sands	Lucky Friday Pond No.1
○	0.148	81.8	27	Tailings Slimes	Lucky Friday Pond No.1
×	0.115	83.0	30	Tailings Slimes	Lucky Friday Pond No.1
□	0.078	80.2	23	Tailings Slimes	Lucky Friday Pond No.1

CYCLIC TRIAXIAL TEST PORE PRESSURE DATA

Boring B3-1
Date Drilled Oct. 2, 1979
Collar Elevation 3041
Borehole Depth 24 feet

Depth (ft)	Sample	Lab Test	Moisture Content %	Blow Count	% #200	Soil Strength TSF	Strength Test	Piezometer		
0									GM	Brown silty sand and gravel - mine waste (loose
	◪		5	7					GM	Brown silty and sandy gravel with trace of organics - hillside borrow (loose)
	◪	G	9	6	31					
	◪	G	10	4	34					- grades (medium dense)
10	◪		11	8						
	◪		14	18						
	◪		13	42					GM	Brown silty and sandy gravel - hillside borrow and mine waste (dense)
	◪			26						
20									ML	Dark grey sandy silt - tailings slimes (very soft)
	◪	G			24		2" PVC		GP	Brown sand, gravel, cobbles and boulders - river gravel (very dense)
30										
40										
50										

For Notes and Key see Plate A-1E



LOG OF BORING — POND 3

DAMES & MOORE

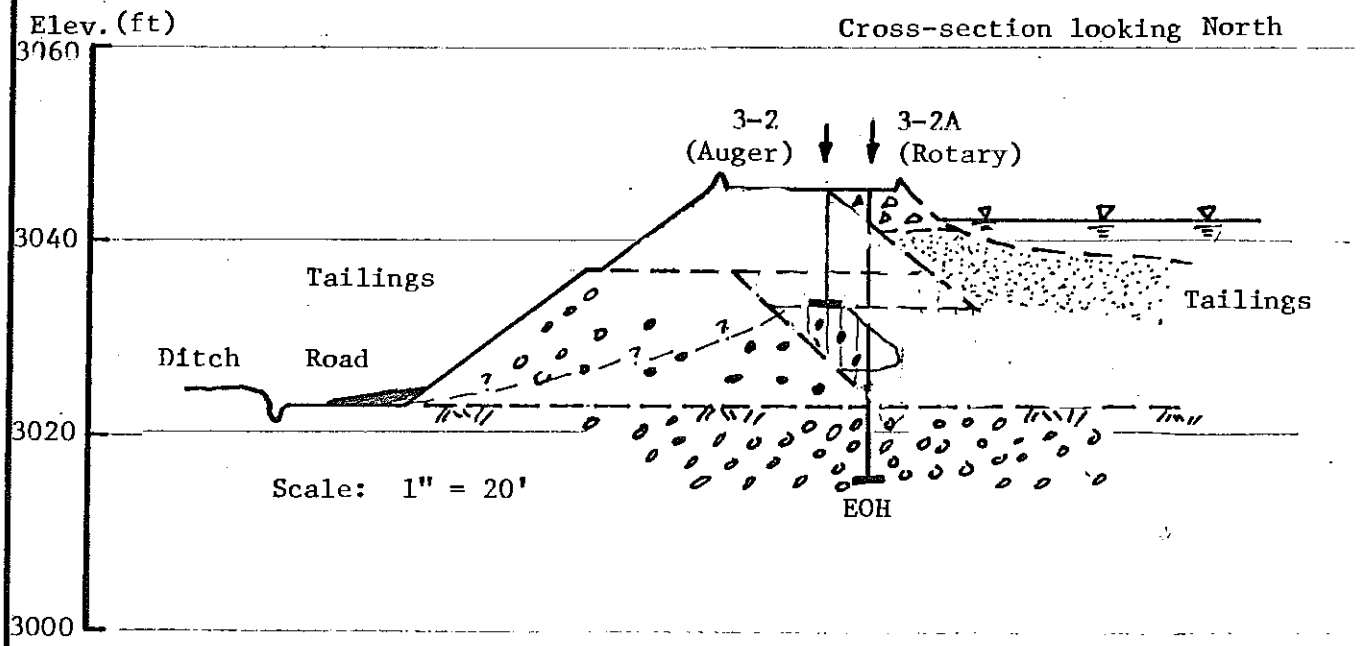
FILE HECLA MINING CO. 05457-012-32 REVISIONS BY DATE

CHECKED BY DATE

Boring B3-2
Date Drilled October 3, 1979
Collar Elevation 3045
Borehole Depth 30 feet

Depth (ft)	Sample	Lab Test	Moisture Content %	Blow Count	% Passing #200	Soil Strength TSF	Strength Test	Piezometer		
0	◪	G	6	18	65				GM	Brown sandy and silty gravel - mine waste (medium dense)
	◪		12	6					GM	Brown silty gravel and grey silty fine sand - hillside borrow and tailings (loose)
	◪	G	10	4	22				GW	Dark brown sandy gravel - hillside borrow (medium dense)
10	◪	G	9	19	25					
									SM	Grey silty fine sand - tailings (loose)
									GP	Brown gravel, cobbles and boulders (medium dense)
20		G			56					
									SM	Grey silty fine sand - tailings (loose)
									GP	Brown sand, gravel, cobbles and boulders - river gravel (very dense)
30								2" PVC		
40										
50										

For Notes and Key see Plate A-1E



LOG OF BORING — POND 3

DAMES & MOORE

PLATE A-1N

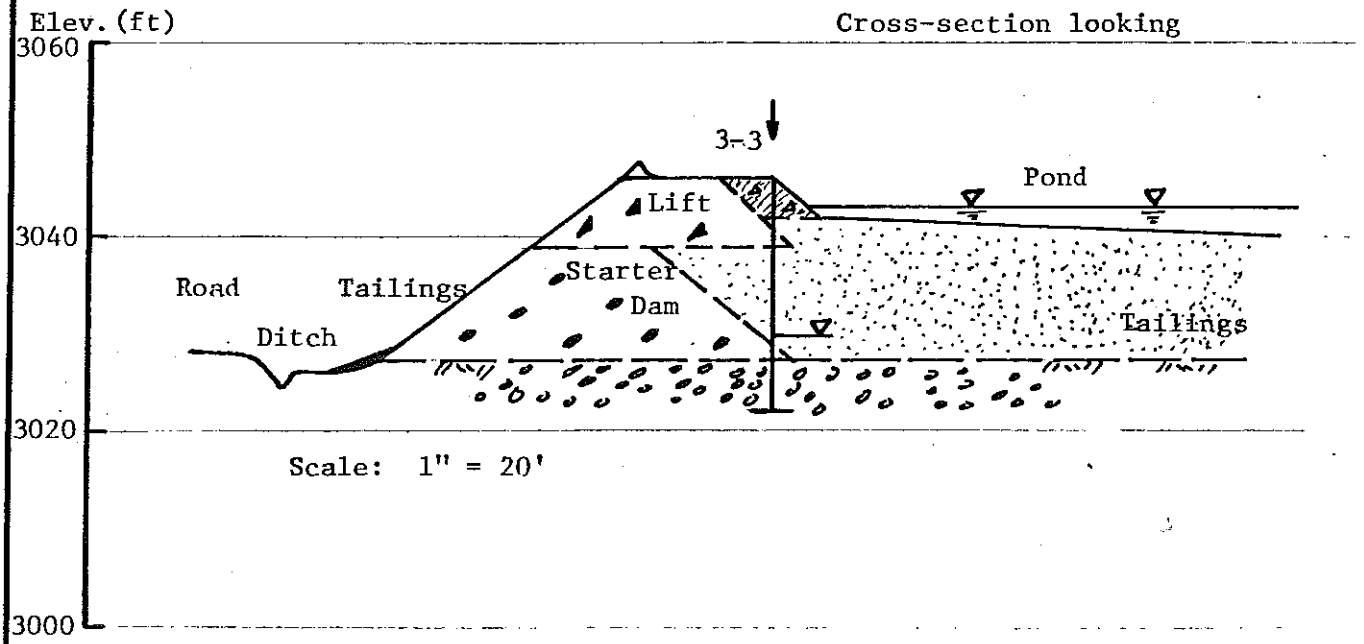
FILE HECLA MINING CO. 05457-012-32 REVISIONS BY DATE

CHECKED BY DATE

Boring B3-3
Date Drilled October 2, 1979
Collar Elevation 3046
Borehole Depth 24 feet

Depth (ft)	Sample	Lab Test	Moisture Content %	Blow Count	% Passing #200	Soil Strength TSF	Strength Test	Piezometer		
0									GM	Brown silty and sandy gravel - mine waste (medium dense)
				16						
				7					SM	Light grey silty fine sand - tailings (loose)
			10	4					GM	Brown silty and sandy gravel - mine waste (loose)
10		G	18	4	25					
			31	2					SM	Light grey silty fine sand - tailings (very loose)
		G	25	3	30					
		G	17	16	26				GM	Dark brown sandy gravel with some silt and fine sand (medium dense)
20									SM	Dark brown silty sand - topsoil
				53					GP	Brown sand, gravel, cobbles and boulders - river gravel (very dense)
								1" PVC		
30										
40										
50										

For Notes and Key see Plate A-1E



LOG OF BORING — POND 3

DAMES & MOORE

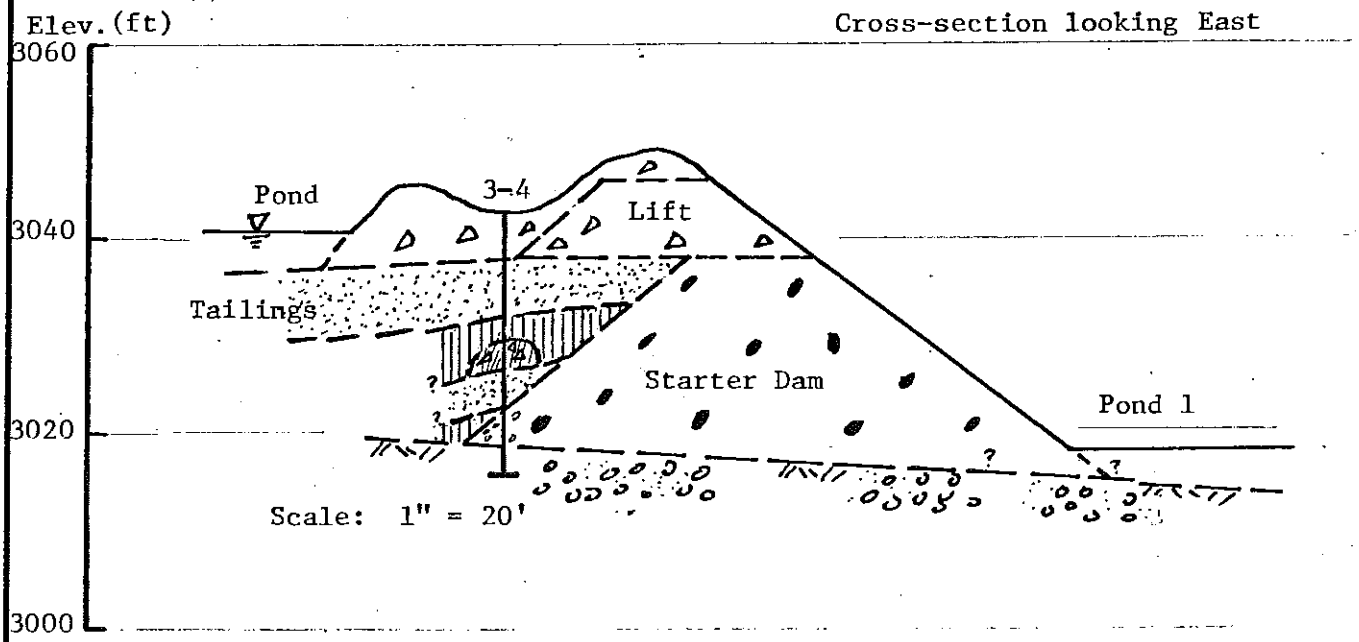
FILE HECLA MINING CO. 05457-012-32 BY ____ DATE ____ CHECKED BY ____

Boring B3-4
Date Drilled October 2, 1979
Collar Elevation 3044
Borehole Depth 27 feet

Depth (ft)	Sample	Lab Test	Moisture Content %	Blow Count	% Passing #200	Soil Strength TSF	Strength Test	Piezometer		
0									GM	Brown silty and sandy gravel - mine waste (medium dense)
	⊘			19						
	⊘		21	1					SM	Light grey silty fine sand - tailings (very loose)
	◪	G	20	1	95					
10	◪		36	1					ML	Dark grey sandy silt - tailings slimes (very soft)
	◪		35	9						
									GM	Brown silt, sand and gravel (loose)
									SM	Light grey silty fine sand - tailings (very loose)
	⊘			1						
20	◪	G	36	15	98				ML	Dark grey sandy silt - tailings slimes (stiff)
	◪		7	37					GM	Brown sand, gravel, cobbles and boulders - river gravel (dense)
30										
40										
50										

For Notes and Key see Plate A-1E

Cross-section looking East



LOG OF BORING — POND 3

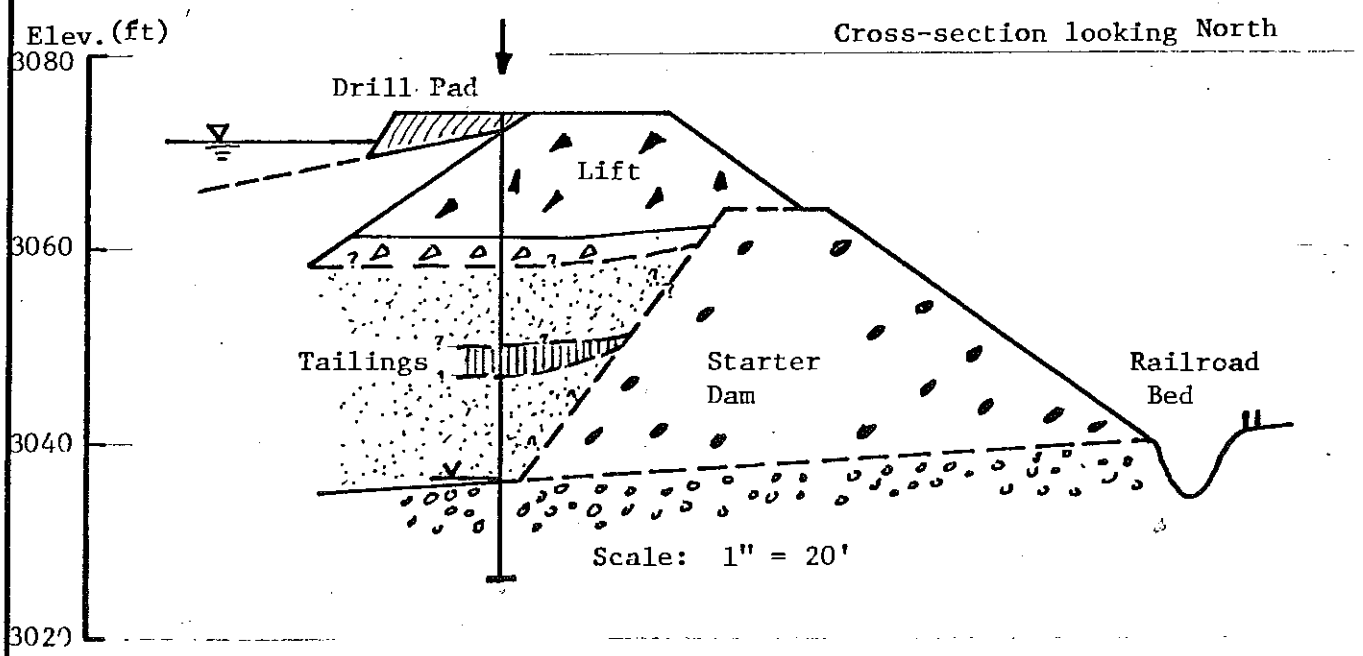
DAMES & MOORE

FILE HECLA MINING CO. 05457-012-32 REVISIONS
BY ____ DATE ____
CHECKED BY ____ DATE ____

Boring B4-1
Date Drilled October 17, 1979
Collar Elevation 3074
Borehole Depth 50 feet

Depth (ft)	Sample	Lab Test	Moisture Content %	Blow Count	% Passing #200	Soil Strength TSF	Strength Test	Piezometer		
0									GM	Reddish brown silty and sandy gravel - hillside borrow (medium dense)
			7							
			7							
		G	10		52					
			9							
10										
		G	7		29					
			5						GM	Brown silty and sandy gravel - mine waste (medium dense)
		G	3		9					
	☒	G	19	14	38					
									SM	Light grey silty fine sand - tailings (loose)
20	☒			P						
			24						ML	Dark grey sandy silt - tailings slimes (very soft)
	☐	G	19		35					
		G	33	P	94				SM	Light grey silty fine sand with layers of dark grey sandy silt - tailings (loose)
		G	33		66					
30										
									GM	Brown sand, gravel, cobbles and boulders - river gravel (very dense)
40										
50										

For Notes and Key see Plates A-1E



LOG OF BORING — POND 4

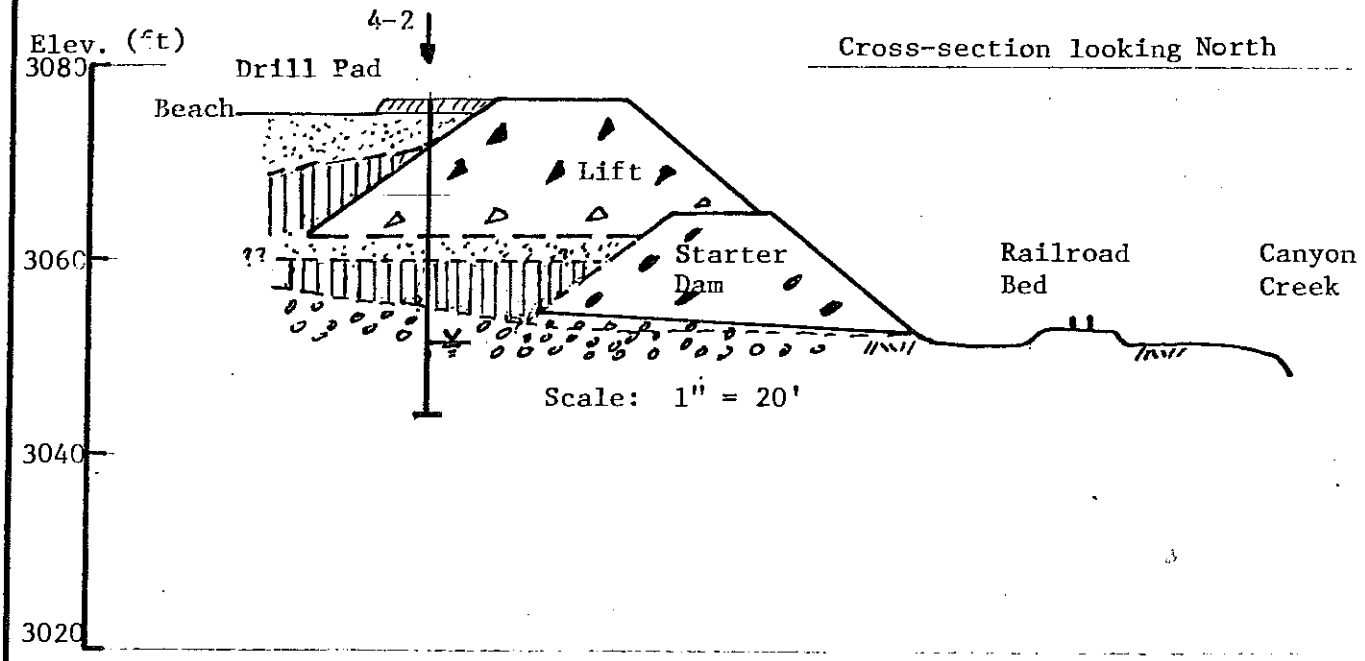
DAMES & MOORE

FILE HECLA MINING CO. 05457-012-32 BY ____ DATE ____
CHECKED BY ____ DATE ____

Boring B4-2
Date Drilled October 19, 1979
Collar Elevation 3077
Borehole Depth 32 feet

Depth (ft)	Sample	Lab Test	Moisture Content %	Blow Count	% Passing #200	Soil Strength TSF	Strength Test	Piezometer		
0									GW	Brown sandy gravel - drill pad (loose)
		G	33		63				SM	Light grey silt and sand - tailings
			11						GM	Brown silty and sandy gravel - hillside borrow (medium dense)
			8							
		G	9		36					
10			12						GM	Brown silty and sandy gravel - mine waste (medium dense)
		G	6		22					
									SM	Light grey silty fine sand - tailings
	◪	G	33	3	88				ML	Dark grey sandy silt - tailings slimes (soft)
20									GP	Brown sand, gravel, cobbles and boulders (dense)
30								½ in. 2" Case		
40										
50										

For Notes and Key See Plate A-1E



Cross-section looking North

LOG OF BORING — POND 4

DAMES & MOORE

PLATE A-1B

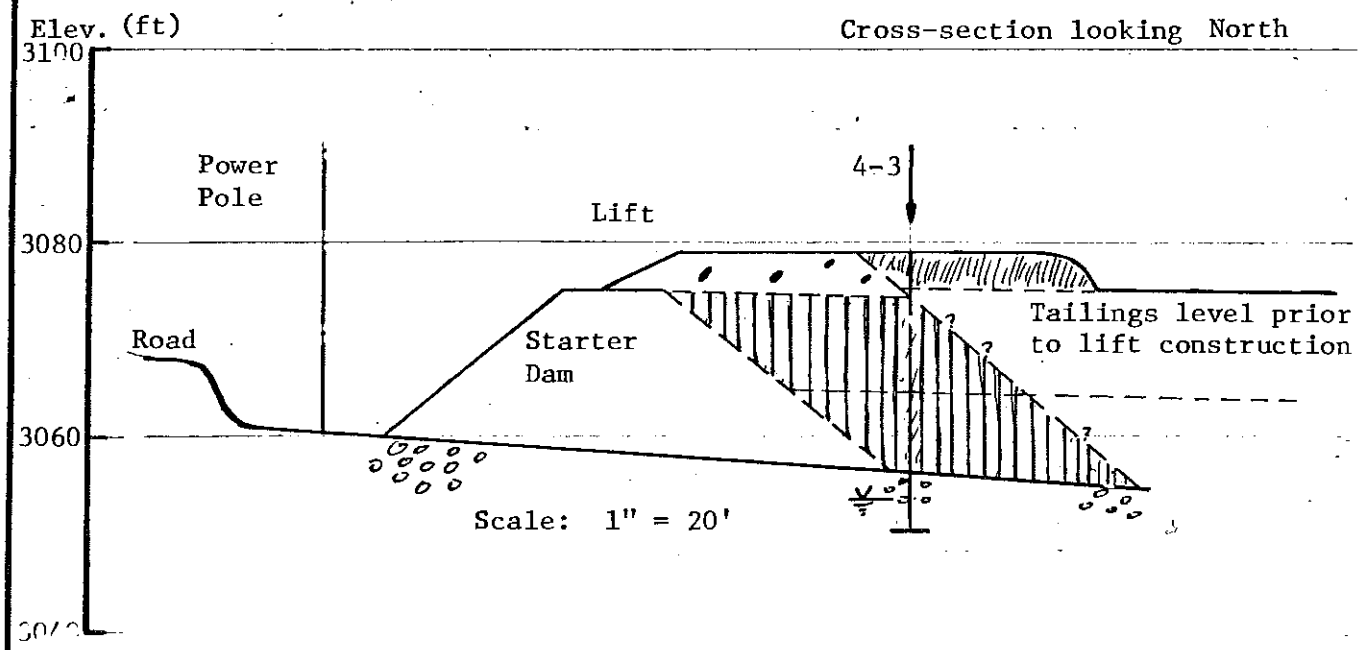
FILE HECLA MINING CO. 05457-012-32 REVISIONS BY DATE

CHECKED BY

Boring B4-3
Date Drilled October 16, 1979
Collar Elevation 3079
Borehole Depth 29 feet

Depth (ft)	Sample	Lab Test	Moisture Content %	Blow Count	% Passing #200	Soil Strength TSF	Strength Test	Piezometer		
0									GW	Brown sandy gravel - drill pad (loose)
									ML	Dark grey sandy silt - tailings slimes (soft
									GM	Brown silty and sandy gravel with trace of organics and some dark grey silt and light grey sand - mixed fill and tailings (loose)
10		G	6		26					
			6							
20										
									GP	Brown sand, gravel, cobbles and boulders - river gravel (very dense)
30										
40										
50										

For Notes and Key see Plate A-1E



LOG OF BORING — POND 4

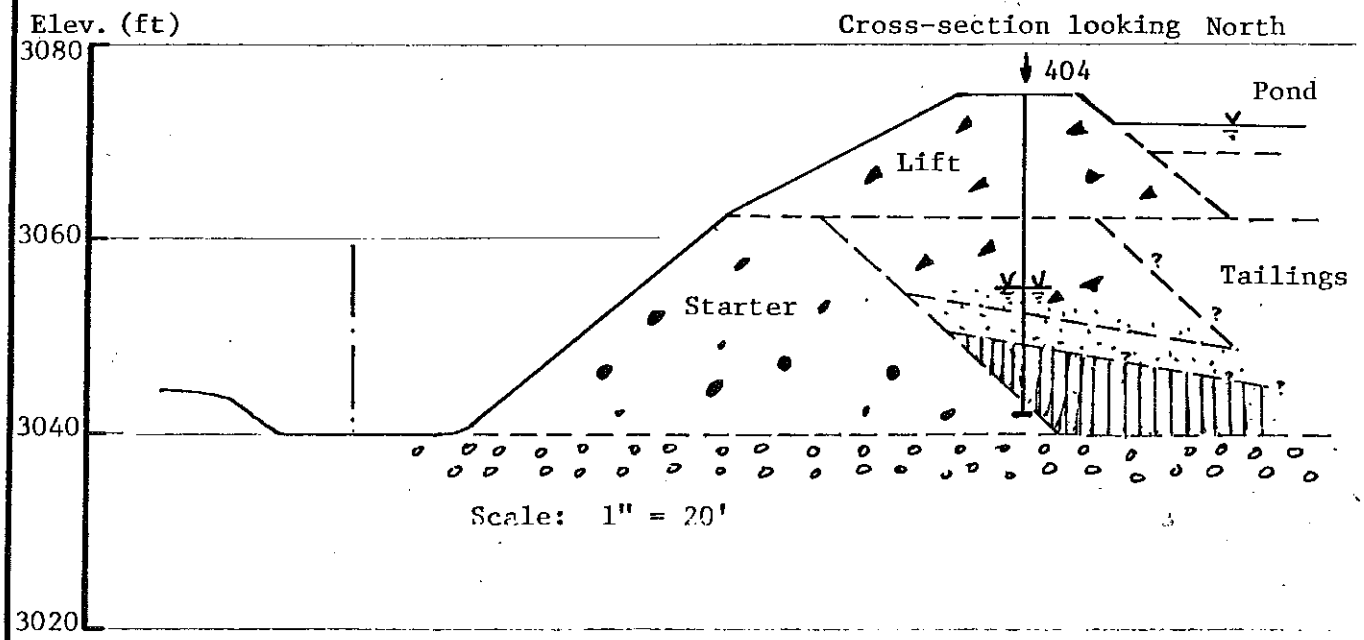
DAMES & MOORE

FILE HECLA MINING CO. 05457-012-32 BY ____ DATE ____ CHECKED BY ____

Boring B4-4
Date Drilled October 16, 1979
Collar Elevation 3076
Borehole Depth 33 feet

Depth (ft)	Sample	Lab Test	Moisture Content %	Blow Count	% Passing #200	Soil Strength TSF	Strength Test	Piezometer		
0		G	8		40				GM	Reddish brown silty and sandy gravel - hillside borrow (medium dense)
									GM	Brown silty and sandy gravel - mine waste (medium dense)
			9						GM	Reddish brown silty and sandy gravel - hillside borrow (medium dense)
10			8	23						
		G	8		44				SM	Reddish brown gravelly sand and light grey silty fine sand with occasional boulders - mixed fill and tailings (very loose)
			9							
		G	13		46					
20				2						
		G	35		94				SM	Light grey silty fine sand - tailings (loose)
									ML	Dark grey sandy silt - tailings slimes (soft)
30									GP	Brown sand, gravel, cobbles and boulders - river gravel (very dense)
40										
50										

For Notes and Key see Plate A-1E



LOG OF BORING — POND 4

DAMES & MOORE

A-1T

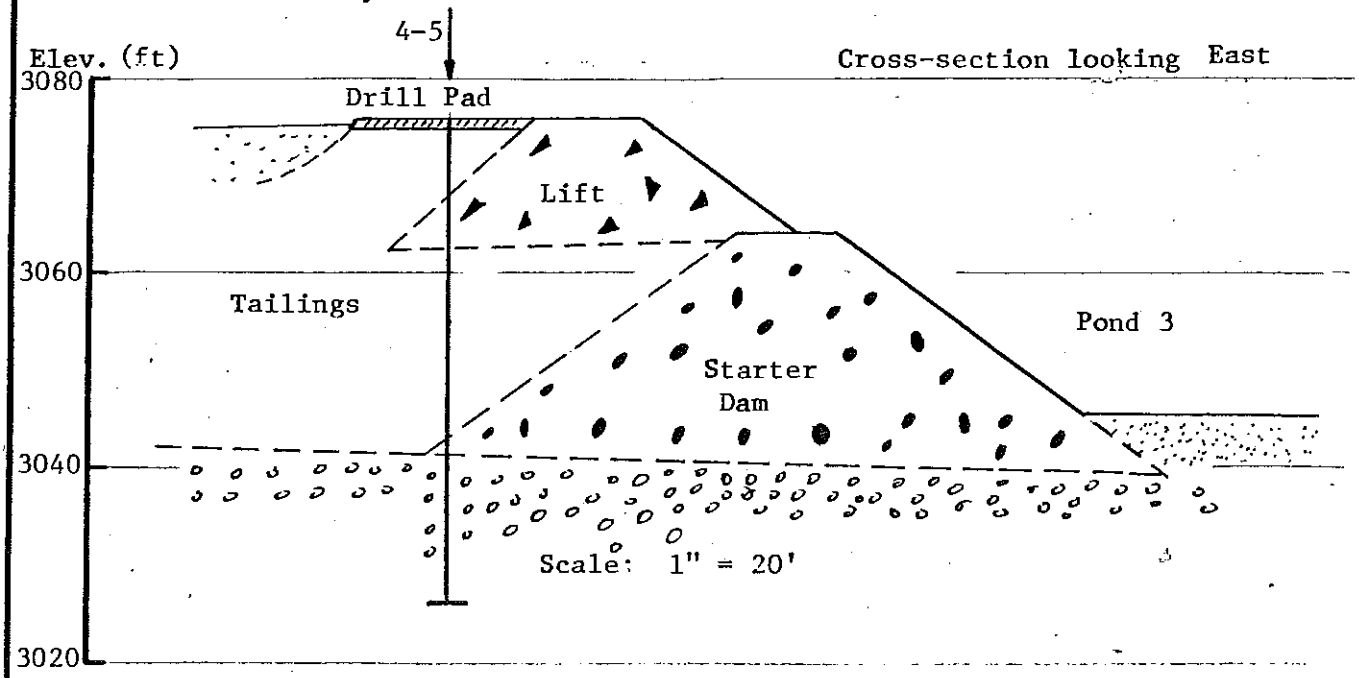
FILE HECLA MINING CO. 05457-012-32 REVISIONS BY DATE

CHECKED BY

Boring B4-5
Date Drilled October 18, 1979
Collar Elevation 3076
Borehole Depth 50 feet

Depth (ft)	Sample	Lab Test	Moisture Content %	Blow Count	% #200	Soil Strength TSF	Strength Test	Piezometer		
0									GW	Brown sandy gravel - drill pad (loose)
	◪	G	14		29				SM	Light grey silty fine sand with layers of dark grey sandy silt - tailings sand (very loose)
			12	P						
10			20						GM	Brown silty and sandy gravel - hillside borrow (medium dense)
	◪			27				▽	SM	Light grey silty fine sand with layers of dark grey sandy silt - tailings sand (medium dense)
20			13							
	◪	G	18	15	39					
			24							
30		G	7		17					
			20						GP	Brown sand, gravel, cobbles and boulders - river gravel (dense)
40										
50										

For Notes and Key see Plate A-1E



LOG OF BORING — POND 4

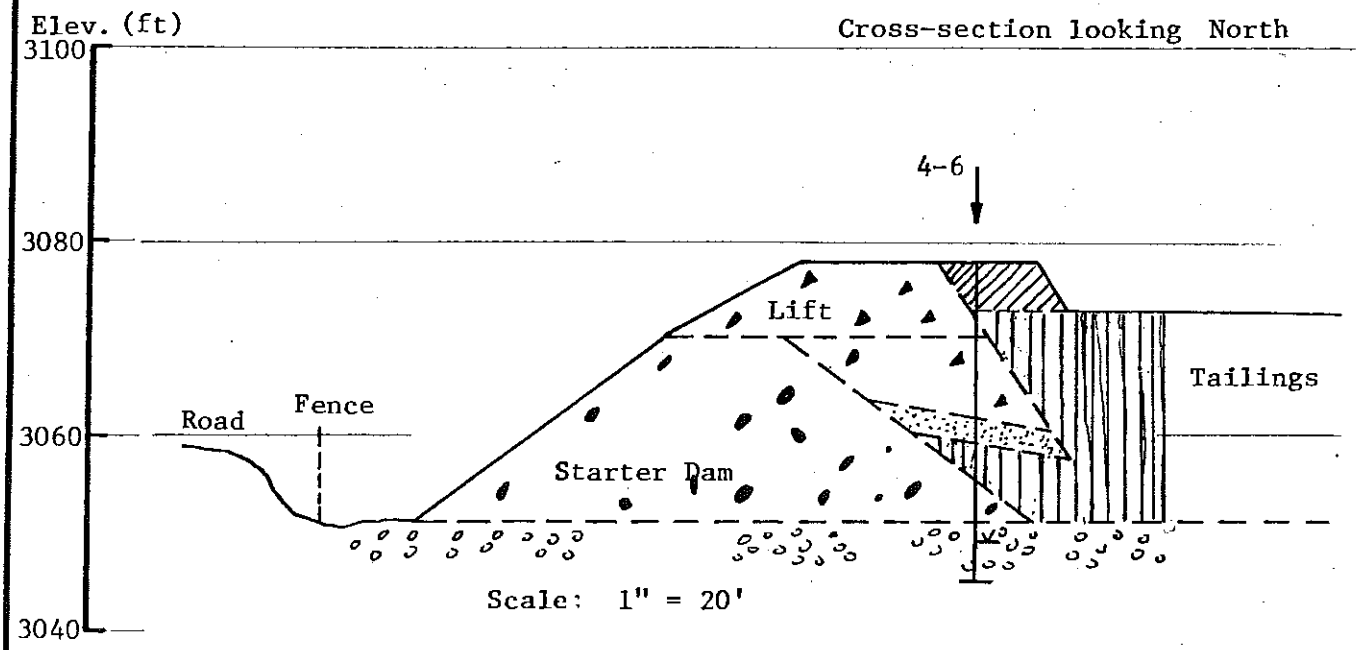
DAMES & MOORE

FILE HECLA MINING CO. 05457-012-32 BY ____ DATE ____ CHECKED BY ____ DATE ____

Boring B4-6
Date Drilled October 17, 1979
Collar Elevation 3078
Borehole Depth 33 feet

Depth (ft)	Sample	Lab Test	Moisture Content %	Blow Count	% Passing #200	Soil Strength TSF	Strength Test	Piezometer		
0									GM	Brown sandy gravel - drill pad (loose)
									ML	Dark grey sandy silt - tailings slimes (soft)
	◪	G	11	21	45					
10			9						GM	Reddish brown silty and sandy gravel - hillside borrow (medium dense)
			7							
			35						SM	Light grey silty fine sand-tailings (loose)
20	◪	G	29	P	75				ML	Dark grey sandy silt - tailings slimes (soft)
									GP	Brown sand, gravel, cobbles and boulders - river gravel (dense)
30								1"in 2" PVC		
40										
50										

For Notes and Key see Plate A-1E



LOG OF BORING — POND 4

DAMES & MOORE

FILE HECLA MINING CO. 05457-012-32 BY ____ DATE ____ CHECKED BY ____ EV. ____ S ____

Boring B4-7

Date Drilled Sept. 11 to 13, 1979
Collar Elevation
Static Water Level Depth 5.5'

Soil Description		
	0' - 16'	Open Hole
	16' - 35'	Boulders, water
	35' - 42'	Boulders and shale, water
	42' - 80'	Blue shale
	80' - 90'	Blue shale, broken, water
	90' -100'	Blue shale

Discharge 40 to 50 gpm at 80' pump level, 2 hours pumping.

Boring B4-8

Date Drilled Sept. 14 to 15, 1979
Collar Elevation 3062
Static Water Level Depth 6'

Soil Description		
	0' - 7'	Backfill
	7' - 10'	Gravel and wood fill
	10' - 20'	Gravel and clay, water
	20' - 27'	Gravel, water
	27' - 42'	Clay and shale
	42' - 75'	Hard green shale

Discharge 25 gpm at 75' pump level, 2 hours pumping.

Boring B4-9

Date Drilled Sept. 20 to 21, 1979
Collar Elevation 3074
Static Water Level Depth 7'

Soil Description		
	0' - 6'	Backfill boulders and clay
	6' - 9'	Loose gravel, water
	9' - 11'	Boulder, green shale
	11' - 36'	Large gravel and clay, water
	36' - 39'	Boulders, green shale
	39' - 45'	Large gravel and clay
	45' - 62'	Hard grey shale
	62' - 77'	Firm grey shale
	77' - 79'	Broken grey shale
	79' - 89'	Firm grey shale
	89' - 92'	Broken grey shale
	92' - 95'	Firm grey shale

Discharge 20 gpm at 90' pump level, 2 hours pumping.

NOTE: Logs of Borings B4-7, B4-8 and B4-9 are obtained directly from "Well Driller's Report" of Brand-X, prepared during water exploration program for Hecla Mining Company

LOG OF BORING — POND 4

DAMES & MOORE

REVISIONS BY DATE

FILE

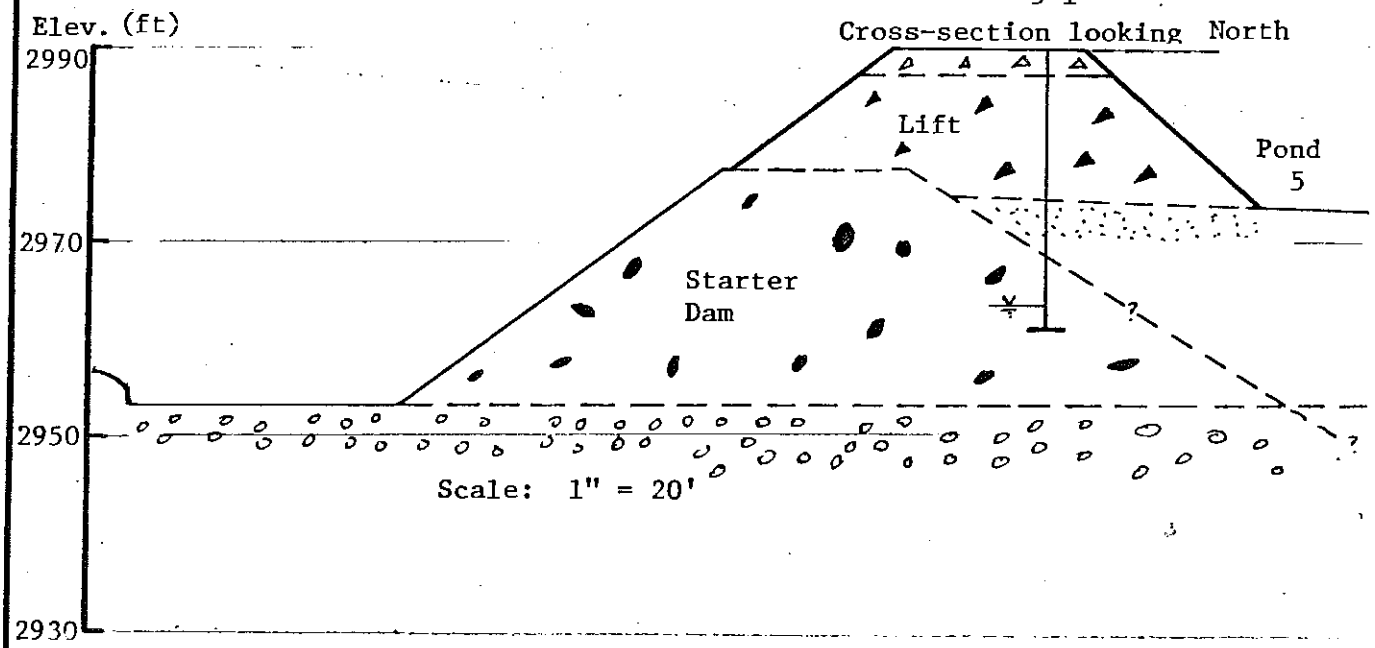
CHECKED BY DATE

Boring B5-1
Date Drilled October 13, 1979
Collar Elevation 2990
Borehole Depth 28.5 feet

Depth (ft)	Sample	Lab Test	Moisture Content %	Blow Count	% #200	Soil Strength TSF	Strength Test	Piezometer		
0									GP	Brown gravel and cobbles - road capping
	◪		1	30					GM	Brown silty and sandy gravel and cobbles - hillside borrow and mine waste (dense to very dense)
10			1							
	◪	G	11	33	46				SM	Light grey silty fine sand - tailings (dense)
20									GP	Brown sand, gravel, cobbles and boulders - river gravel (very dense)
		G	4		22					
30										
40										
50										

For Notes and Key see Plate A-1E

5-1
Cross-section looking North



LOG OF BORING — POND 5

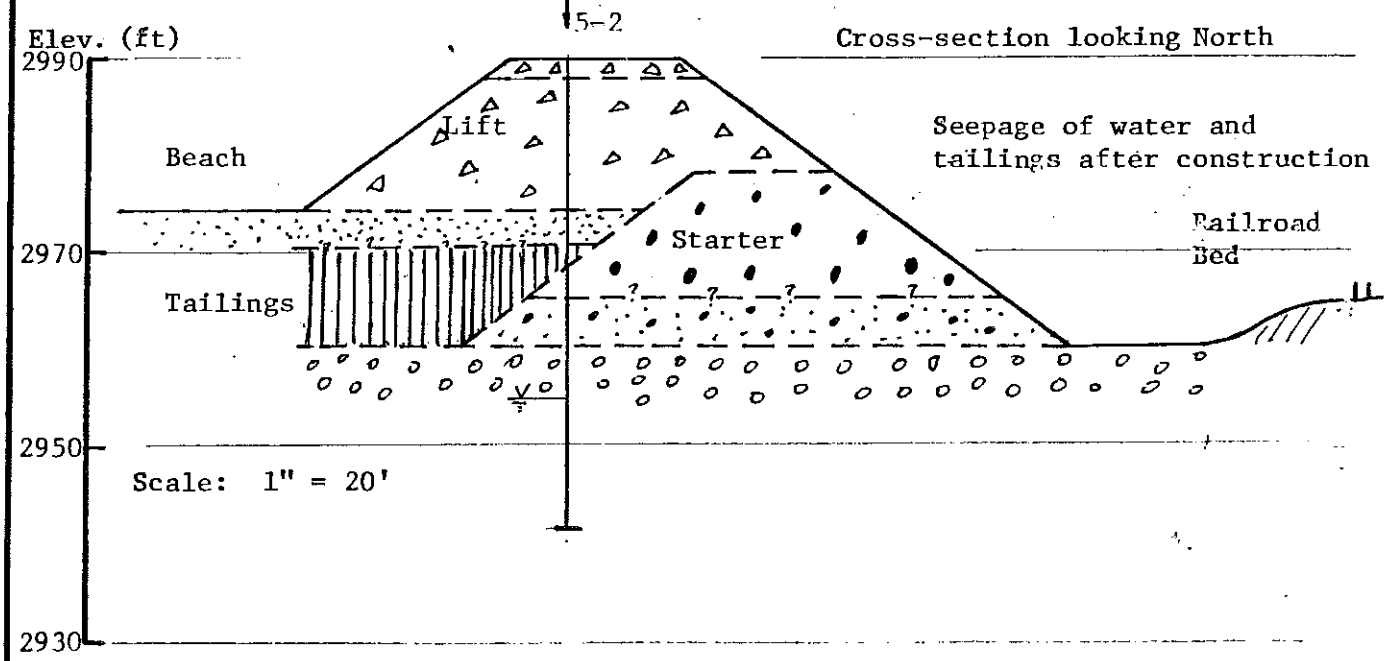
DAMES & MOORE

FILE HECLA MINING CO. 05457-012-32 BY ____ DATE ____ CHECKED BY ____ DATE ____

Boring B5-2
Date Drilled October 14, 1979
Collar Elevation 2990
Borehole Depth 49 feet

Depth (ft)	Sample	Lab Test	Moisture Content %	Blow Count	% Passing #200	Soil Strength TSF	Strength Test	Piezometer		
0									GP	Brown gravel and cobbles - road capping
									GM	Brown silty and sandy gravel - mine waste (very dense)
10			1							
			25							
20	◪	G	24	2	76				SM	Light grey silty fine sand - tailings (loose)
		G	23		77				ML	Dark grey sandy silt - tailings slimes (soft)
		G	9		31				GM	Brown gravelly sand with some grey silt and sand - hillside borrow and tailings (medium dense)
			7							
30		G	9		64				GP	Brown sand, gravel, cobbles and boulders - river gravel (dense) - grades (very dense) with a trace of silt
			6							
		G	3		10					
40			6						GM	Brown silt, sand, gravel, cobbles and boulders - river gravel (very dense)
50										

For Notes and Key see Plate A-1E



LOG OF BORING — POND 5

DAMES & MOORE

PLATE A-1Y

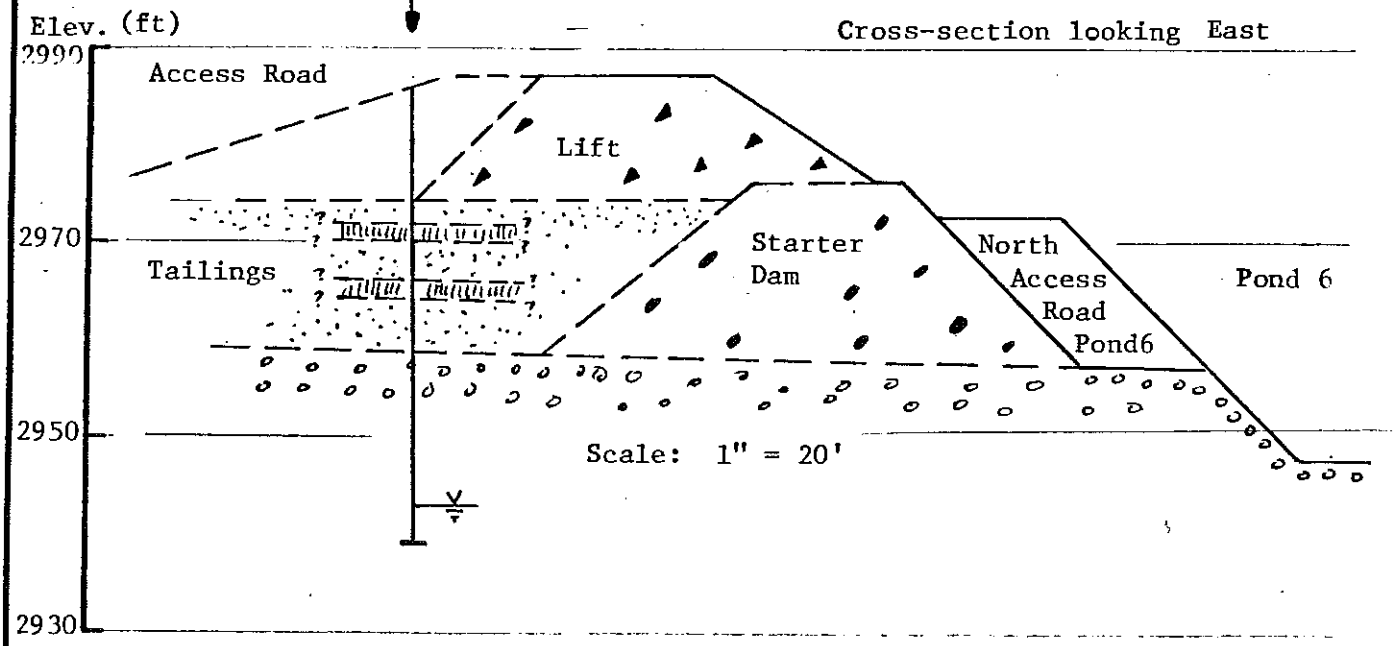
FILE HECLA MINING CO. 05457-012-32 BY ____ DATE ____ CHECKED BY ____ DATE ____

Boring B5-3
Date Drilled October 15, 1979
Collar Elevation 2988
Borehole Depth 48 feet

Depth (ft)	Sample	Lab Test	Moisture Content %	Blow Count	% Passing #200	Soil Strength TSF	Strength Test	Piezometer		
0									GM	Brown silty and sandy gravel - mine waste fill (medium dense)
10		G	8		65					
	◪	G	30	10	91				SM	Light grey silty fine sand - tailings (loose)
		G	13		36				ML	Dark grey sandy silt - tailings (medium)
			11						SM	Light grey silty fine sand with layers of dark grey silt - tailings (loose)
20	◪	G	22	3	75				ML	Dark grey sandy silt with layers of grey silty fine sand - tailings (medium)
			31		92					
	◪		14	6						
			30							
30									GP	Brown sand, gravel, cobbles and boulders - river gravel (very dense)
40										
50										

For Notes and Key see Plate A-1E

5-3



LOG OF BORING — POND 5

DAMES & MOORE

FILE HECLA MINING CO. 05457-012-32 REVISIONS BY DATE

CHECKED BY

MAJOR DIVISIONS			GRAPH SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING NO. 4 SIEVE	CLEAN SAND (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND-SILT MIXTURES
				SC	CLAYEY SANDS, SAND-CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

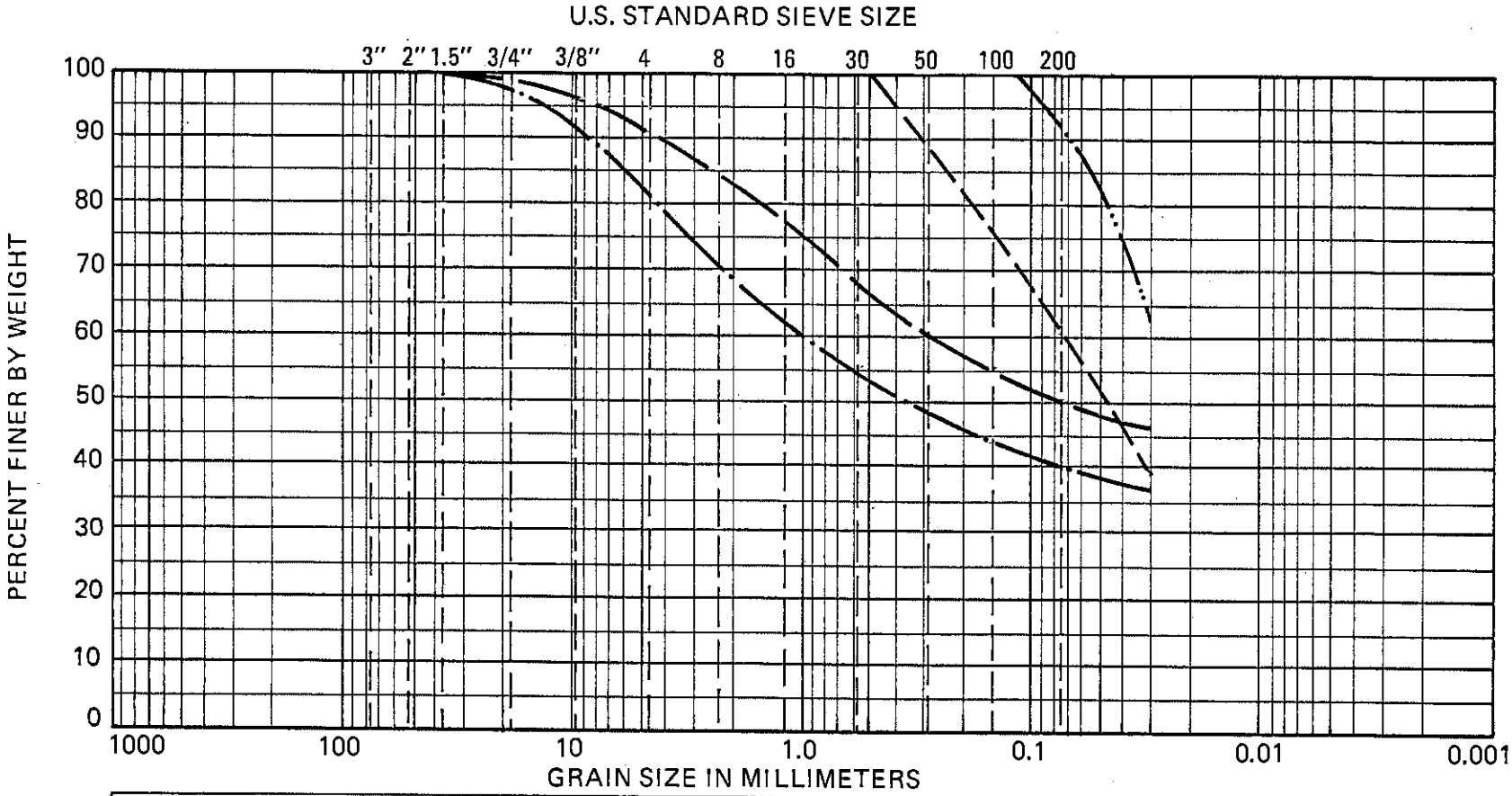
NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS.

SOIL CLASSIFICATION CHART

UNIFIED SOIL CLASSIFICATION SYSTEM

BY LL DATE JAN 9, 80
CHECKED BY DATE

REVISIONS
BY DATE
BY DATE
PLATE OF



COBBLES	GRAVEL		SAND			SLIT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

	DEPTH	CLASSIFICATION		NAT. W C	LL	PL	PI	
———	B1-1, 2'	SM	Silty sand, trace gravel	20				Hillside borrow
—·—	B1-1, 4'	SM	Silty sand, some gravel	16				Hillside borrow
— — —	B1-1,12'	SM	Silt and fine sand	17				Tailings
—··—	B1-1,18'	ML	Sandy Silt	25				Tailings

GRADATION CURVES
POND 1

DAMES & MOORE

PLATE A-3A

757.9 (5-75)

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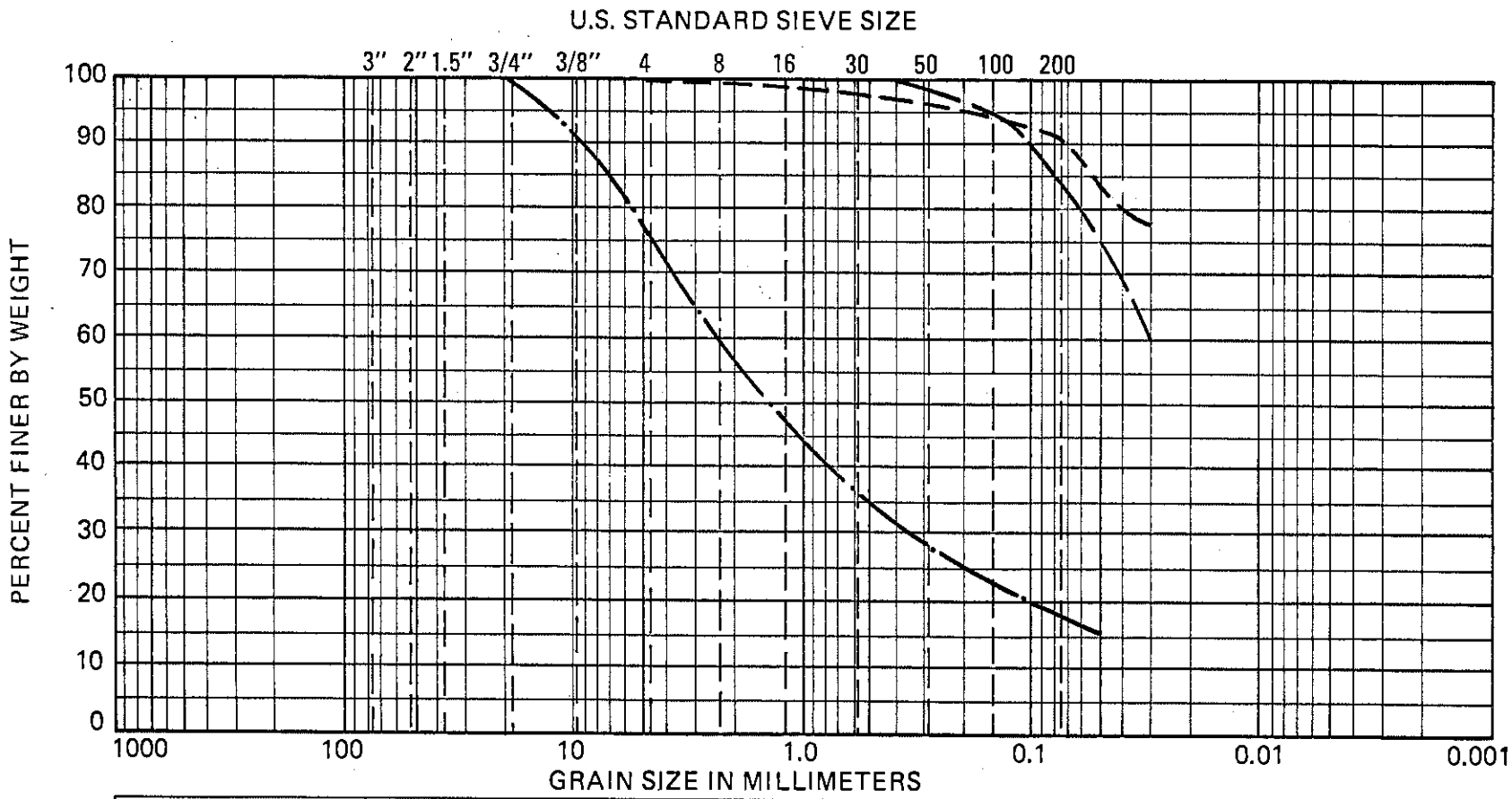

	DEPTH	CLASSIFICATION		NAT. W C	LL	PL	PI	
———	B1-1,19'	ML	Sandy Silt	31				Tailings
—·—	B1-1,27'	GW	Sand and gravel, trace silt	10				River Gravel
- - - -	B1-2, 3'	ML	Sandy Silt	23				Tailings

GRADATION CURVES
POND 1

DAMES & MOORE

PLATE A-25

BY LL DATE JAN 9, 80
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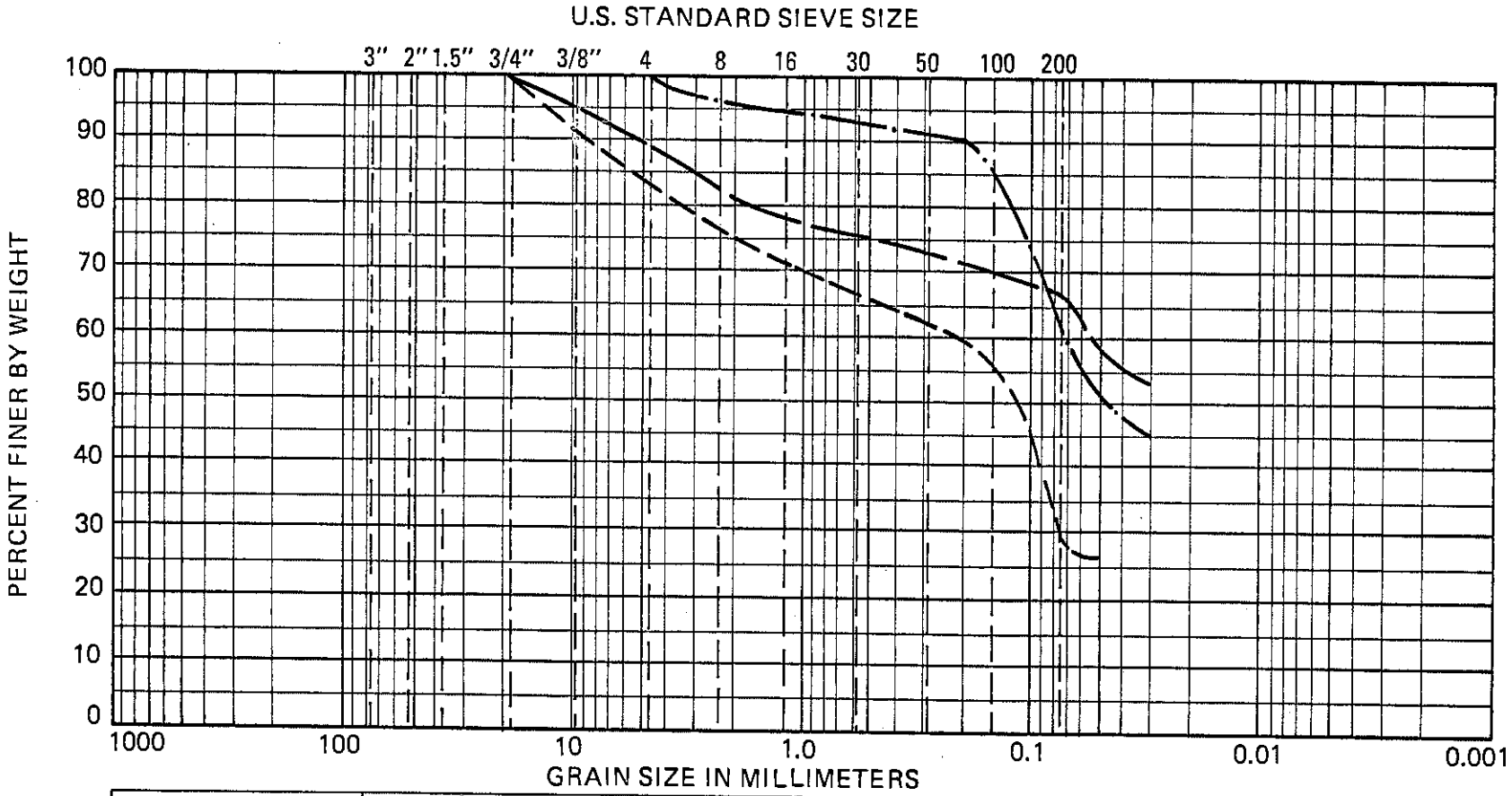

COBBLES	GRAVEL		SAND			SLIT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

	DEPTH	CLASSIFICATION		NAT. W C	LL	PL	PI	
	B1-2, 7'	SM	Silt and sand, trace gravel	13				Hillside borrow
	B1-2,12'	SM	Silt and fine sand	26				Tailings
	B1-2,22'	SM	Silty sand, some gravel	16				Tailings

GRADATION CURVES
POND 1

DAMES & MOORE

BY LL DATE JAN 11, 80
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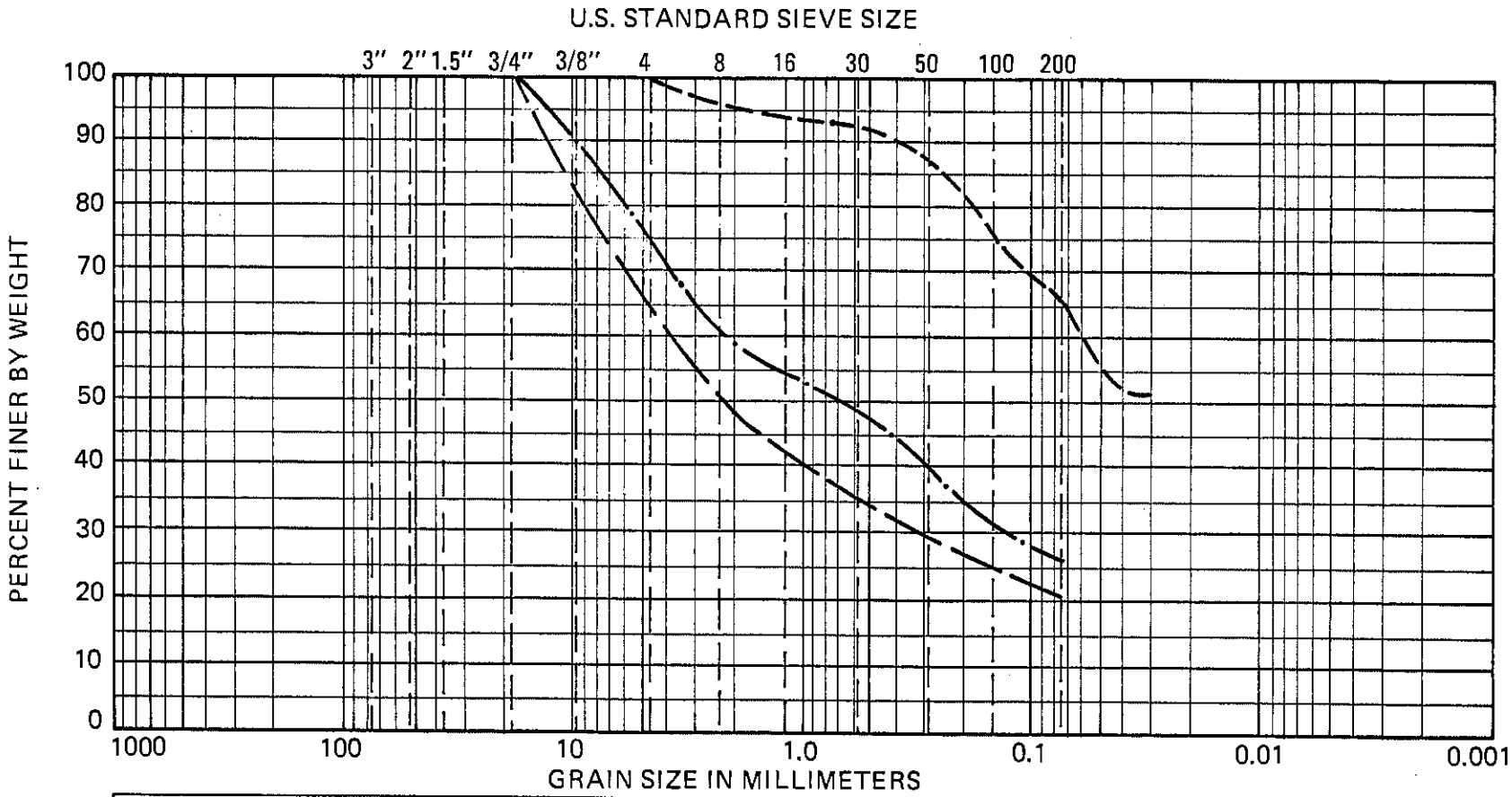
BY DATE
BY DATE
PLATE OF



COBBLES	GRAVEL		SAND			SLIT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

	DEPTH	CLASSIFICATION		NAT. W C	LL	PL	PI	
—— ——	B1-3, 5'	GM	Silty sand and gravel	3				Mine Waste
——·——	B1-3,13'	GM	Silty sand and gravel	6				Mine Waste
·— — —	B1-3,13'	SM	Silt and sand	24				Tailings

GRADATION CURVES
POND 1

DAMES & MOORE

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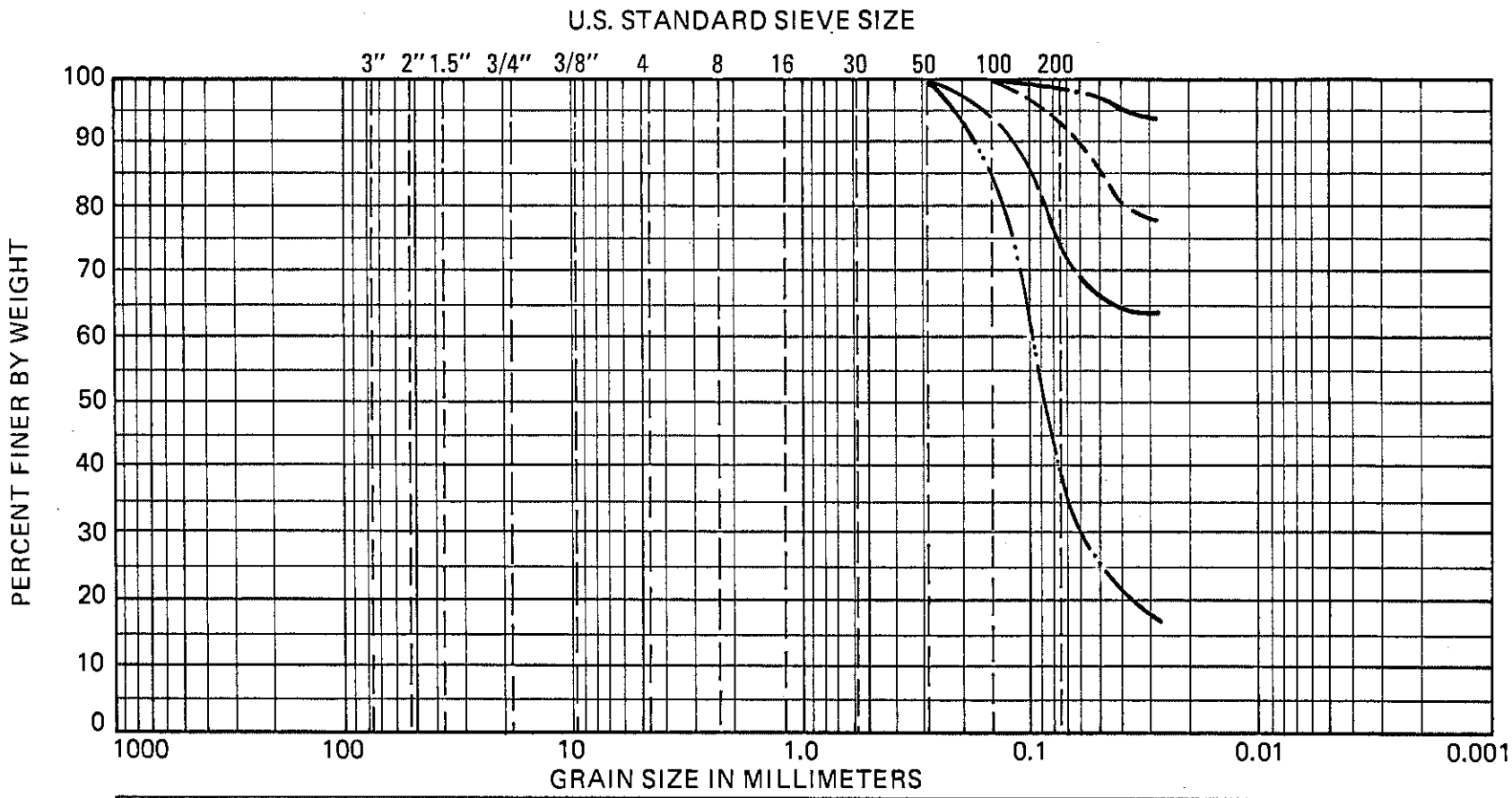

COBBLES	GRAVEL		SAND			SLIT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

	DEPTH	CLASSIFICATION		NAT. W C	LL	PL	PI	
——— ———	S1-1, 2'	ML	Sandy Silt	34				Tailings
——·——	S1-2, 2'	ML	Silt	35				Tailings
— — — —	S1-3, 2'	ML	Silt, trace fine sand	29				Tailings
——··——	S1-4, 2'	SM	Fine sand and silt	27				Tailings

GRADATION CURVES
POND 1

DAMES & MOORE

757 9 (5-75)

PLATE A-3E

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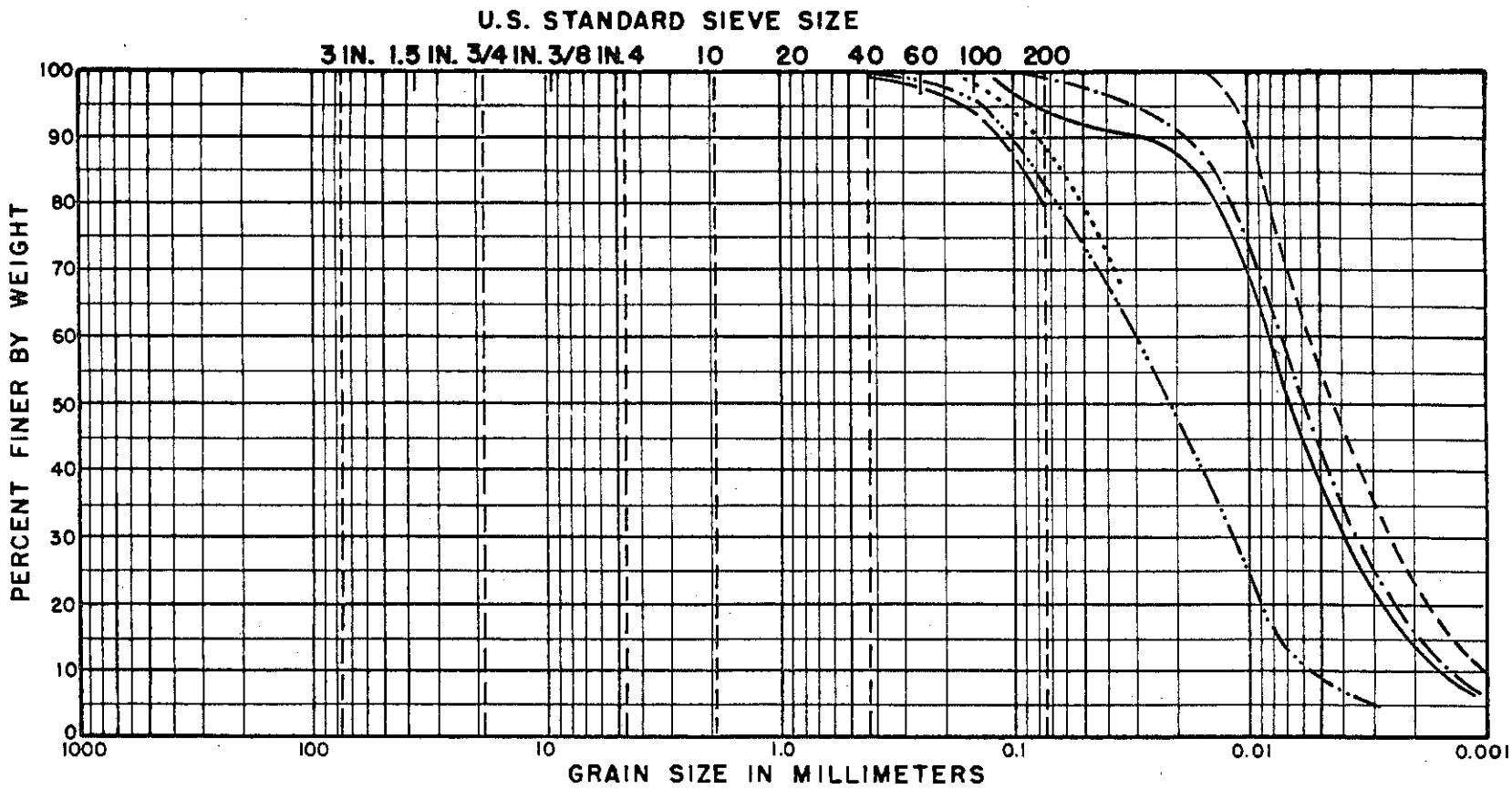
PLATE _____ OF _____



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	
———	B-2, 12½'	ML	Sandy Silt	21				Tailings Slimes with sand
—··—··—	B-2, 5'	ML	Sandy Silt	12				Tailings Slimes with sand
·····	Surface	ML	Sandy Silt	Performed by		Hecla		Tailings Slimes with sand
———	B-4, 35'	ML	Silt	36				Tailings Slimes
—·—·—	B-4, 10'	ML	Silt	27				Tailings Slimes
— — — —	B-6, 32½'	ML	Silt	44				Tailings Slimes

GRADATION CURVES POND 2

DAMES & MOORE

757.2 (REV. 4-62)

Plate A-20

FILE 3457-009-32
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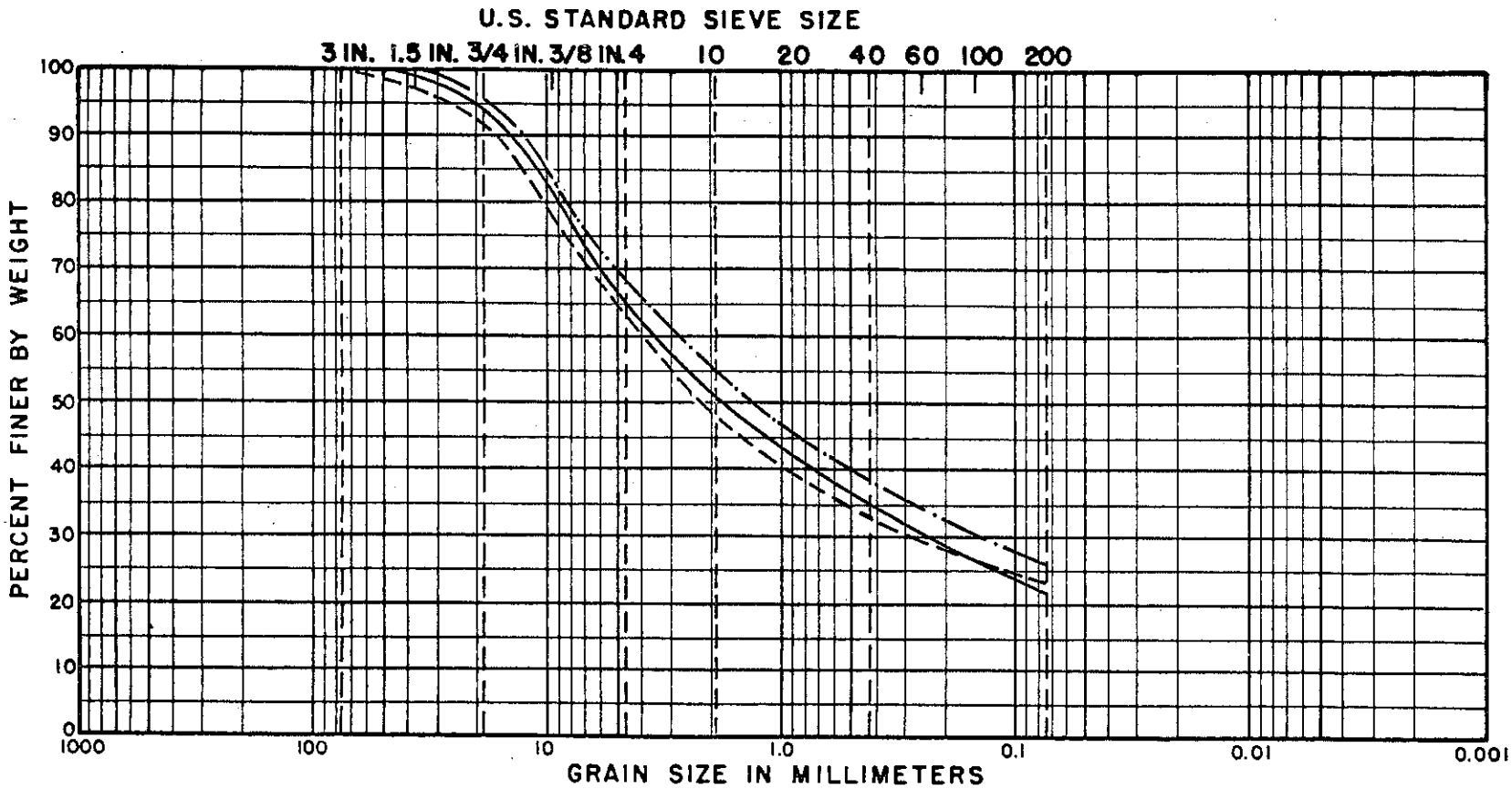
757.2 (REV. 4-62)



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	
— — — — —	B-3, 5'	GM	Silty sand & gravel	14				Dyke Lift Construction Material
————	B-5, 2½ & 5'	GM	Silty sand & gravel	6, 7				Dyke Lift Construction Material
—·—·—	B-3, 5'	GM	Silty sand & gravel	7				Dyke Lift Construction Material

DAMES & MOORE

GRADATION CURVES
POND 2

Plate A-3G

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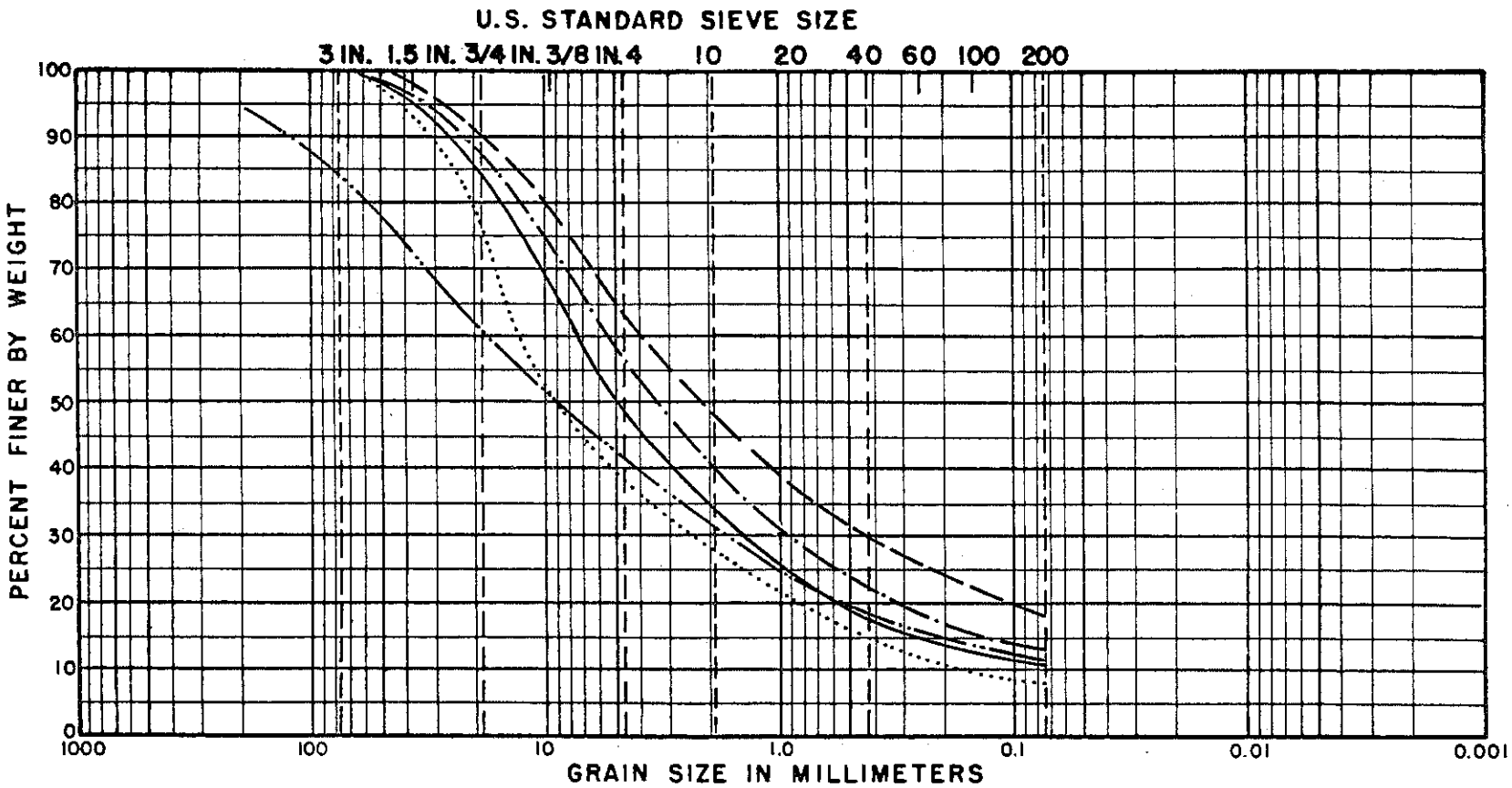

COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	
——··——	B-4, 30'	GP	Sa gravel, trace silt	8				Foundation river gravels
.....	B-5, 17½'	GP	Sa gravel, trace silt	8				Starter dyke construction
————	B-7, 15'	GW	Gravel and Sand	6				Starter dyke construction
—·—·—	B-6, 32'	GW	Gravel and Sand					Foundation river gravels
— — — —	B-1, 15'	GM	Gr sand, some silt	14				Starter dyke construction

GRADATION CURVES POND 2

DAMES & MOORE

Plate A-3H

757.2 (REV. 4-62)

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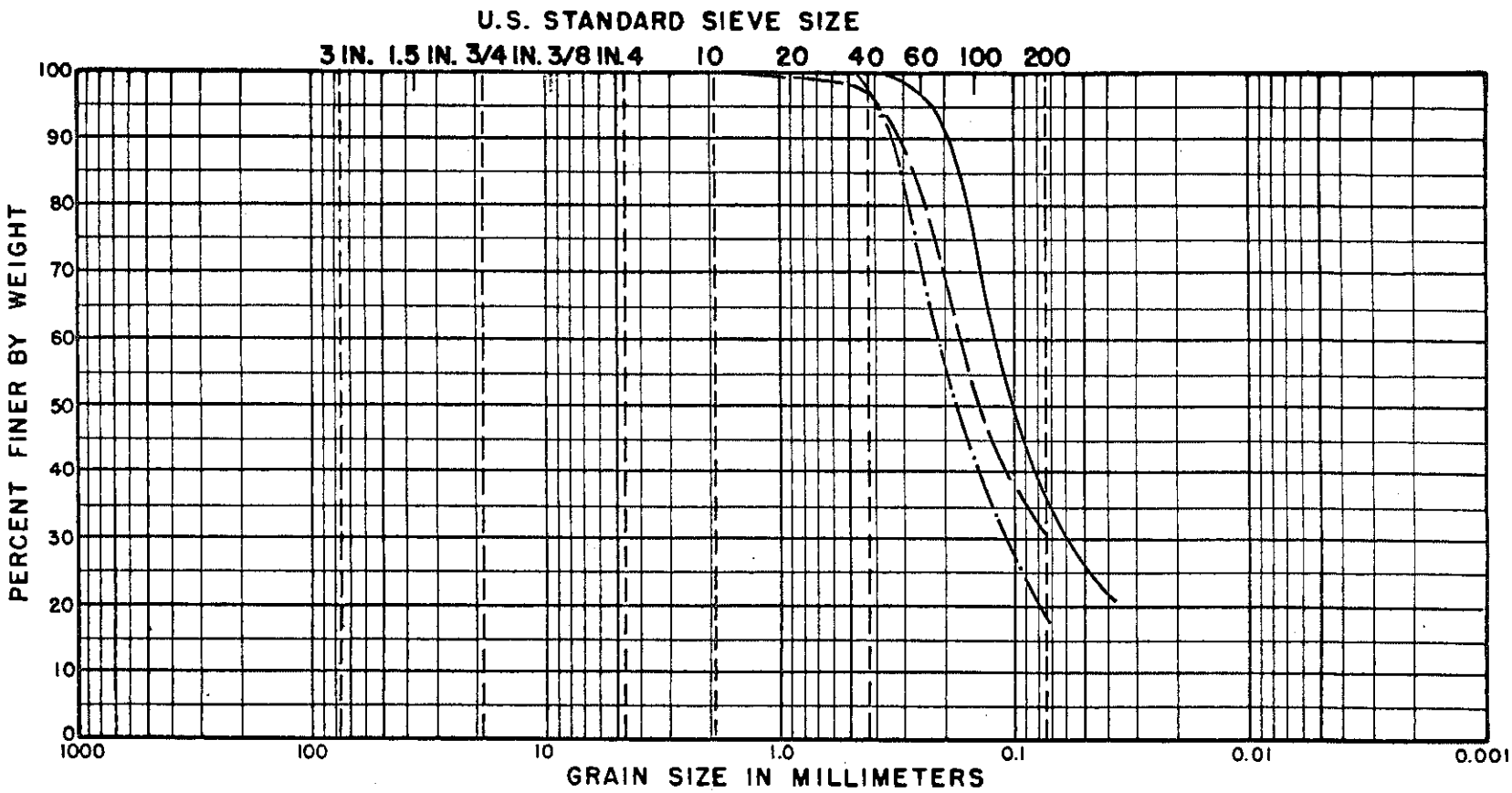

COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	
—·—·—	B-4, 15'	SM	Silty fine sand	7				Tailings sand
— — —	B-6, 10'	SM	Silty fine sand	6				Tailings sand
———	Surface	SM	Silty fine sand	Performed by Hecla				Tailings sand

GRADATION CURVES
POND 2

DAMES & MOORE

737.2 (REV. 4-62)

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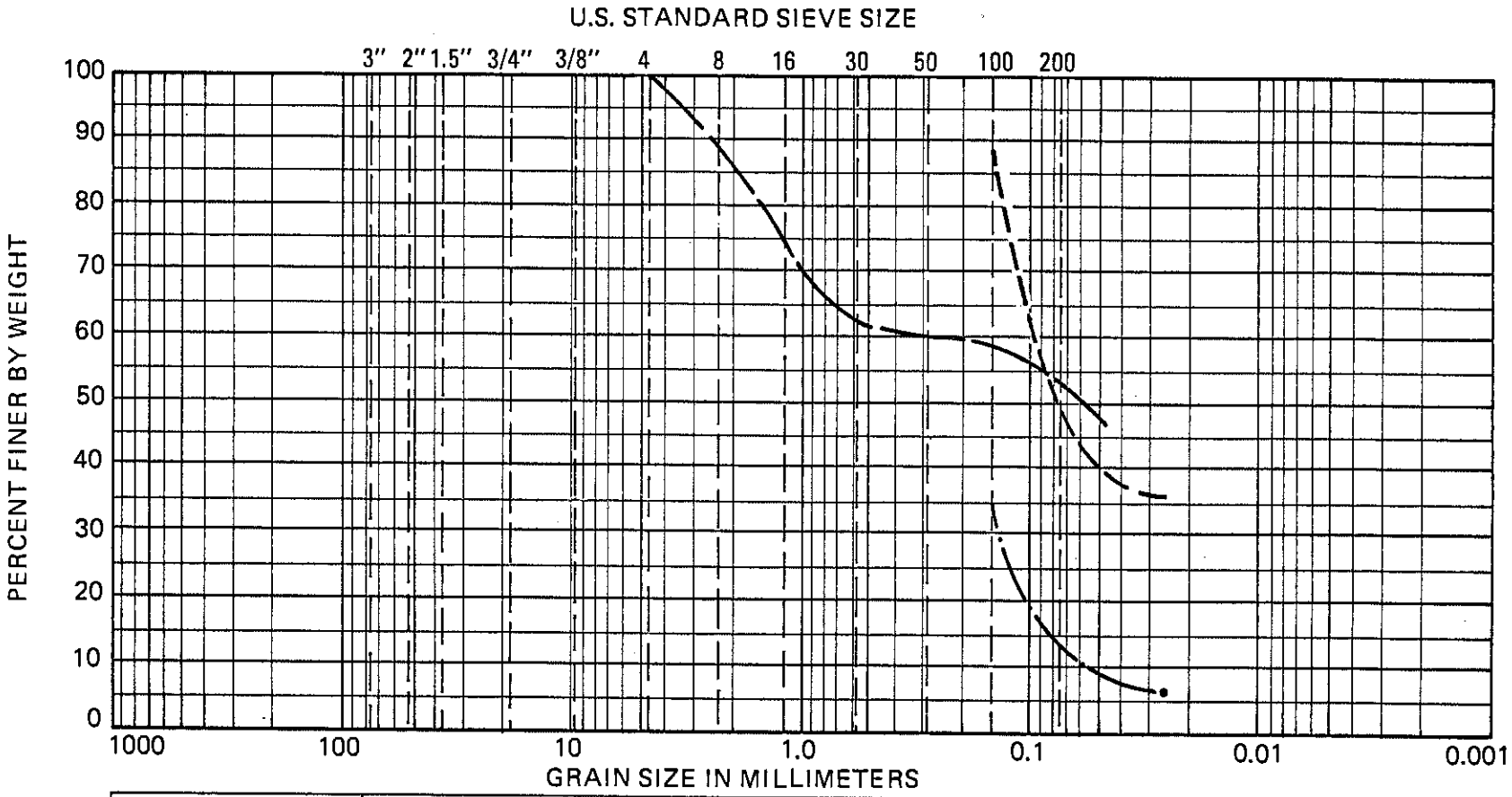
PLATE OF



COBBLES	GRAVEL		SAND			SLIT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

	DEPTH	CLASSIFICATION		NAT. W C	LL	PL	PI	
——— ———	B2-1,22'	SM	Sand and Silt	23				River Gravel
——·——	S2-a 2'	SM	Silty fine sand	2				Tailings
— — — —	S2-1	SM	Fine sand and silt	11				Tailings

GRADATION CURVES
POND 2

DAMES & MOORE

757.9 (5-75)

PLATE A-31

FILE 05457-012-32

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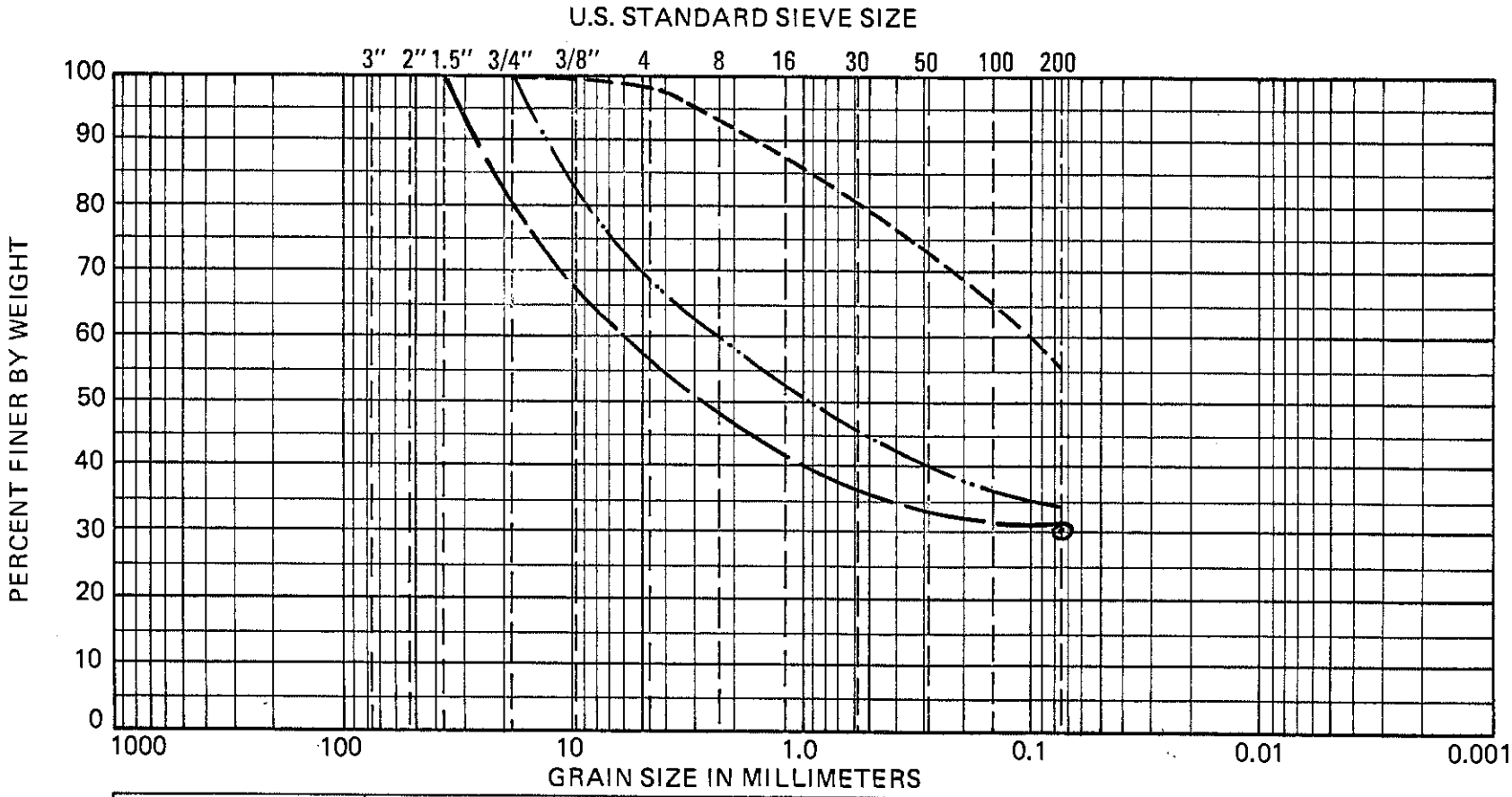
PLATE _____ OF _____



COBBLES	GRAVEL		SAND			SLIT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

	DEPTH	CLASSIFICATION		NAT. W C	LL	PL	PI	
——— ———	B3-1, 6'	GM	Silt, sand and gravel	4				Hillside borrow
· ⊙ ·	B3-1,24'	GM	Silt, sand and gravel	12				River gravel
— — — —	B3-2,20'	SM	Silt and sand	21				Tailings
——..——	B3-1, 7'	GM	Silt and sand, some gravel	10				Hillside borrow

GRADATION CURVES
POND 3

DAMES & MOORE

757 0 (5-75)

PLATE A-27

FILE 05457-012-32

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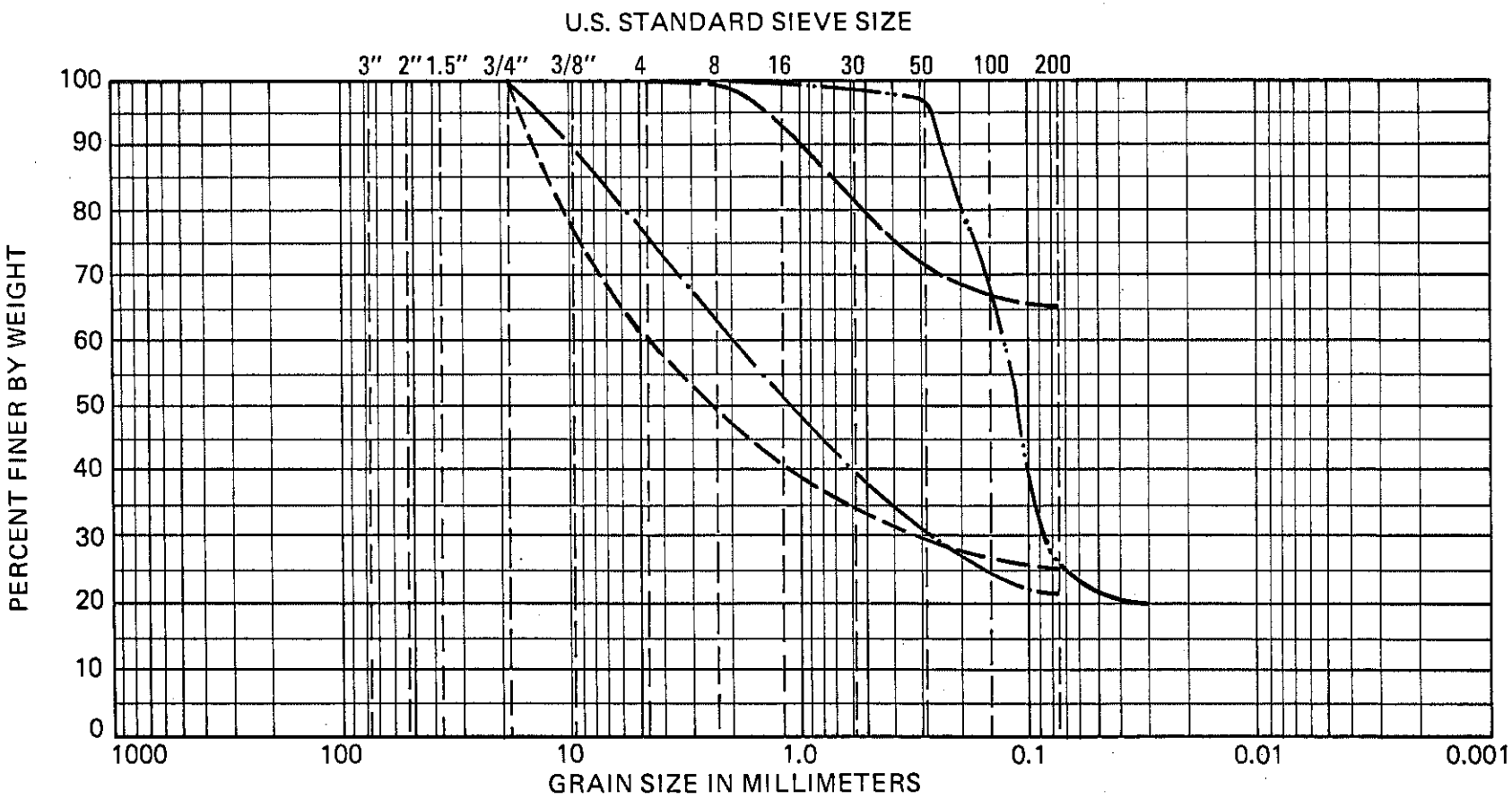

COBBLES	GRAVEL		SAND			SLIT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

	DEPTH	CLASSIFICATION		NAT. W C	LL	PL	PI	
—— ——	B3-2, 2'	SM	Silt and sand					Mine Waste
—— · ——	B3-2, 7'	GM	Silty sand and gravel	10				Hillside Borrow
— — — —	B3-2,10'	GM	Silty sand and gravel	9				Hillside Borrow
—— .. ——	B3-3,10'	SM	Silty fine sand	18				Tailings

GRADATION CURVES
POND 3

DAMES & MOORE

PLATE A-31

FILE 05457-012-32

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BY DATE

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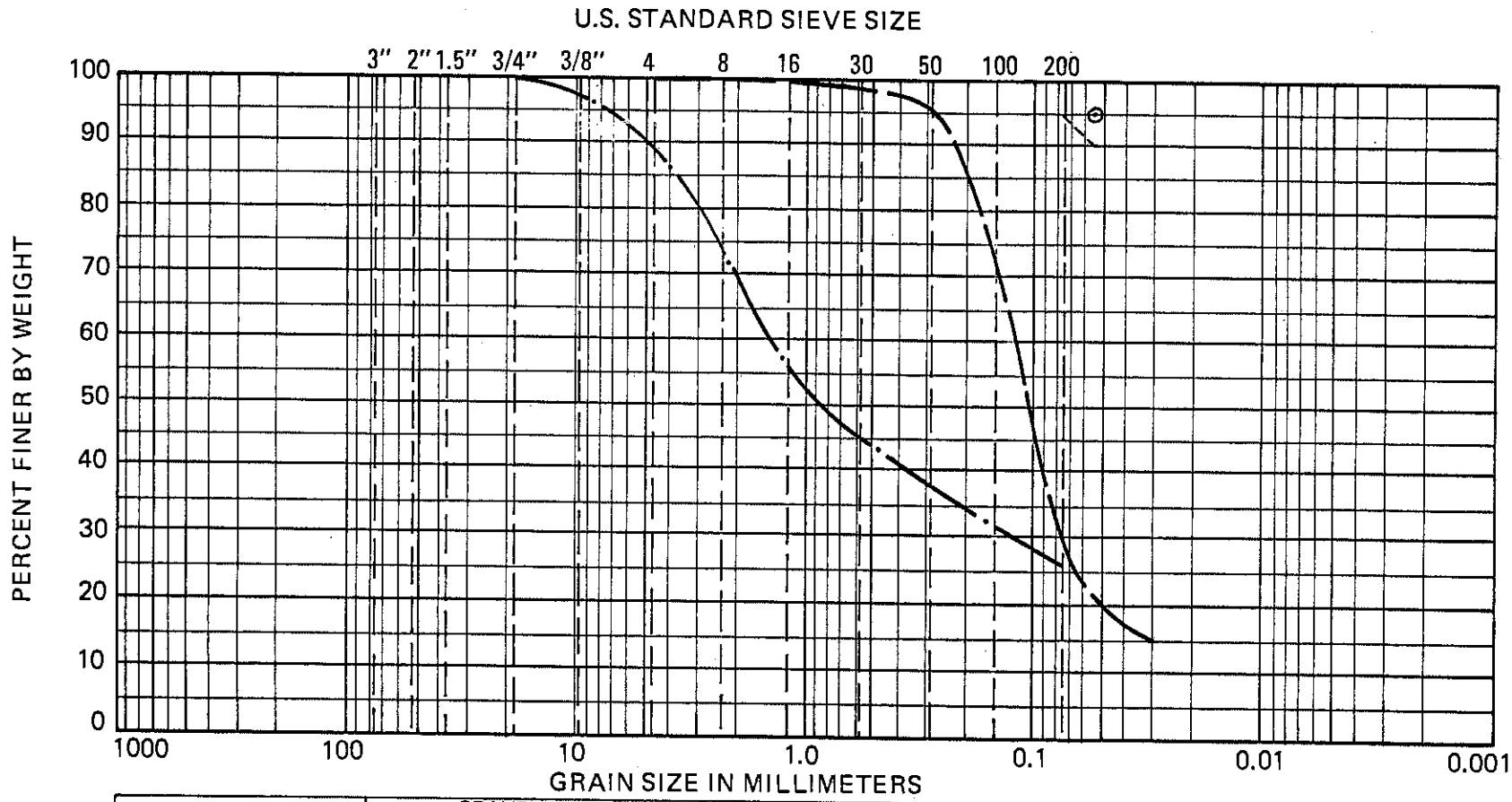
PLATE OF



COBBLES	GRAVEL		SAND			SLIT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

	DEPTH		CLASSIFICATION	NAT. W C	LL	PL	PI	
———	B3-3,15'	SM	Silty fine sand	25				Tailings
—·—	B3-3,18'	SM	Silty sand, trace gravel	17				Hillside Borrow
- - - -	B3-4, 8'	ML	Sandy Silt					Tailings
⊙	B3-4,20'	ML	Sandy Silt	36				Tailings

GRADATION CURVES
POND 3

DAMES & MOORE

FILE 05457-012-32

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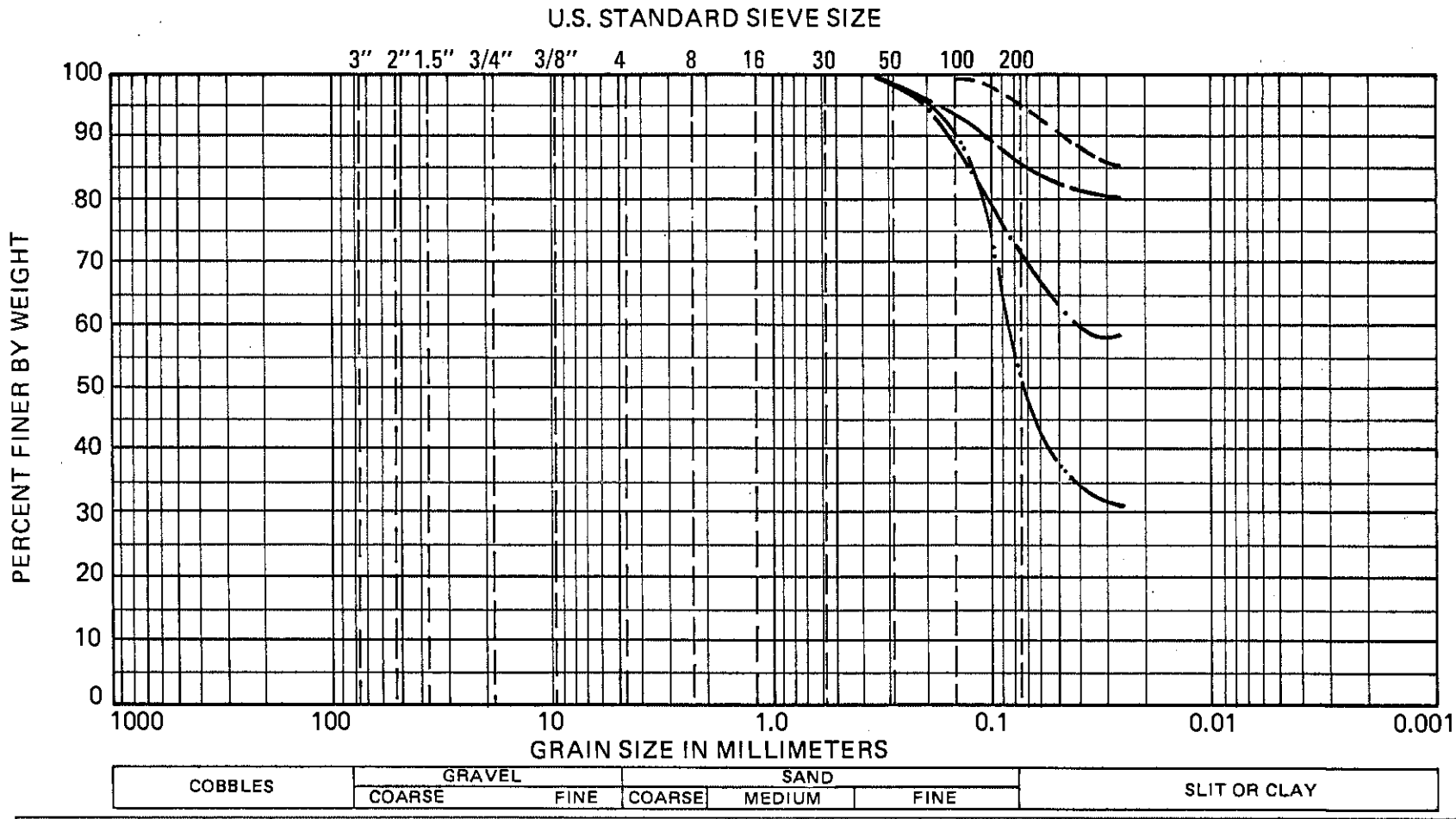

	DEPTH	CLASSIFICATION		NAT. W C	LL	PL	PI	
——— ———	S3-1, 2'	ML	Silt, trace fine sand	37				Tailings
——·——	S3-2, 2'	ML	Sandy Silt	25				Tailings
- - - - -	S3-3, 2'	ML	Silt	41				Tailings
——··——	S3-4, 2'	SM	Fine sand and silt	16				Tailings

GRADATION CURVES
POND 3

DAMES & MOORE

PLATE A-32

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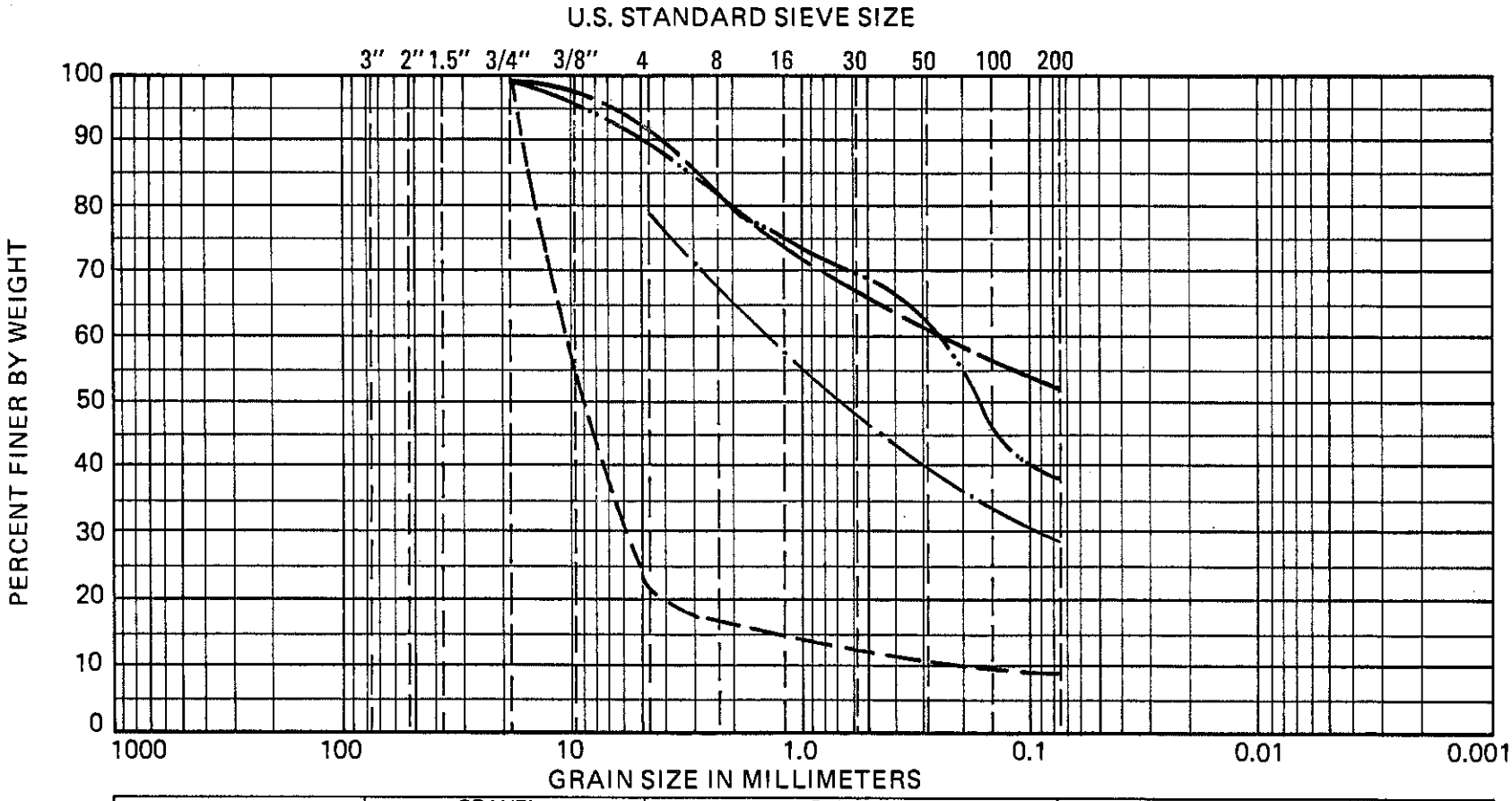

COBBLES	GRAVEL		SAND			SLIT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

	DEPTH	CLASSIFICATION		NAT. W C	LL	PL	PI	
——— ———	B4-1, 8'	SM	Silt and sand, trace gravel	10				Hillside Borrow
———·———	B4-1,12'	GM	Silty sand and gravel	7				Mine Waste
— — — —	B4-1,15'	GW	Sandy gravel, trace silt	3				Mine Waste
——··——	B4-1,16'	SM	Sand and silt, trace gravel	19				Mine Waste

GRADATION CURVES
POND 4

DAMES & MOORE

PLATE A-30

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BY LL DATE JAN 11, 80.

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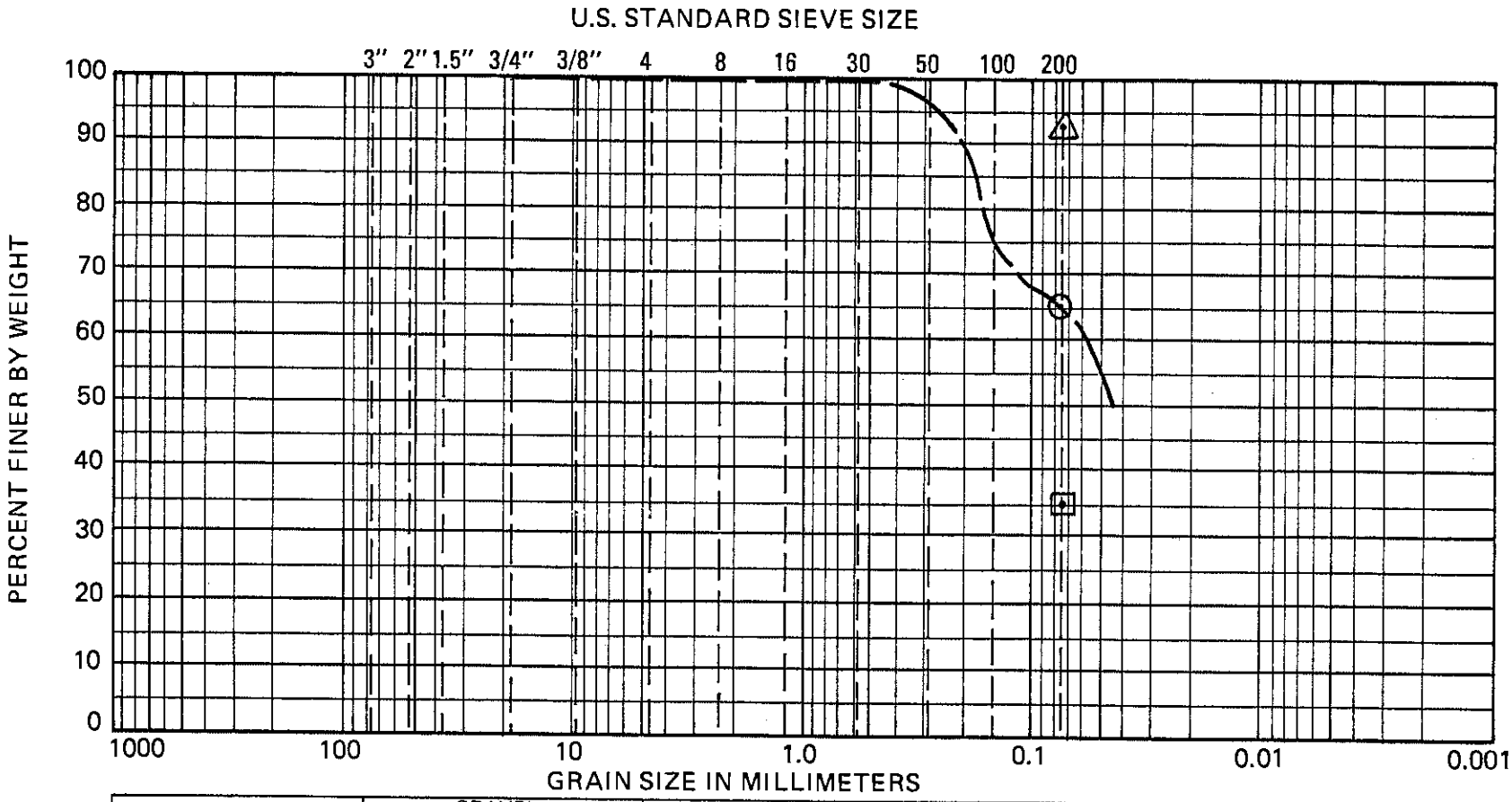

COBBLES	GRAVEL		SAND			SLIT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

	DEPTH	CLASSIFICATION		NAT. W C	LL	PL	PI	
⊡	B4-1,23'	SM	Fine sand and silt	19				Tailings
△	B4-1,25'	ML	Silt, trace fine sand	33				Tailings
⊙	B4-1,30'	SM	Silt and fine sand	33				Tailings
—— ——	B4-2, 3'	SM	Silt and fine sand	33				Tailings

GRADATION CURVES
POND 4

DAMES & MOORE

757 0 (5-75)

FILE 05457-012-32

BY LL DATE JAN 11, 80

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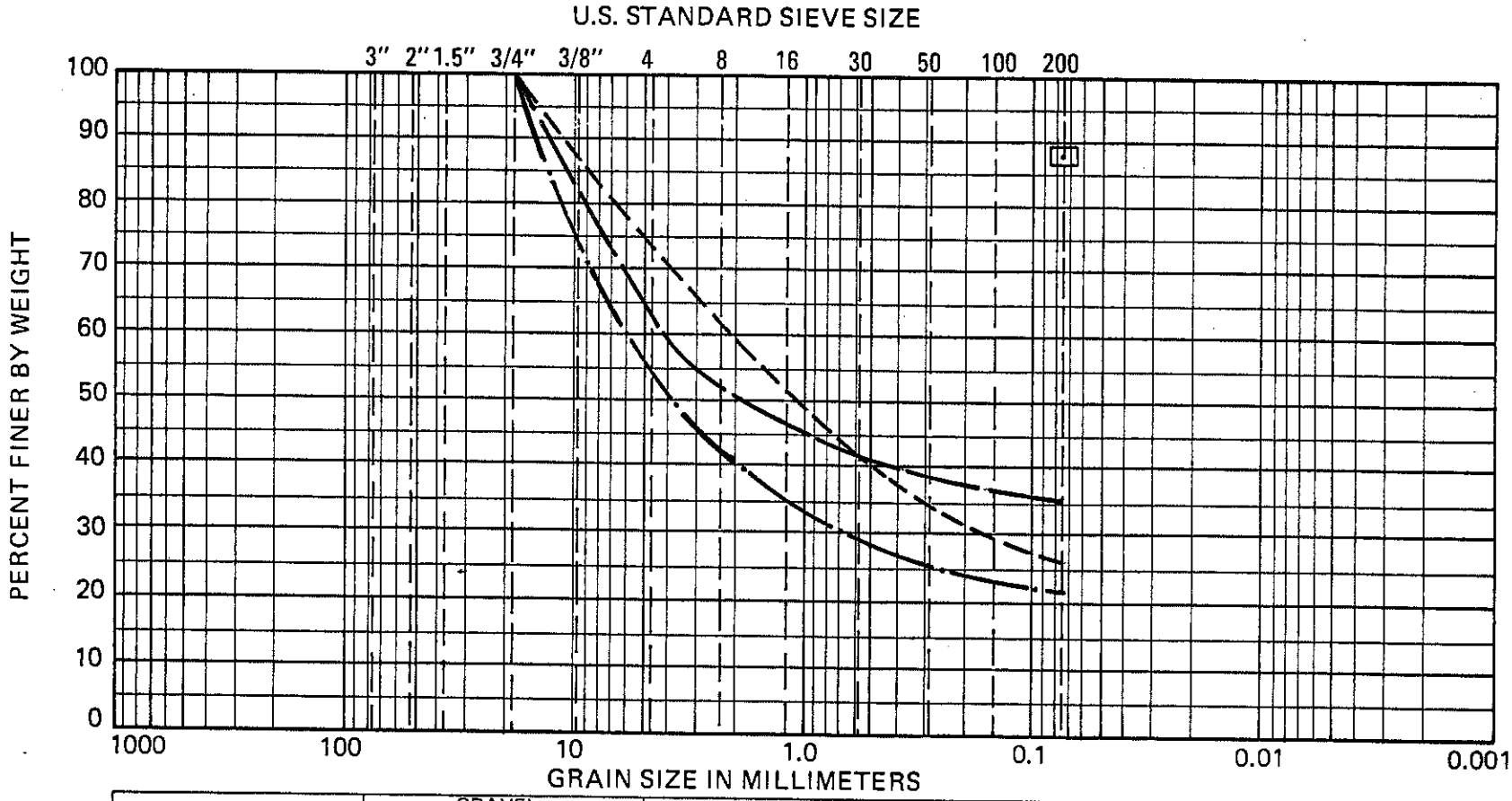
BY _____ DATE _____

PLATE _____ OF _____



COBBLES	GRAVEL		SAND			SLIT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

	DEPTH	CLASSIFICATION		NAT. W C	LL	PL	PI	
——— ———	B4-2, 9'	GM	Silt, sand and gravel	9				Hillside borrow
——·——	B4-2,13'	GM	Gravel, sand and silt	6				Mine Waste
⊡	B4-2,18'	ML	Silt, trace fine sand	33				Tailings
— — — —	B4-3,13'	GM	Gravel, sand and silt	6.0				Mine Waste

GRADATION CURVES
POND 4

DAMES & MOORE

757 9 (5-75)

FILE 05457-012-32

BY LL DATE JAN 11, 80

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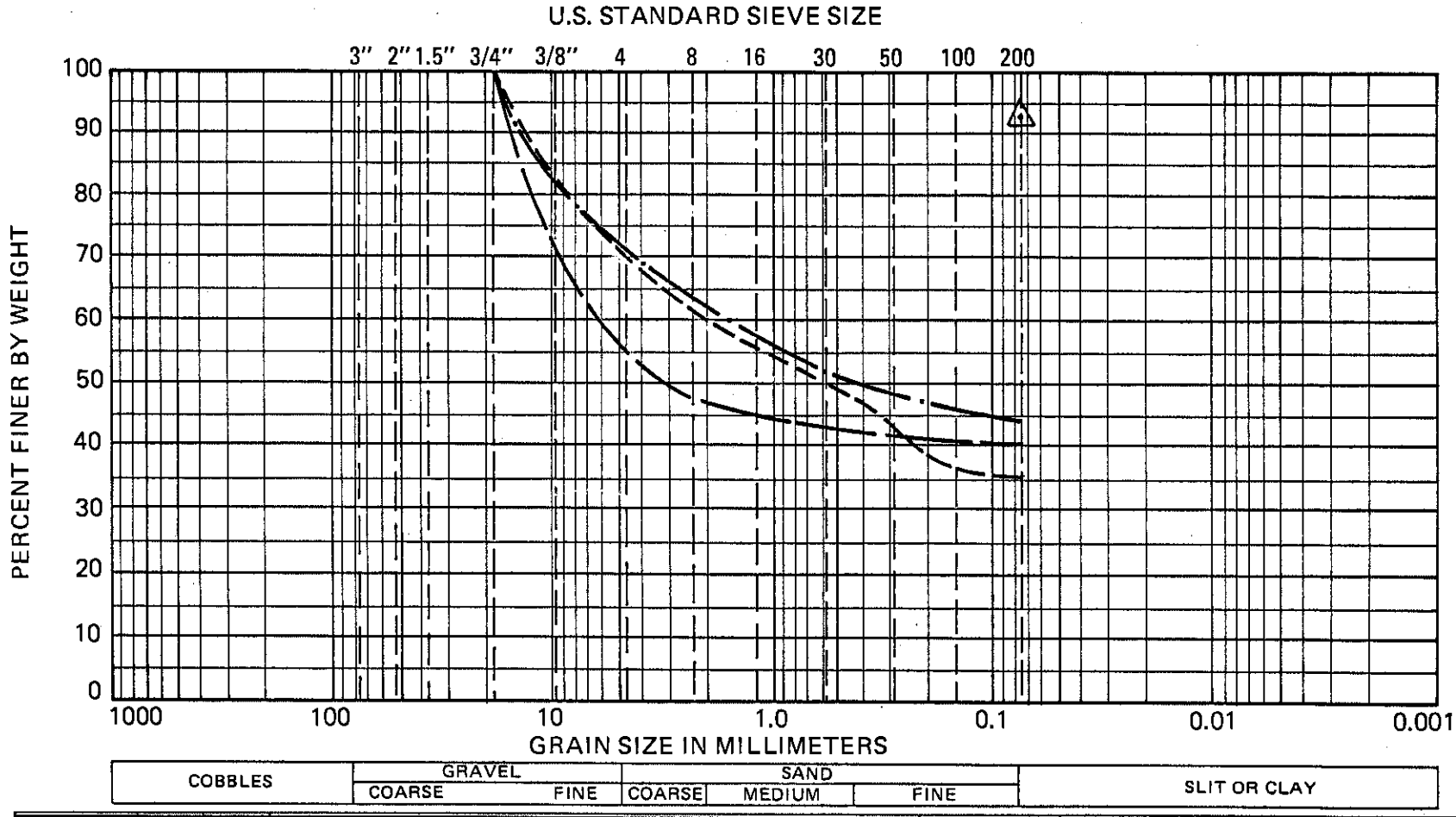
BY DATE

BY DATE

PLATE OF



	DEPTH		CLASSIFICATION	NAT. W C	LL	PL	PI	
——— ———	B4-4, 3'	GM	Gravel and silt, some sand	8				Hillside borrow
—·—·—	B4-4,13'	GM	Silt, sand and gravel	8				Hillside borrow
— — — —	B4-4,18'	GM	Silt, sand and gravel	14				Hillside borrow
△	B4-4,25'	ML	Silt, trace fine sand	35				Tailings

GRADATION CURVES
POND 4

DAMES & MOORE

PLATE A-39

757.9 (5-75)

FILE 05457-012-32

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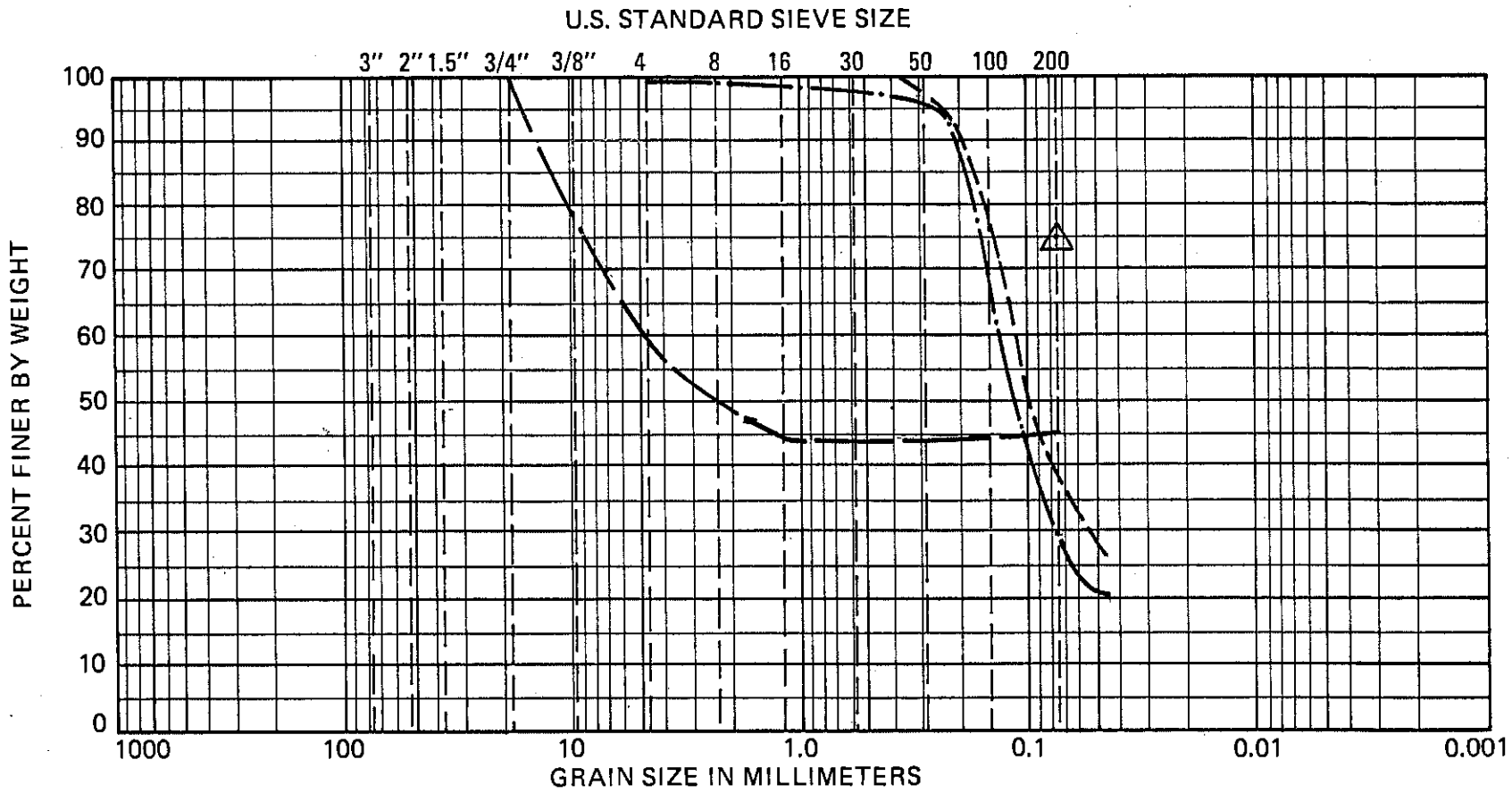

COBBLES	GRAVEL		SAND			SLIT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

	DEPTH		CLASSIFICATION	NAT. W C	LL	PL	PI	
———	B4-6, 7'	GM	Silt and gravel, trace sand	11				Hillside borrow
△	B4-6,17'	ML	Sandy Silt	29				Tailings
—·—	B4-5, 4'	SM	Silty fine sand	14				Tailings
– – – –	B4-5,25'	SM	Silty fine sand	18				Tailings

GRADATION CURVES
POND 4

DAMES & MOORE

757 Q (5-75)

PLATE A-3

FILE 05457-012-32

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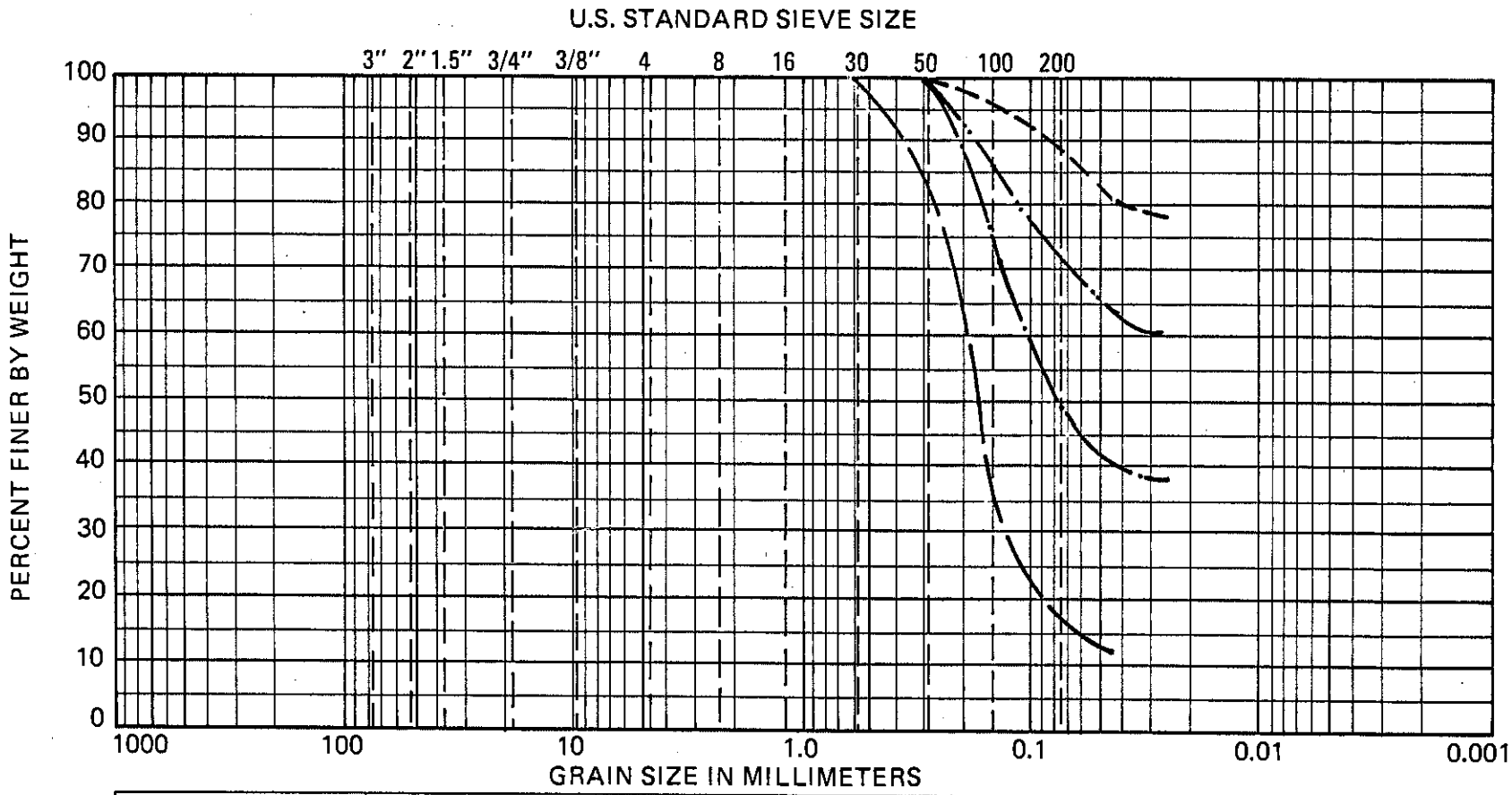

COBBLES	GRAVEL		SAND			SLIT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

	DEPTH	CLASSIFICATION		NAT. W C	LL	PL	PI	
———	B4-5,33'	SM	Silty fine sand	7				Tailings
—·—	S4-1, 2'	SM	Fine sand and silt	35				Tailings
— — —	S4-2, 2'	ML	Sandy Silt	51				Tailings
—··—	S4-3, 2'	ML	Silt, trace fine sand	45				Tailings

GRADATION CURVES
POND 4

DAMES & MOORE

757 9 (5-75)

PLATE A-31

FILE 05457-012-32

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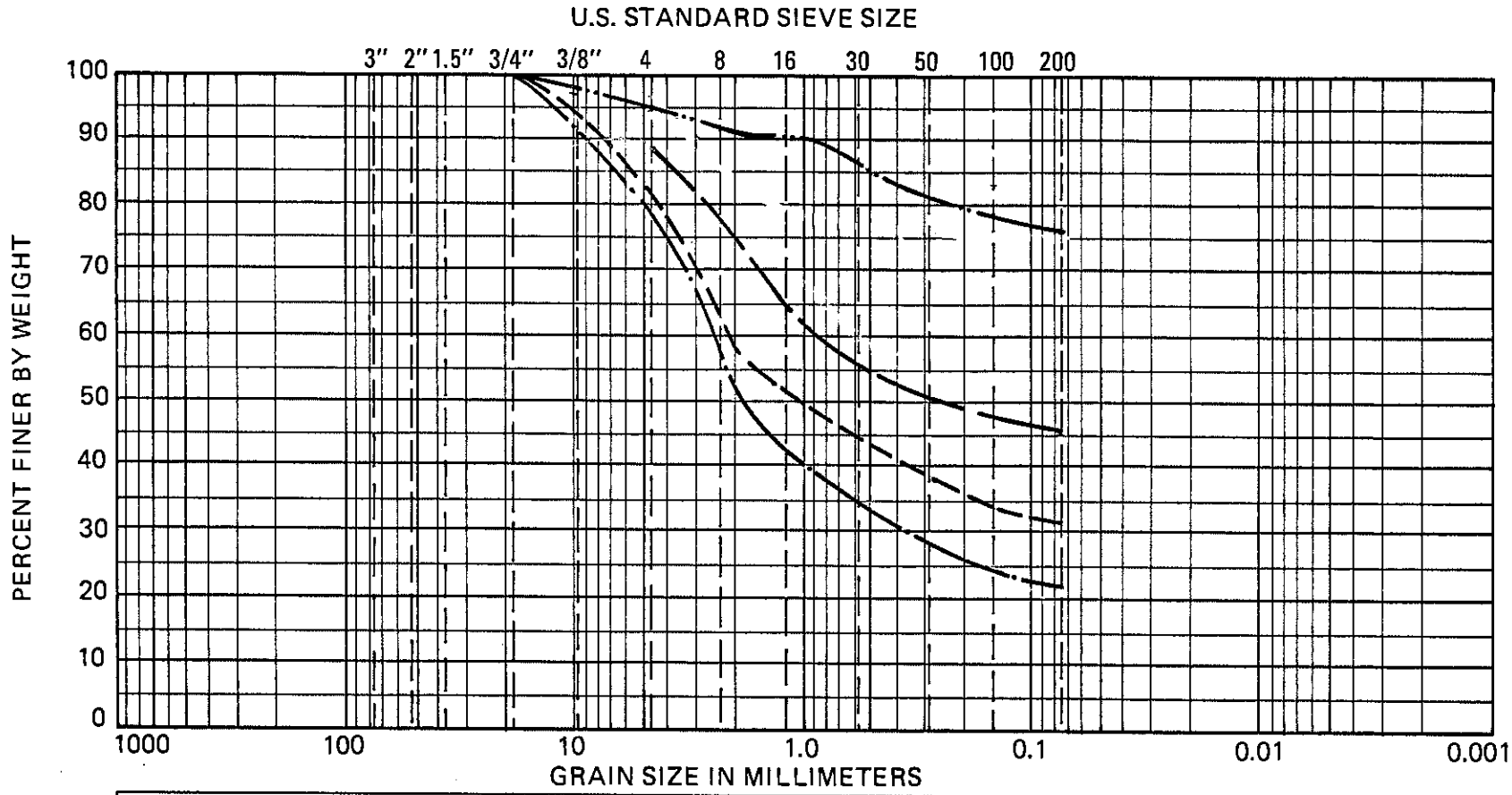

COBBLES	GRAVEL		SAND			SLIT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

	DEPTH	CLASSIFICATION		NAT. W C	LL	PL	PI	
——— ———	B5-1,17'	SM	Sand and silt, trace gravel	11				Hillside borrow
——·———	B5-1,25'	GM	Sand, silt and gravel	4				River gravel
— — — —	B5-2,24'	GM	Sand, silt and gravel	9				Hillside borrow
——··——	B5-2,17'	ML	Sandy silt, trace gravel	24				Tailings

GRADATION CURVES
POND 5

DAMES & MOORE

PLATE A-311

757 9 (5-75)

FILE 05457-012-32

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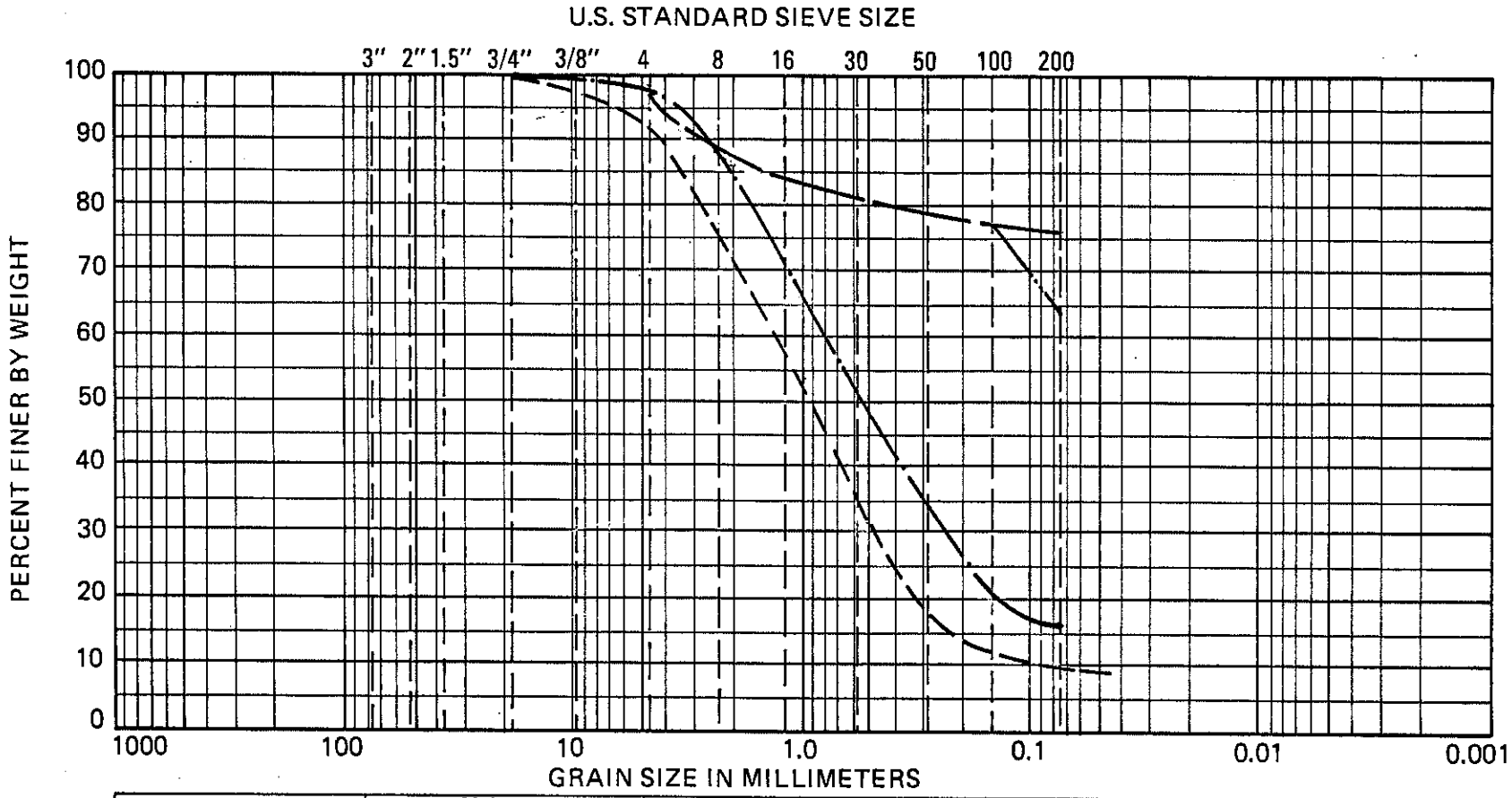
PLATE _____ OF _____



COBBLES	GRAVEL		SAND			SLIT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

	DEPTH	CLASSIFICATION		NAT. W C	LL	PL	PI	
——— ———	B5-2,20'	ML	Sandy Silt	23				Tailings
——·——	B5-2,31'	SM	Silty Sand	9				River Gravel
— — — —	B5-2,38'	SP	Sand, traces silt and gravel					River Gravel
——··——	B5-3,15'	SM	Silt and fine sand	8				Tailings

GRADATION CURVES
POND 5

DAMES & MOORE

FILE 05451-012-32

BY LL DATE JAN 11, 80

CHECKED BY _____ DATE _____

REVISIONS _____

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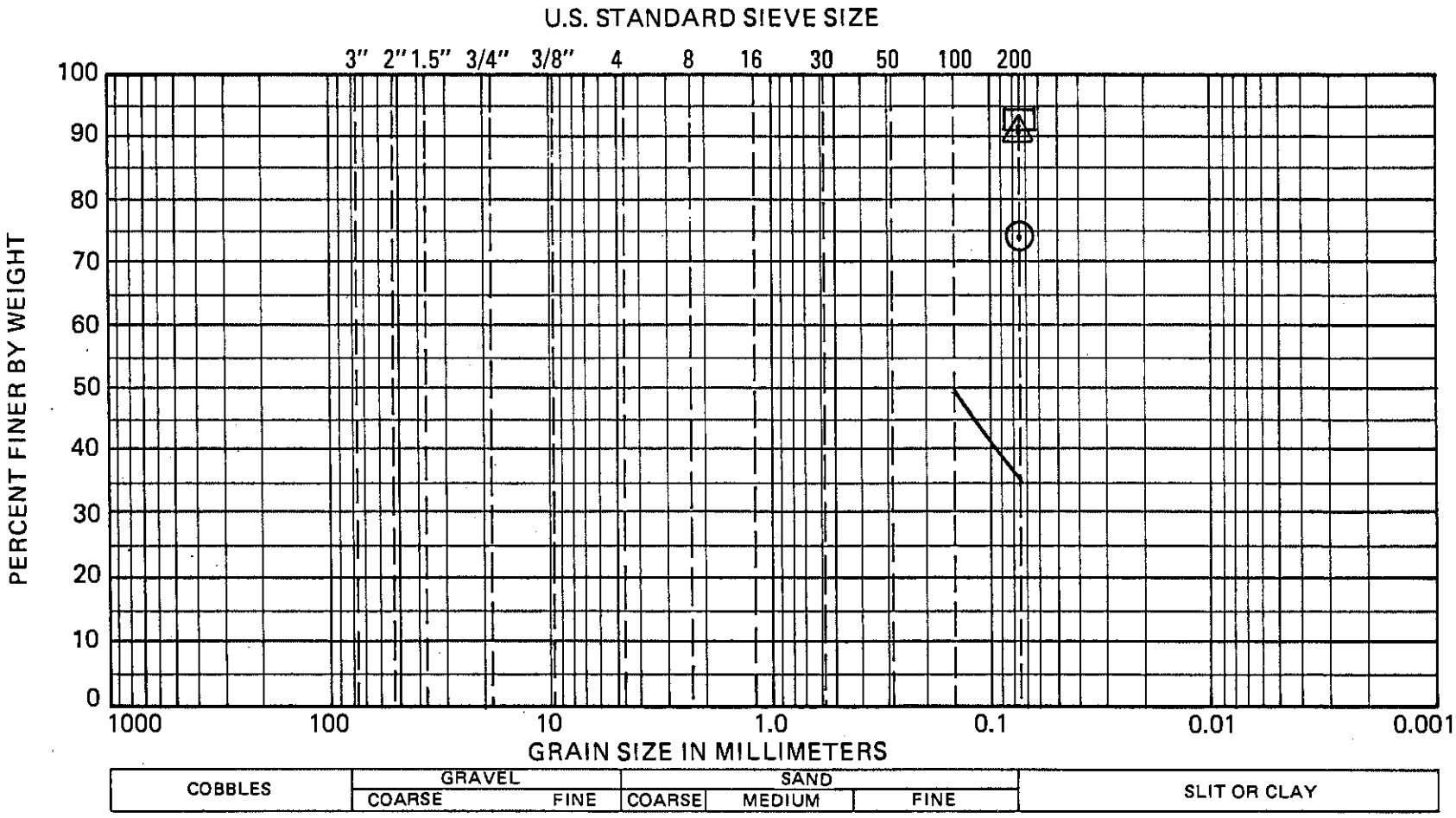
BY _____ DATE _____

PLATE _____ OF _____



	DEPTH		CLASSIFICATION	NAT. W C	LL	PL	PI	
△	B5-3,16'	ML	Silt, trace fine sand	30				Tailings
———	B5-3,17'	SM	Fine sand and silt	13				Tailings
⊙	B5-3,20'	ML	Sandy Silt	22				Tailings
⊡	B5-3,21'	ML	Silt, trace fine sand	31				Tailings

GRADATION CURVES
POND 5

DAMES & MOORE

PLATE A-3W

7570 (5.75)

FILE 05457-012-32

BY LL DATE JAN 11, 80

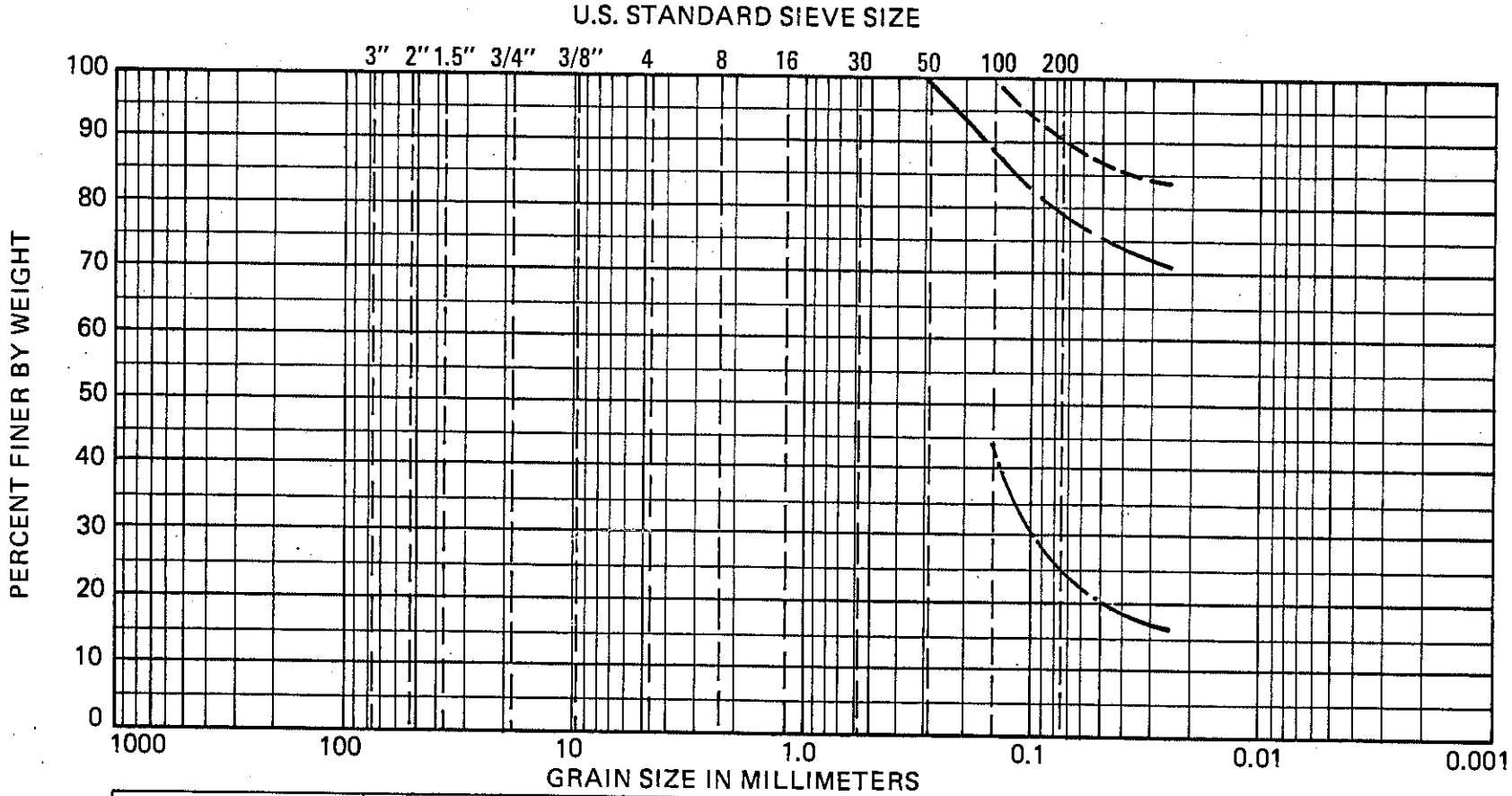
CHECKED BY DATE

REVISIONS

BY DATE

BY DATE

PLATE OF



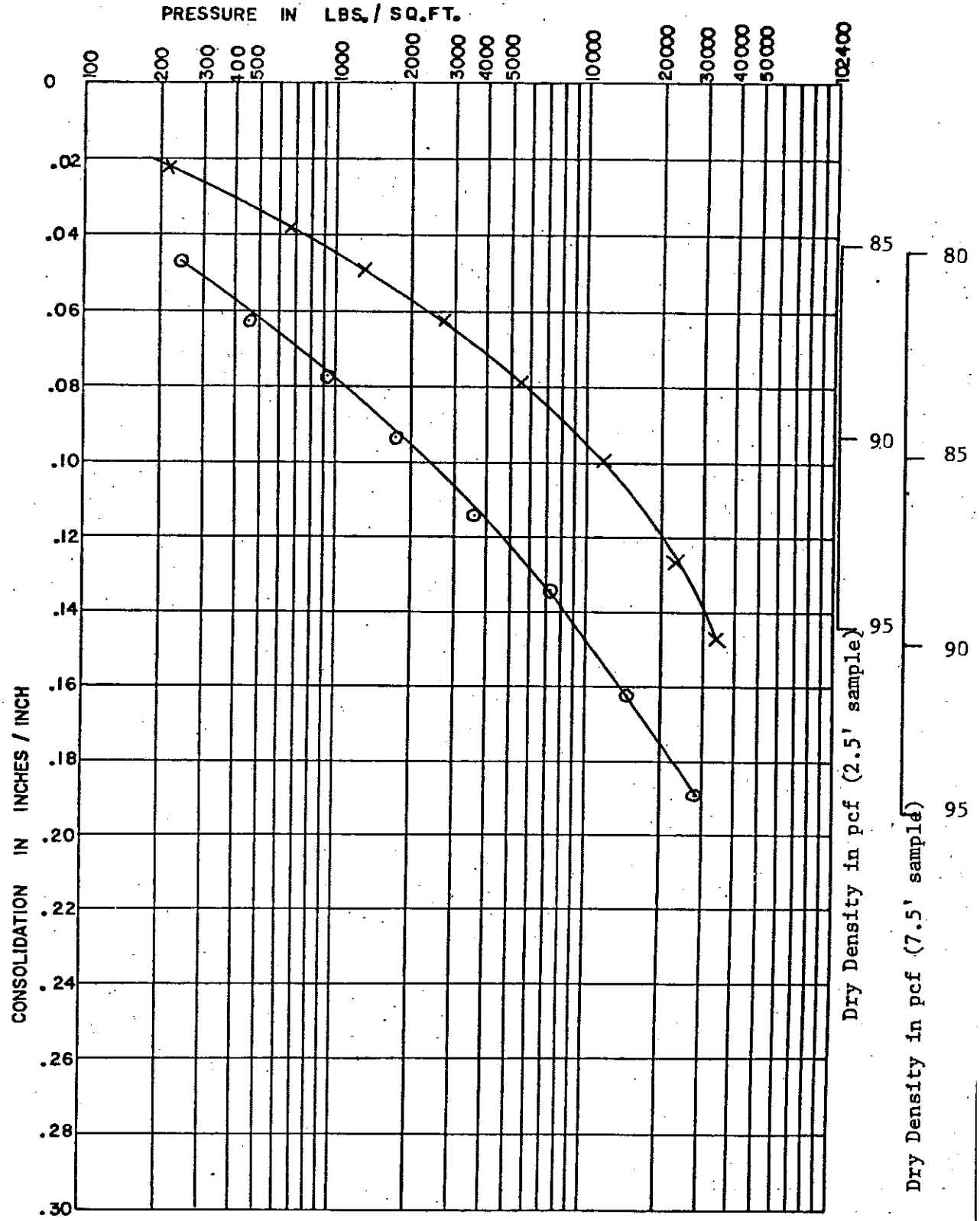
COBBLES	GRAVEL		SAND			SLIT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

	DEPTH	CLASSIFICATION		NAT. W C	LL	PL	PI	
—— ——	S5-1, 2'	ML	Sandy silt	26				Tailings
—·—	S5-2, 2'	SM	Silty fine sand	14				Tailings
— — —	S5-3, 2'	ML	Silt, trace fine sand	36				Tailings

GRADATION CURVES
POND 5

DAMES & MOORE

757 9 (5-75)



LEGEND	BORING	DEPTH	SOIL DESCRIPTION
X——X	B-8	2.5'	Gray silt - tailings slimes
O——O	B-8	7.5'	Gray silt - tailings slimes*
			* remolded to a slurry

CONSOLIDATION TEST DATA

DAMES & MOORE

PLATE A-4

REVISIONS BY _____ DATE _____

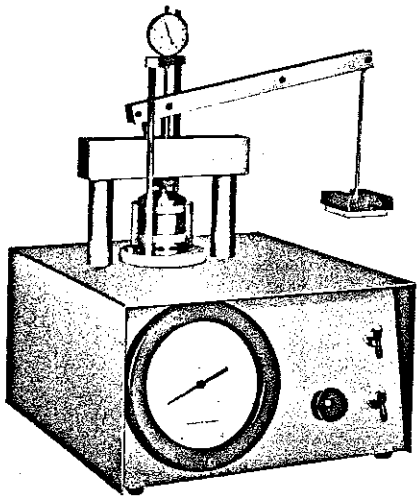
FILE 5457-007-32

BY _____ DATE _____ CHECKED BY _____

METHOD OF PERFORMING CONSOLIDATION TESTS

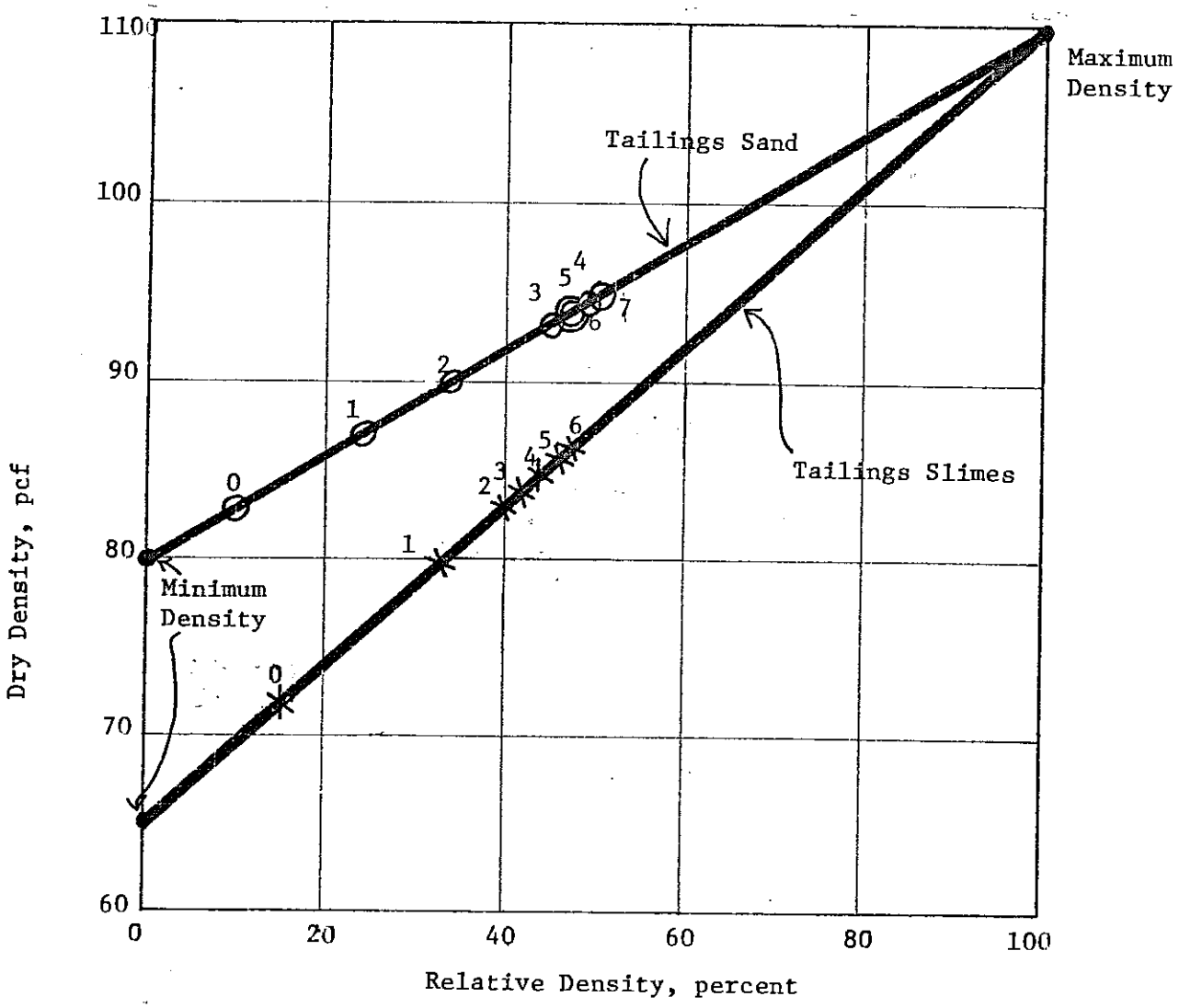
CONSOLIDATION TESTS ARE PERFORMED TO EVALUATE THE VOLUME CHANGES OF SOILS SUBJECTED TO INCREASED LOADS. TIME-CONSOLIDATION AND PRESSURE-CONSOLIDATION CURVES MAY BE PLOTTED FROM THE DATA OBTAINED IN THE TESTS. ENGINEERING ANALYSES BASED ON THESE CURVES PERMIT ESTIMATES TO BE MADE OF THE PROBABLE MAGNITUDE AND RATE OF SETTLEMENT OF THE TESTED SOILS UNDER APPLIED LOADS.

EACH SAMPLE IS TESTED WITHIN BRASS RINGS TWO AND ONE-HALF INCHES IN DIAMETER AND ONE INCH IN LENGTH. UNDISTURBED SAMPLES OF IN-PLACE SOILS ARE TESTED IN RINGS TAKEN FROM THE SAMPLING DEVICE IN WHICH THE SAMPLES WERE OBTAINED. LOOSE SAMPLES OF SOILS TO BE USED IN CONSTRUCTING EARTH FILLS ARE COMPACTED IN RINGS TO PREDETERMINED CONDITIONS AND TESTED.



DEAD LOAD-PNEUMATIC CONSOLIDOMETER

IN TESTING, THE SAMPLE IS RIGIDLY CONFINED LATERALLY BY THE BRASS RING. AXIAL LOADS ARE TRANSMITTED TO THE ENDS OF THE SAMPLE BY POROUS DISKS. THE DISKS ALLOW DRAINAGE OF THE LOADED SAMPLE. THE AXIAL COMPRESSION OR EXPANSION OF THE SAMPLE IS MEASURED BY A MICROMETER DIAL INDICATOR AT APPROPRIATE TIME INTERVALS AFTER EACH LOAD INCREMENT IS APPLIED. EACH LOAD IS ORDINARILY TWICE THE PRECEDING LOAD. THE INCREMENTS ARE SELECTED TO OBTAIN CONSOLIDATION DATA REPRESENTING THE FIELD LOADING CONDITIONS FOR WHICH THE TEST IS BEING PERFORMED. EACH LOAD INCREMENT IS ALLOWED TO ACT OVER AN INTERVAL OF TIME DEPENDENT ON THE TYPE AND EXTENT OF THE SOIL IN THE FIELD.



		O Tailings Sand		X Tailings Slime	
		Boring	Depth	Boring	Depth
	0	Insitu Field Density Test	0	Insitu Field Density Test	0
	1	B-4	17.5	B-7	2.5
	2	B-6	7.5	B-2	17.5
	3	B-4	12.5	B-8	12.5
	4	B-6	2.5	B-8	7.5
	5	B-4	2.5	B-8	2.5
	6	B-4	7.5	B-4	27.5
	7	B-6	12.5		

RELATIVE DENSITY TEST RESULTS

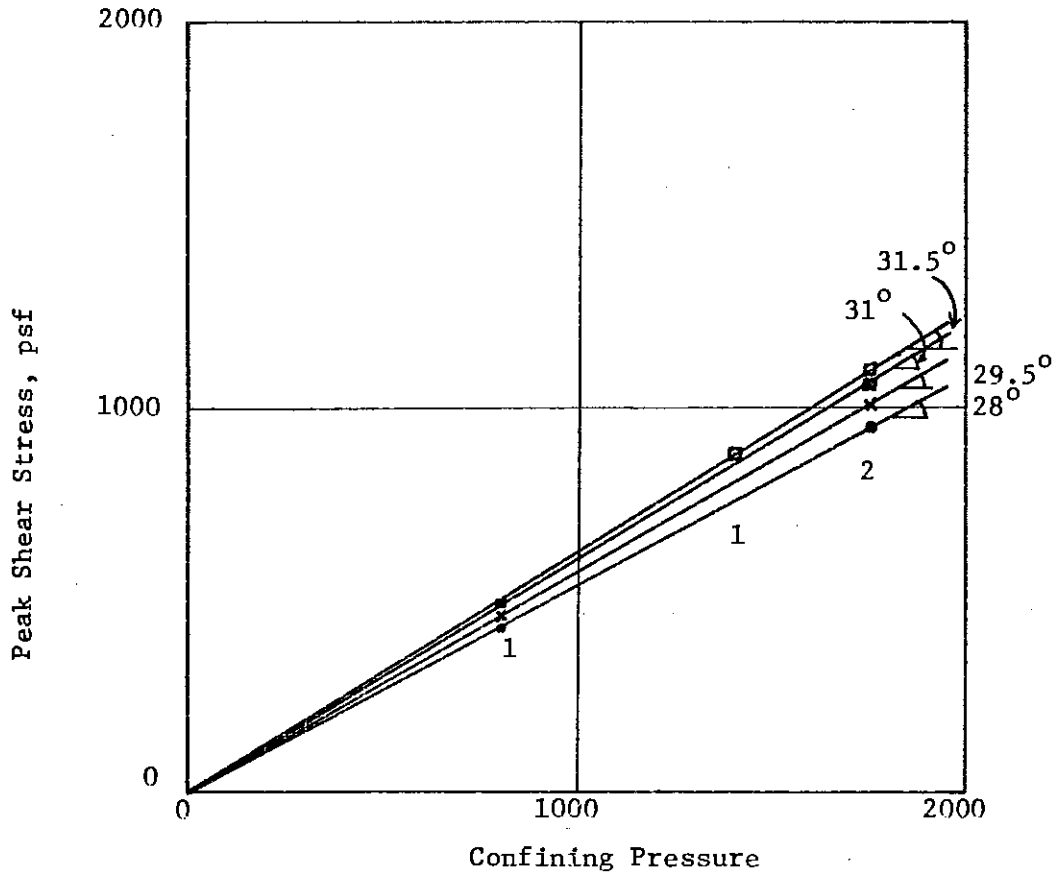
DAMES & MOORE

REVISIONS BY CMU DATE Oct 31 77 CMU Nov 15 77

FILE 5457-009-32

BY CMU DATE Sept 19 77

CHECKED BY



	Boring	Depth (feet)	Soil Description	Dry Density 1 (pcf)	2	Test Detail
□	B-4	17.5	Tailing Sand	87	86	Placed loose and dry
■	B-6	7.5	Tailing Sand	88	87	Placed loose and dry
×	B-8	7.5	Tailing Slimes	83	85	Placed as a slurry
○	B-6	17.5	Tailing Slimes	79	81	Placed as a slurry

DIRECT SHEAR TEST RESULTS

DAMES & MOORE

BY CMU DATE Sept 16, 77
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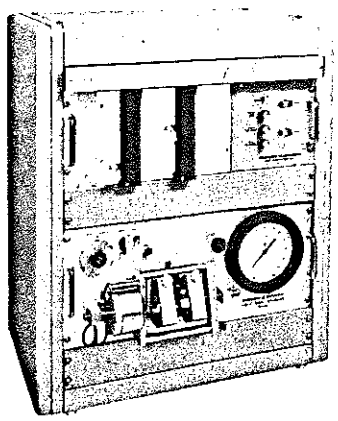
FILE 5457-007-32
REVISIONS
BY DATE

METHOD OF PERFORMING DIRECT SHEAR AND FRICTION TESTS

DIRECT SHEAR TESTS ARE PERFORMED TO DETERMINE THE SHEARING STRENGTHS OF SOILS. FRICTION TESTS ARE PERFORMED TO DETERMINE THE FRICTIONAL RESISTANCES BETWEEN SOILS AND VARIOUS OTHER MATERIALS SUCH AS WOOD, STEEL, OR CONCRETE. THE TESTS ARE PERFORMED IN THE LABORATORY TO SIMULATE ANTICIPATED FIELD CONDITIONS.



DIRECT SHEAR APPARATUS WITH ELECTRONIC RECORDER (IN SEATTLE OFFICE)

EACH SAMPLE IS TESTED WITHIN THREE BRASS RINGS, TWO AND ONE-HALF INCHES IN DIAMETER AND ONE INCH IN LENGTH. UNDISTURBED SAMPLES OF IN-PLACE SOILS ARE TESTED IN RINGS TAKEN FROM THE SAMPLING DEVICE IN WHICH THE SAMPLES WERE OBTAINED. LOOSE SAMPLES OF SOILS TO BE USED IN CONSTRUCTING EARTH FILLS ARE COMPACTED IN RINGS TO PREDETERMINED CONDITIONS AND TESTED.

DIRECT SHEAR TESTS

A THREE-INCH LENGTH OF THE SAMPLE IS TESTED IN DIRECT DOUBLE SHEAR. A CONSTANT PRESSURE, APPROPRIATE TO THE CONDITIONS OF THE PROBLEM FOR WHICH THE TEST IS BEING PERFORMED, IS APPLIED NORMAL TO THE ENDS OF THE SAMPLE THROUGH POROUS STONES. A SHEARING FAILURE OF THE SAMPLE IS CAUSED BY MOVING THE CENTER RING IN A DIRECTION PERPENDICULAR TO THE AXIS OF THE SAMPLE. TRANSVERSE MOVEMENT OF THE OUTER RINGS IS PREVENTED.

THE SHEARING FAILURE MAY BE ACCOMPLISHED BY APPLYING TO THE CENTER RING EITHER A CONSTANT RATE OF LOAD, A CONSTANT RATE OF DEFLECTION, OR INCREMENTS OF LOAD OR DEFLECTION. IN EACH CASE, THE SHEARING LOAD AND THE DEFLECTIONS IN BOTH THE AXIAL AND TRANSVERSE DIRECTIONS ARE RECORDED AND PLOTTED. THE SHEARING STRENGTH OF THE SOIL IS DETERMINED FROM THE RESULTING LOAD-DEFLECTION CURVES.

FRICTION TESTS

IN ORDER TO DETERMINE THE FRICTIONAL RESISTANCE BETWEEN SOIL AND THE SURFACES OF VARIOUS MATERIALS, THE CENTER RING OF SOIL IN THE DIRECT SHEAR TEST IS REPLACED BY A DISK OF THE MATERIAL TO BE TESTED. THE TEST IS THEN PERFORMED IN THE SAME MANNER AS THE DIRECT SHEAR TEST BY FORCING THE DISK OF MATERIAL FROM THE SOIL SURFACES.

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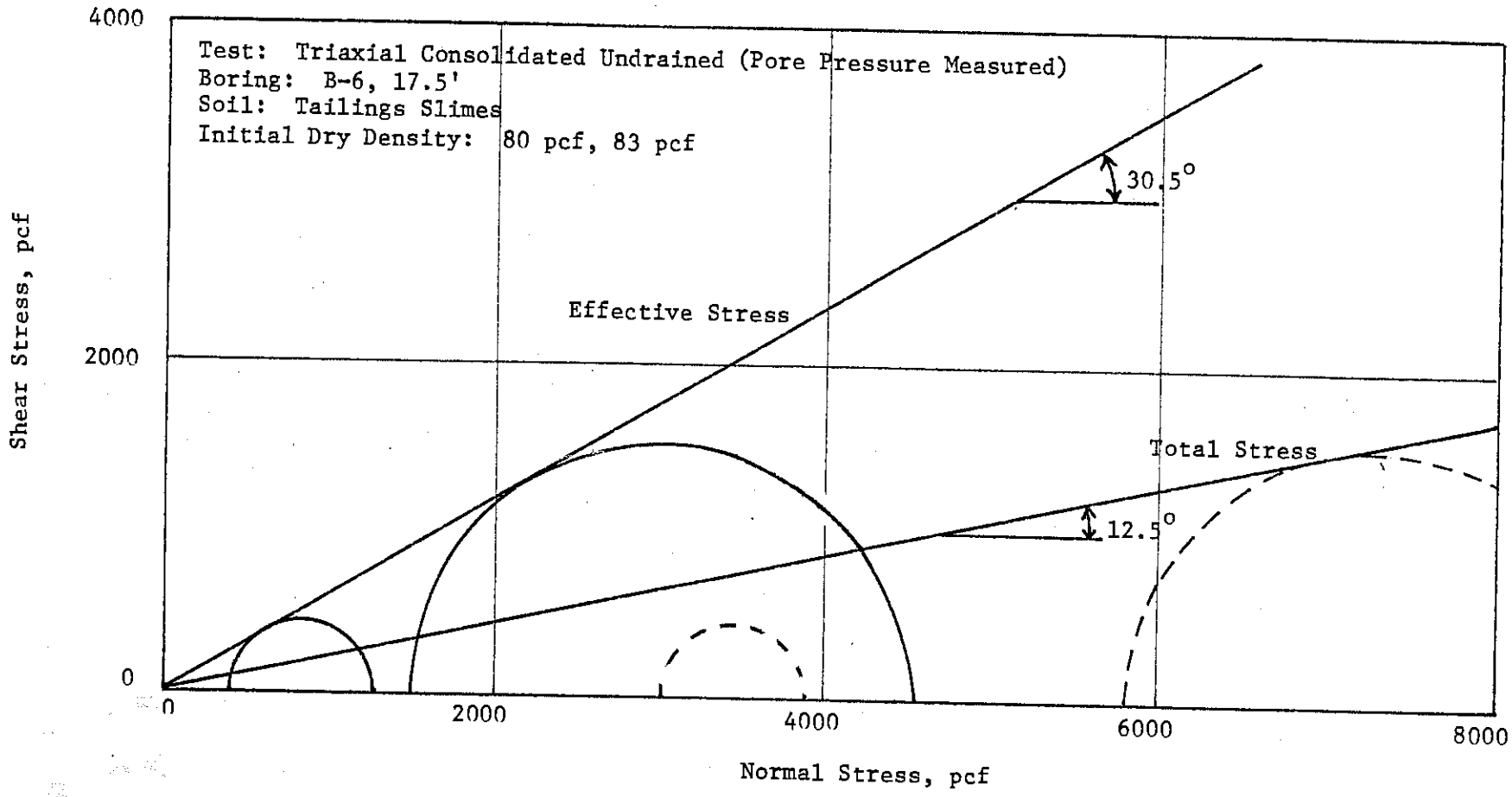


TRIAXIAL TEST RESULTS

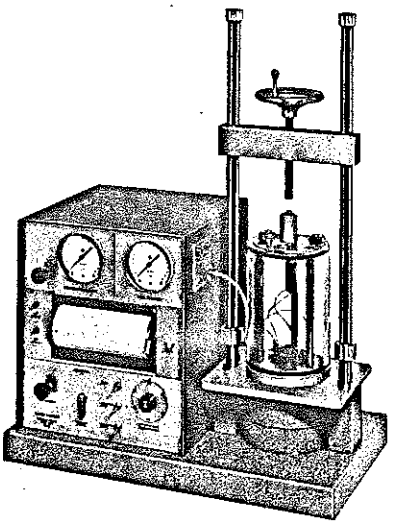
DAMES & MOORE

PLATE A-0

METHODS OF PERFORMING UNCONFINED COMPRESSION AND TRIAXIAL COMPRESSION TESTS

THE SHEARING STRENGTHS OF SOILS ARE DETERMINED FROM THE RESULTS OF UNCONFINED COMPRESSION AND TRIAXIAL COMPRESSION TESTS. IN TRIAXIAL COMPRESSION TESTS THE TEST METHOD AND THE MAGNITUDE OF THE CONFINING PRESSURE ARE CHOSEN TO SIMULATE ANTICIPATED FIELD CONDITIONS.

UNCONFINED COMPRESSION AND TRIAXIAL COMPRESSION TESTS ARE PERFORMED ON UNDISTURBED OR REMOLDED SAMPLES OF SOIL APPROXIMATELY SIX INCHES IN LENGTH AND TWO AND ONE-HALF INCHES IN DIAMETER. THE TESTS ARE RUN EITHER STRAIN-CONTROLLED OR STRESS-CONTROLLED. IN A STRAIN-CONTROLLED TEST THE SAMPLE IS SUBJECTED TO A CONSTANT RATE OF DEFLECTION AND THE RESULTING STRESSES ARE RECORDED. IN A STRESS-CONTROLLED TEST THE SAMPLE IS SUBJECTED TO EQUAL INCREMENTS OF LOAD WITH EACH INCREMENT BEING MAINTAINED UNTIL AN EQUILIBRIUM CONDITION WITH RESPECT TO STRAIN IS ACHIEVED.



TRIAXIAL COMPRESSION TEST UNIT

YIELD, PEAK, OR ULTIMATE STRESSES ARE DETERMINED FROM THE STRESS-STRAIN PLOT FOR EACH SAMPLE AND THE PRINCIPAL STRESSES ARE EVALUATED. THE PRINCIPAL STRESSES ARE PLOTTED ON A MOHR'S CIRCLE DIAGRAM TO DETERMINE THE SHEARING STRENGTH OF THE SOIL TYPE BEING TESTED.

UNCONFINED COMPRESSION TESTS CAN BE PERFORMED ONLY ON SAMPLES WITH SUFFICIENT COHESION SO THAT THE SOIL WILL STAND AS AN UNSUPPORTED CYLINDER. THESE TESTS MAY BE RUN AT NATURAL MOISTURE CONTENT OR ON ARTIFICIALLY SATURATED SOILS.

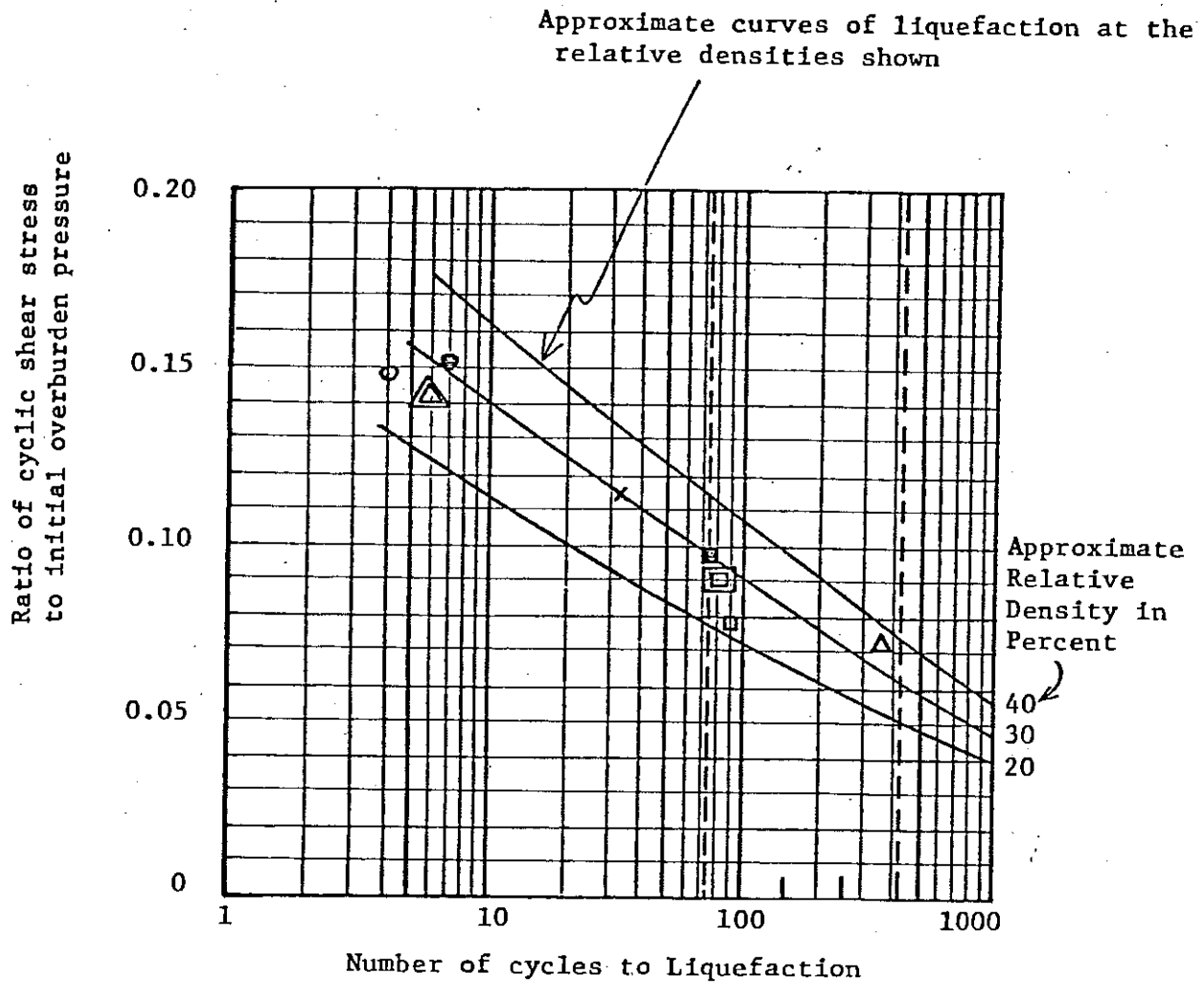
IN A TRIAXIAL COMPRESSION TEST THE SAMPLE IS ENCASED IN A RUBBER MEMBRANE, PLACED IN A TEST CHAMBER, AND SUBJECTED TO A CONFINING PRESSURE THROUGHOUT THE DURATION OF THE TEST. NORMALLY, THIS CONFINING PRESSURE IS MAINTAINED AT A CONSTANT LEVEL, ALTHOUGH FOR SPECIAL TESTS IT MAY BE VARIED IN RELATION TO THE MEASURED STRESSES. TRIAXIAL COMPRESSION TESTS MAY BE RUN ON SOILS AT FIELD MOISTURE CONTENT OR ON ARTIFICIALLY SATURATED SAMPLES. THE TESTS ARE PERFORMED IN ONE OF THE FOLLOWING WAYS:

UNCONSOLIDATED-UNDRAINED: THE CONFINING PRESSURE IS IMPOSED ON THE SAMPLE AT THE START OF THE TEST. NO DRAINAGE IS PERMITTED AND THE STRESSES WHICH ARE MEASURED REPRESENT THE SUM OF THE INTERGRANULAR STRESSES AND PORE WATER PRESSURES.

CONSOLIDATED-UNDRAINED: THE SAMPLE IS ALLOWED TO CONSOLIDATE FULLY UNDER THE APPLIED CONFINING PRESSURE PRIOR TO THE START OF THE TEST. THE VOLUME CHANGE IS DETERMINED BY MEASURING THE WATER AND/OR AIR EXPELLED DURING CONSOLIDATION. NO DRAINAGE IS PERMITTED DURING THE TEST AND THE STRESSES WHICH ARE MEASURED ARE THE SAME AS FOR THE UNCONSOLIDATED-UNDRAINED TEST.

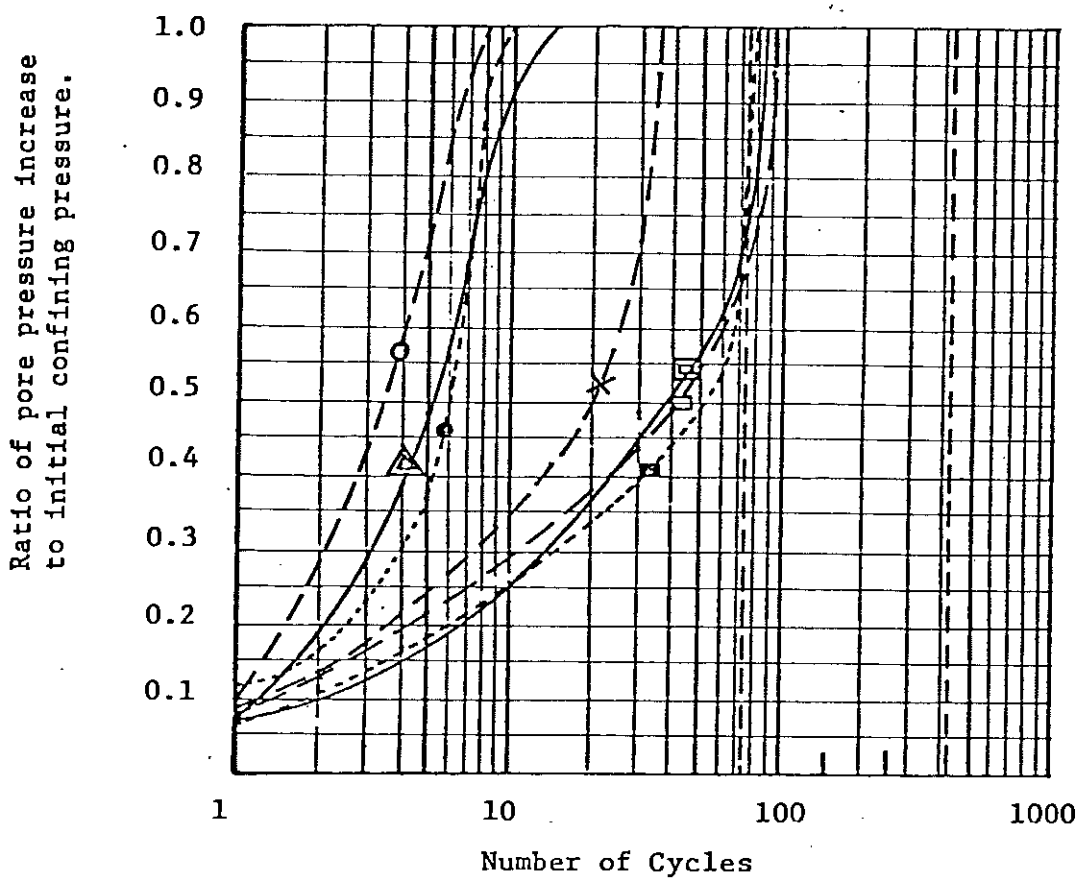
DRAINED: THE INTERGRANULAR STRESSES IN A SAMPLE MAY BE MEASURED BY PERFORMING A DRAINED, OR SLOW, TEST. IN THIS TEST THE SAMPLE IS FULLY SATURATED AND CONSOLIDATED PRIOR TO THE START OF THE TEST. DURING THE TEST, DRAINAGE IS PERMITTED AND THE TEST IS PERFORMED AT A SLOW ENOUGH RATE TO PREVENT THE BUILDUP OF PORE WATER PRESSURES. THE RESULTING STRESSES WHICH ARE MEASURED REPRESENT ONLY THE INTERGRANULAR STRESSES. THESE TESTS ARE USUALLY PERFORMED ON SAMPLES OF GENERALLY NON-COHESIVE SOILS, ALTHOUGH THE TEST PROCEDURE IS APPLICABLE TO COHESIVE SOILS IF A SUFFICIENTLY SLOW TEST RATE IS USED.

AN ALTERNATE MEANS OF OBTAINING THE DATA RESULTING FROM THE DRAINED TEST IS TO PERFORM AN UNDRAINED TEST IN WHICH SPECIAL EQUIPMENT IS USED TO MEASURE THE PORE WATER PRESSURES. THE DIFFERENCES BETWEEN THE TOTAL STRESSES AND THE PORE WATER PRESSURES MEASURED ARE THE INTERGRANULAR STRESSES.



	Dry Density (pcf)	Relative Density	Soil Description	Soil Source
△	77.0	27	Tailings Slimes	Star Pond No. 2
⊡	75.1	23	Tailings Slimes	Star Pond No. 2
●	93.7	28	Tailings Sands	Lucky Friday Pond No.1
■	91.6	22	Tailings Sands	Lucky Friday Pond No.1
○	81.8	27	Tailings Slimes	Lucky Friday Pond No.1
×	83.0	30	Tailings Slimes	Lucky Friday Pond No.1
□	80.2	23	Tailings Slimes	Lucky Friday Pond No.1
△	86.6	39	Tailings Slimes	Lucky Friday Pond No.1

CYCLIC TRIAXIAL TEST RESULTS



	Stress Ratio	Dry Density (pcf)	Relative Density	Soil Description	Soil Source
△	0.141	77.0	27	Tailings Slimes	Star Pond No. 2
▣	0.091	75.1	23	Tailings Slimes	Star Pond No. 2
●	0.151	93.7	28	Tailings Sands	Lucky Friday Pond No.1
■	0.098	91.6	22	Tailings Sands	Lucky Friday Pond No.1
○	0.148	81.8	27	Tailings Slimes	Lucky Friday Pond No.1
×	0.115	83.0	30	Tailings Slimes	Lucky Friday Pond No.1
□	0.078	80.2	23	Tailings Slimes	Lucky Friday Pond No.1

CYCLIC TRIAXIAL TEST PORE PRESSURE DATA

Appendix D

Geotechnical Stability Analysis – 30% Design Submittal Memorandum

CDM Smith

Memorandum

To: *Mr. Ryan Osterman, CDM Smith Project Engineer*
Mr. Cody Lechleitner, P.E. – CDM Smith Project Manager

From: *Mr. Mike Lach, P.E. (WA) – CDM Smith Project Geotechnical Engineer*
Mr. Joe Souther, P.E. – CDM Smith Senior Geotechnical Engineer

Date: *February 1, 2013*

Subject: *Revised Geotechnical Stability Analysis – 30% Design Submittal*
Lower Burke Canyon Repository (LBCR)
Wallace, Idaho

The purpose of this memorandum is to summarize our stability analyses of the proposed consolidation area known as the Lower Burke Canyon Repository (LBCR). Our understanding of the proposed design is based on internal team meetings and initial configuration of the LBCR (e.g., CAD 3D modeled cross-sections). The project consists of constructing a new mine waste repository on an existing mine tailings impoundment within the Canyon Creek valley.

Geotechnical Conditions

The proposed LBCR site sits atop the inactive portion of the historical tailings impoundment facility known as the Hecla-Star Tailings Ponds, collectively known as the Star Tailings Impoundment (STI). The Hecla-Star Tailings Ponds were constructed and filled with tailings from the Star Mine beginning in 1965. The proposed LBCR will be constructed on top of four inactive ponds which lie north of Grays Bridge Road. The closed tailings ponds, Ponds No. 1 through No. 4, and surrounding area that will be used for repository construction encompass approximately 30 acres (TerraGraphics, 2012).

Exploration History

The site has been an active tailings repository since 1965. In preparing this report, we reviewed and utilized the following data sources:

- From 1977 through 1979, Dames & Moore conducted a series of geotechnical investigations and provided recommendations for expansion of the STI. These investigations included borings and laboratory testing to characterize the strength and deformation properties of the perimeter dams and the impounded tailings at the site (D&M 1979, D&M 1980).

- TerraGraphics Environmental Engineering, Inc. completed two geotechnical investigations at the LBCR site to gather data necessary for repository design (TerraGraphics 2012, Appendix H). The 2010 and 2011 investigations collected soil testing data from the underlying alluvium, impounded tailings, and tailings impoundment berm to assess existing geotechnical soil properties.
- Under CDM Smith's direction, Maul, Foster and Alongi (MFA) conducted an additional investigation in 2012 to supplement the previously collected data (MFA 2012).

Data Review

In developing the subsurface profiles used in our analyses, we generally referred to cross-sections provided in the D&M (1980) report, which was developed to evaluate additional dike extensions to the impoundment facilities. We then used the data collected by TerraGraphics and MFA to confirm that the current condition of the ponds matched the previously collected data.

The first full cross-section that we evaluated was from Section H-H' to I-I' (see Attachment 1 for Plate 1 showing the section location and Plates 11 and 12 showing the subsurface profile). This section, a portion of Pond 3, contains the steepest exposed perimeter; therefore, we consider it to be a critical section for analysis. Recent LiDAR and surveyed elevation data[1] matches closely with the elevations presented on this cross-section, indicating that no additional filling has been completed in this area. However, the elevation of the base of the starter dam at Section H-H' does not appear to be correct on the cross section. A boring completed by D&M near Section H-H' encountered "river gravel" at a depth of 21 feet, or approximate elevation 3020 (see Attachment 1 for "Log of Boring – Pond 3"). This matches well with the underlying elevation contours presented on Plate 1 as well as the toe elevation seen on our topographic site plan. In addition, cone penetrometer test (CPT) soundings CPT-5, CPT-6, and CPT-7 were completed on Pond 3 (TerraGraphics, 2011) and confirm the stratigraphy shown in the Section. For example, sounding CPT-6 (see Attachment 2 for the log of this sounding), completed in the middle of Pond 3, indicated that there was approximately 25 feet of soft material, likely tailings, before reaching an extremely dense layer that the CPT device was unable to penetrate. This confirms the depth of tailings at the center of the pond between Sections H-H' and I-I'.

The second full cross-section that we evaluated was from Section K-K' to N-N' (See Attachment 1 for Plates 14 and 17 showing the subsurface profile). The 1980 D&M Report concluded that additional material should not be consolidated on Star Tailings Pond 4, located at the northern portion of the facility, because of long-term stability concerns. Regarding Pond 4, the 1980 Report states:

> *There are numerous signs of stress in the northwest embankment. From borings drilled on the northwest side of the pond, it is evident that the 1977 dike extension was actively slumping*

[1] The elevation datum for the 30% Design Drawings is the North American Vertical Datum of 1988 (NAVD88). Documents produced prior to 1988 are most likely referenced to the National Geodetic Vertical Datum of 1929 (NGVD29). At the LBCR site, NAVD88 = NGVD29 + 3.8 feet.

> *into the soft tailings deposit as it was being built. Tension cracks along the embankment crest verify some slumping continued after construction was completed. Older cracks and crest depressions have been infilled with mine waste. Existing tension cracks, of widths between 6 to 18 inches, extend to depths greater than 9 inches….Pond 4 has been abandoned with no intension of future embankment raises. (D&M 1980, pgs. 13-14)*
>
> *We do not recommend future raising of Pond 4. (D&M 1980, pg. 27)*

Constructing additional tailings storage on top of the existing pond as proposed in 1980 would have involved placing more saturated tailings on the pile and thus saturating portions of the existing perimeter dams in the process, likely resulting in an unacceptable factor of safety and leading to D&M's recommendation not to raise Pond 4. By contrast, our current design will include surface runoff and infiltration controls to minimize saturation of the perimeter dam, and therefore our factor of safety is higher than it would be for expanding the tailings storage capacity as proposed in 1980. In addition, building additional tailings capacity would have required a larger perimeter dam on top of the existing perimeter dam, increasing the weight on the crest of the existing dam significantly – our design will include a setback and waste slopes going up at a 3H:1V slope, producing a much lower load on the existing perimeter dam. Due to these significant differences, we felt that using Pond 4 for additional repository area was feasible, and we analyzed the stability of this section, as described later in this memorandum.

Recent LiDAR and surveyed elevation data matches closely with the elevations presented on this cross-section, indicating that no additional filling has been completed in this area. Boring B-102 and test pit TP-08 (MFA, 2012) were completed in the vicinity of Section N-N' to confirm the stratigraphy and composition of the perimeter dams in this location. The logs of these explorations confirm the stratigraphy presented on the Section (see Attachment 3 for these logs).

In addition, the current ground surface elevation on top of Pond 2 does not match the historic elevations provided in the D&M (1980) report, indicating that as much as 12 to 14 feet of new material had been placed on that repository. Based on historic documentation (EPA 1995, Section 5.4), it appears that this material may be mine waste material that was consolidated in this area during the 1995-1996 Canyon Creek response action. CPT soundings CPT-1 through -4 and borings BH-1 and BH-2 (TerraGraphics, 2011) were completed on Pond 2. However, a majority of these explorations were conducted on the perimeter dams, and only CPT-3 and BH-2 (see Attachment 2 for these logs) were completed in locations that could provide information on the composition of the additional material. Boring BH-2 encountered this material, and the boring log indicates that it consists of sand with gravel, silt, clay, and cobbles. However, laboratory grain size testing was only completed on a sample obtained in conjunction with the standard penetration test (SPT), and likely underrepresented the coarser (i.e., larger than about 3/4-inch) fraction of the material. No information on the upper 14 feet of sounding CPT-3 was provided; it is likely that the material was too coarse to push a CPT through, which provides circumstantial evidence that the material consists of coarse mine wastes.

Borings B-101 and B-103 (MFA, 2012) were completed on Pond 2 to confirm the presence and further classify the fill added to the impoundment in the 1990's (see Attachment 3 for these logs). Grain size testing conducted on sample B-103-20120912-SB-4.0 indicated that the soil was a silty gravel with sand (see Attachment 3 for the laboratory data), confirming that the material is likely a mixture of coarse mine waste material, tailings, and Canyon Creek alluvium.

Subsurface Data

Based on the data review described above, we divided the subsurface materials into three distinct strata for the purposes of analysis: Impoundment Materials, Alluvium, and Bedrock. In addition to the existing subsurface materials, mine wastes will be brought in from other nearby abandoned mining sites as a part of the consolidation activity. The strata are described in the following sections.

Impoundment Materials

The STI generally consists of a perimeter dam predominantly composed of silty to clayey gravel with sand that is most likely derived from the local alluvium. The visible faces of the perimeter dams are generally standing at slopes ranging from 1.1H:1V to 1.5H:1V. Within the perimeter dam, the impoundment consists of mill tailings. The tailings generally consist of silty sand to sandy silt that were placed in the wet and are normally to slightly underconsolidated. Pond 2 also includes a 12- to 14-foot cap of consolidated mine wastes.

Alluvium

Alluvium associated with nearby Canyon Creek underlies the entire STI. The alluvium is generally very dense and consists of slightly silty to silty gravel with sand, cobbles, and boulders. In addition, the upper few feet of this stratum may contain intermixed tailings that were disposed of in Canyon Creek during the early mining history of the valley. The thickness of this layer is on the order of 20 to 40 feet beneath the STI (CH2M Hill, 2007 and 2012; see attachment 1 for Figures 3 and 3-6 of the 2007 and 2012 reports, respectively).

Bedrock

This alluvium sits on top of a bedrock layer consisting of sedimentary rocks assigned to the Precambrian Belt Supergroup, which are the dominant rocks in the Canyon Creek watershed. Two formations within the Precambrian-age Belt Supergroup that predominate are the Prichard and, to a lesser degree, the Burke Formation of the Ravalli Group. The Prichard consists of argillite, quartz-rich argillite, and quartzite, and the Burke Formation consists of impure to less pure quartzite (CH2M Hill, 2007).

Mine Waste

Currently, only some of the wastes that will be impounded in the LBCR have been identified. We have assumed that the wastes that will be placed in the LBCR will be similar to wastes placed in other repositories in the Coeur d'Alene valley.

Groundwater

Groundwater at the site is tied to the level of the nearby Canyon Creek. In general, groundwater occurs within a few feet of the native ground surface, and flows down-gradient in a southwesterly direction (CH2M Hill, 2007).

Seismic Setting

The LBCR site is located near the western terminus of the Lewis and Clark line, a prominent zone of strike-slip, dip-slip, and oblique-slip faults which extends approximately 250 miles across western Montana and northern Idaho. The Lewis and Clark line generally consists of a series of southeast-northwest trending strike-slip (left-right) faults, and evidence suggests that offsets of up to 17.4 miles have occurred along these faults (Wallace et al., 1990). In addition, a series of north-south trending faults associated with this lateral movement are mapped in the area. In general, these faults are mapped as normal (up-down) faults (Gott and Cathrall, 1979).

The U.S. Geological Survey (USGS) maintains a database of active faults within the U.S. For the purposes of the database, active faults are defined as faults and associated folds that are believed to be sources of earthquakes greater than Magnitude 6 during the Quaternary Period (the past 1,600,000 years). A search of this database revealed that the nearest active fault to the site is the Thompson Valley Fault, approximately 46 miles to the east-northeast (USGS, 2008b). Although there are no known active faults in the immediate vicinity of the site, historical records indicate that an earthquake between Magnitudes 5.0 and 5.4 occurred in the Wallace area in 1957 (Idaho Geological Survey, 2012).

The Osburn Fault traverses the area in a general east-west trend, and passes within about one-half mile to the south of the LBCR site. An unnamed secondary fault parallel to and associated with the Osburn Fault passes near the southern boundary of the site, and may lie beneath the repository (Gott and Cathrall, 1979). The Osburn Fault is mapped as a strike-slip fault, while the unnamed fault is mapped as a normal fault. There is evidence to suggest that the most recent movement on the Osburn Fault occurred between 81 and 100 million years ago (Wallace et al., 1990). In addition, since these faults do not appear in the USGS database, it can be assumed that no significant movement has occurred on these faults in the last 1,600,000 years.

Design peak ground acceleration (PGA) was determined based on data from the U.S. Geological Survey (USGS, 2008a). Based on data presented by USGS, the site may experience a PGA equal to 17 percent (%) of the acceleration due to gravity (0.17g), with a 10% probability of exceedance in 250 years. In accordance with 40 CFR 258, the site is located in a seismic impact zone since the 10% in 250 years PGA exceeds 0.1g, and the design documents must demonstrate that the LBCR will remain intact under the anticipated seismic load.

Slope Stability Analysis

This section describes the slope stability analyses conducted for the LBCR and presents information regarding the design criteria (e.g., slope stability factor of safety), soil and material properties utilized in the analyses, and selected LBCR cross-sections and cases (e.g., past, current, and future LBCR configurations)

Stability Design Criteria

The LBCR is designed to meet certain stability design criteria. The minimum factors of safety (FS) for design are adapted from U.S. Army Corps of Engineers criteria for earth and rock-fill dams (USACE, 2003). For static, seismic, and rapid drawdown conditions, the minimum FS are 1.5, 1.1, and 1.3, respectively.

The stability analyses were performed using a Morgenstern-Price limit-equilibrium calculation using the computer program SLOPE/W (GEO-SLOPE, 2007). SLOPE/W performs a search routine to find the most critical circular slip surface; we specified entry and exit ranges to allow the most flexibility for the search routine to find a critical slip surface. In addition, we used an optimization routine provided with SLOPE/W. In the optimization routine, the critical slip surface is altered incrementally and a new FS is computed and compared to the previously computed FS, which enables non-circular slip surfaces to be included and generally converges on the most critical slip surface.

As described in the previous section, the design PGA for the site is equal to 0.17g. For seismic slope stability, a pseudostatic force is added to the static analysis. The pseudo-static force is obtained from a seismic coefficient (K_h), generally 1/2 to 2/3 of the PGA. For the analysis, we conservatively assumed K_h = (2/3 x 0.17), or 0.11.

Soil Properties

We have selected the following soil properties for use in the evaluation based on the index properties of the soils, strength test data, and our experience in the local area. The validity of the selected properties was demonstrated by modeling the deposition process of the tailings, as described later in this memorandum. The selected parameters are summarized in Table 1 and described in more detail in subsequent sections.

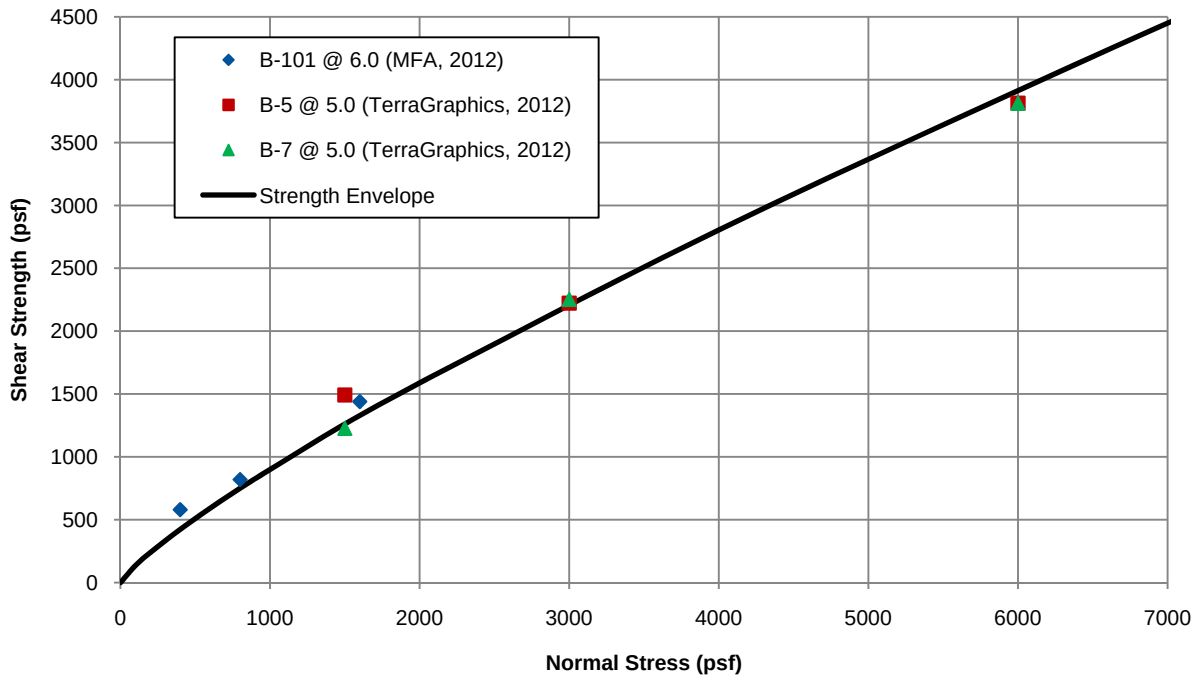
Table 1: Material Properties for Slope Stability Analyses

Material Type	Total Unit Weight, γ_t (pcf)	Cohesion, c' (psf)	Effective Friction Angle, Φ' (°)
Perimeter Dams	125	Strength Envelope – See Text	
Sloughed Perimeter Dams	120	0	30
Tailings Sands	110	0	31
Talings Silts	110	0	14
Native Alluvium	125	0	34.5
Mine Wastes	125	0	31

Notes:
pcf – pounds per cubic foot
psf – pounds per square foot

Perimeter Dams
As noted previously, the perimeter dams were likely constructed from alluvial borrow material and consist predominantly of silty to clayey gravel with sand. Index testing completed during the 2012 investigation indicated that the perimeter dam material contained between 22 and 33% fines (i.e., material passing the #200 sieve). Samples B101-20120913-SB-3.5 and TP-02-20120907-SB-4.0 show typical grain size distributions for this material (see Attachment 3 for the laboratory data). Additionally, Atterberg limits testing of the of the perimeter dam material indicated that the fines generally consist of lean clay and silty clay (USCS symbols CL and CL-ML). During the 2012 investigation, a sample of the perimeter dam material was obtained with a modified California sampler (sample number B101-20120913-SB-6.0). Although this sampling method results in a somewhat disturbed sample, it generally results in the highest quality sample that can be expected in a coarse material. A direct shear test series was conducted on this sample, indicating that the cohesion and friction angle of the material were 270 psf and 36 degrees, respectively (see Attachment 3 for the laboratory data). Previously, TerraGraphics (2012) completed two direct shear test series on remolded embankment samples at higher normal loads; the results of these tests showed a higher cohesion and lower friction angle. In order to incorporate the change in strength with increasing normal load, we plotted all of the test data on a single graph and found a best fit power equation for the lower bound values using the built-in regression tools in Microsoft Excel. Figure 1 shows the test data and the strength envelope used in the SLOPE/W model.

Figure 1: Strength Envelope for Perimeter Dams



Sloughed Perimeter Dams

During the initial filling of Pond 4, the interior face of the west perimeter dam failed and sloughed into the tailings (Dames & Moore, 1980). We assume that the material in these sloughed zones consists of a mixture of perimeter dam material and tailings. We conservatively biased the strength parameters of this material towards that of the tailings, and assigned a cohesion and friction angle of 0 and 30 degrees, respectively.

Tailings

The tailings consist of fine sands and silts, with the strength generally being higher in the sand. Saturated tailings silts (often referred to as tailings slimes) are generally the weakest soils in an impoundment, and were found in several borings throughout the exploration history of the site. The location of saturated silts cannot be correlated between any two borings, indicating that the silts likely occur in discontinuous pockets or layers throughout the impoundment. However, it appears that the saturated silts predominantly occur in the lower half of the existing impoundment.

Historical direct shear and triaxial shear testing on the tailings material (Dames & Moore, 1980 and TerraGraphics, 2011) indicates that the friction angle of the tailings lies between 28 and 31.5 degrees (see Attachments 1 and 2 for the laboratory data), with the higher values corresponding to sandier samples. During the 2012 investigation, a direct shear test series was conducted on an undisturbed sample of the tailings material to confirm the earlier data. This test series indicated that the cohesion and friction angle of the sample were 60 psf and 33 degrees, respectively (see

Attachment 3 for the laboratory data). Although the current test result indicates that the tailings may have gained strength due to 30 years of consolidation, we conservatively biased our selection of material properties for the tailings sands towards the older data, and selected a friction angle of 31 degrees with no cohesion, similar to the properties previously assumed (TerraGraphics 2012, Table 1; see Attachment 2).

SPT blow counts in the tailings silts were as low as zero (i.e. the sampler fell 18 inches under the weight of the drilling rods with no impact from the hammer) with the low blow counts generally occurring near the base of the tailings. CPT soundings indicated a general trend of the tailings becoming weaker with depth. Using the method of Robertson and Campanella (1983, as presented in FHWA, 2002), we correlated CPT tip resistance with friction angles. Although the correlated friction angles were as low as 5 degrees, these extremely low values were very rare, and the friction angle of the tailings were generally higher than about 14 degrees. Therefore, we conservatively selected 14 degrees as the friction angle for the tailings silts.

Figure 2 shows a compilation of all of the CPT data along with the selected friction angle for the tailings sands and silts.

Native Alluvium

During the 2011 investigation, direct shear testing was conducted on remolded alluvium samples over a reasonably wide range of densities. This testing was presented with two interpretations:

1. The friction angle of the material (with zero cohesion) ranged from about 33 to 36 degrees.

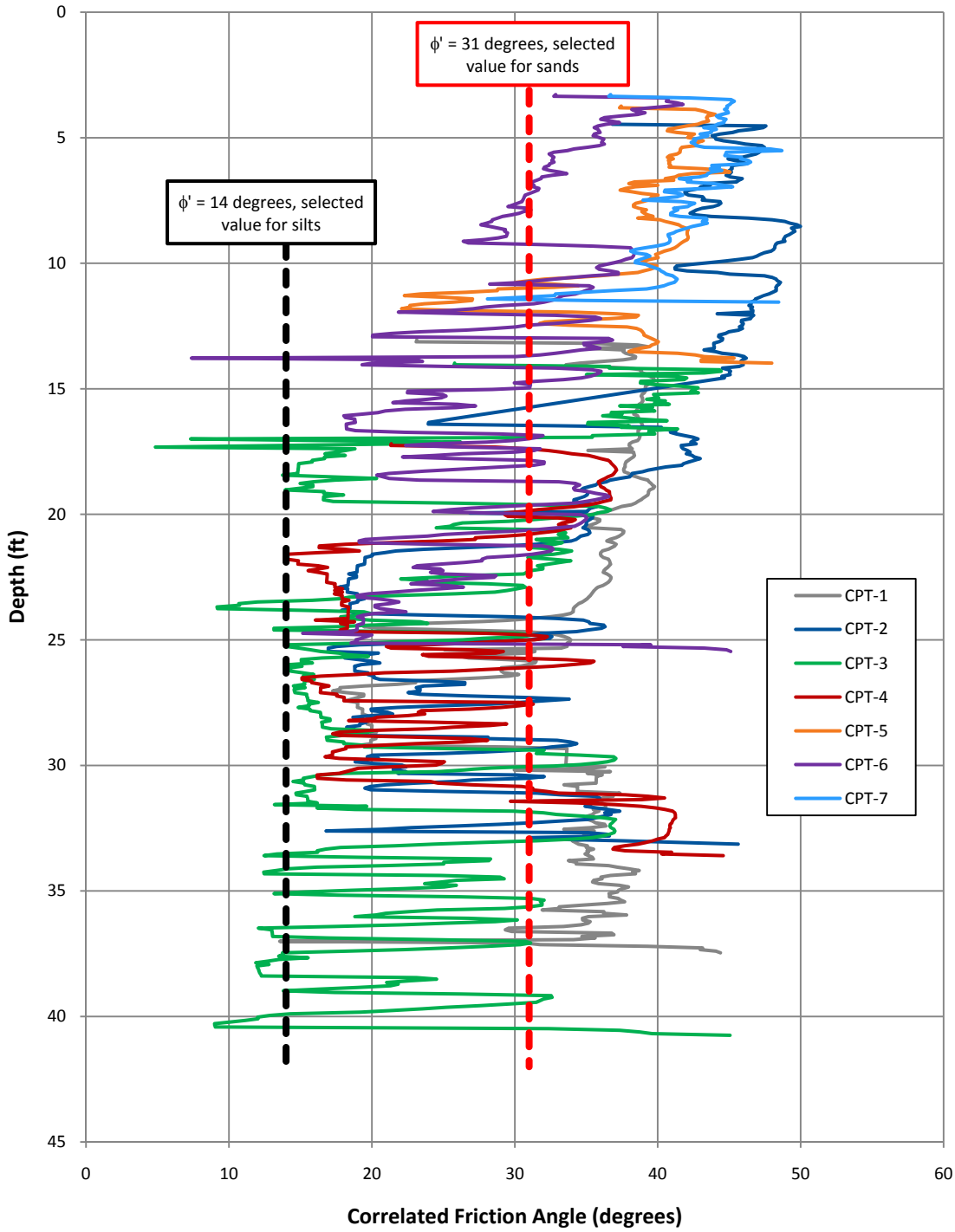
2. The friction angle of the material ranged from about 31 to 32 degrees with cohesion values ranging from 220 to 410 pounds per square foot (psf).

The previously assumed approach conservatively selected a friction value based on Interpretation 2; however, a cohesion of zero was also selected which is overly conservative (Terragraphics 2012, Table 1; see Attachment 2). SPT blow counts are very high in this material (50 blows for less than 6 inches of penetration), indicating that the in-situ density is likely towards the higher end of the tested range; however, we selected a median friction angle of 34.5 degrees with no cohesion (based on interpretation 1) to represent this material.

Mine Wastes

Currently, only some of the wastes that will be impounded in the LBCR have been identified, and will likely consist of a mix of coarse mine wastes, tailings, and soils from the Basin Property Remediation Program (BPRP) and Institutional Controls Program (ICP). We have assumed that the wastes that will be placed in the LBCR will be similar to wastes placed in other repositories in the Coeur d'Alene valley. The East Mission Flats Repository was designed assuming a friction angle of 31 degrees for the waste material (TerraGraphics, 2009). The East Mission Flats Repository was designed to primarily hold ICP wastes, while the LBCR will contain a much higher percentage of

Figure 2: CPT Data for Tailings Strength Parameter Selection



coarse mine wastes, which will exhibit higher frictional strength. Therefore, the selection of a friction angle of 31 degrees is conservative, and was used in our analysis.

Selected Cross Sections and Cases

For the purposes of the 30% LBCR design, two critical cross sections were selected for analysis: (1) a portion of Pond 3 containing perimeter dams with exterior slope angles as steep as 1.1H:1V, the steepest slopes at the STI and (2) the portion of Pond 4 which experienced slope failure during the filling of the impoundment. The configuration of the consolidated waste material was based on conceptual drawings which included a setback of 10 feet from the crest of the existing Perimeter Dams and a final slope angle of 3H:1V with a single intermediate bench. For each of the two selected cross sections, we evaluated the following cases:

- Case 1, Past Tailings Deposition: In order to verify the selection of soil properties, we evaluated the condition of the impoundment immediately after the placement of tailings. For this case, we assumed the tailings were 100% saturated throughout the entire profile.
- Case 2, Current Conditions: This case is the same as Case 1, except it assumes that the tailings are no longer saturated. Groundwater for this case is assumed to be at the average water elevation of Canyon Creek.
- Case 3, Final: In this case, the LBCR is completed with all additional wastes being placed and the groundwater remaining at the average water elevation of Canyon Creek.
- Case 4, Rapid Drawdown: In this case, the LBCR is completed with all additional wastes being placed. Groundwater for this case is assumed to be at the 100-year flood elevation, with no surcharge due to water in the creek bed, simulating the case that the floodwaters rapidly recede, leaving the bed saturated up to the flood elevation. It should be noted that in some areas, the bottom of the drainage ditch between the STI and Highway 4 is beneath the flood elevation and would also be saturated under these conditions.
- Cases 5 and 6, Final (regraded): In order to promote vegetative growth and reduce erosion of the existing STI slopes, it has been proposed that some of the slopes be regraded to flatter slope angles. In order to quantify the effect of this regrading, Cases 5 and 6 involve regrading the side slopes to 1.5H:1V and 2H:1V, respectively. On the Canyon Creek side of the STI, there is generally little to no room to extend the toe of the slopes without encroaching on the 100-year floodplain; therefore, it was assumed that the slope would be cut back from the toe with no fill. On the Highway 4 side of the STI, there is room to extend the toe; therefore it was assumed that any regrading would occur using a cut and fill balance approach (i.e. the volume of material cut at the top of the slope would be used to fill at the toe, creating a constant, flatter slope). Groundwater conditions for these cases are the same as for Case 3.

Analysis Results

The computed FS are presented in Table 2. It should be noted that these FS represent global stability, and do not consider minor surface sloughing or performance of any cover system added to the repository.

Table 2: Slope Stability Analysis Results

Case	Target FS	Computed FS	
		Pond 3	Pond 4
Case 1	N/A	1.03	0.98
Case 2	N/A	1.52	1.50
Case 3 (Static)	1.5	1.52	1.50
Case 3 (Seismic)	1.1	1.13	1.10
Case 4	1.3	1.37	1.40
Case 5 (Static)	1.5	1.54	1.50
Case 5 (Seismic)	1.1	1.12	1.11
Case 6 (Static)	1.5	1.51	1.62
Case 6 (Seismic)	1.1	1.04	1.20

The computed FS for Ponds 3 and 4, Case 1 are 1.03 and 0.98, respectively. During construction of the tailings impoundment, the interior of the Pond 4 perimeter dam failed and sloughed into the tailings. This is a good indication that the dams were constructed at or near their angle of repose, and that during construction, the impoundment may have been very near failure. The results of the analysis also indicate that the impoundment was near failure during construction. This gives us high confidence in our selected material properties.

The remainder of the results indicates that target FS will generally be met provided that some minimum setback is provided between the crest of the existing impoundment and the toe of the new wastes. A more detailed analysis of the selected configuration will be completed as a part of the intermediate design. In addition, as the design develops, special attention will be paid to locations where regrading the slopes to 2H:1V is not feasible, such as areas where doing so would place the toe of the repository within the Canyon Creek 100-year floodplain.

Construction Recommendations

The analyses presented above are based on the assumption that construction will be completed by a competent contractor utilizing typical construction practices such as compaction of mine waste.

Specifically, we recommend that the technical specifications for the LBCR construction include the recommendations of this section, at a minimum.

Prior to constructing the repository, the subgrade should be stripped and grubbed, and all topsoil removed. The subgrade should be proof-rolled prior to the placement of any wastes, and any soft or unstable subgrade soils should be removed to a maximum of three (3) feet below grade and replaced with compacted fill material.

Mine wastes placed at the LBCR should be compacted as they are placed. It is likely that the wastes will contain a large percentage of coarse material, which does not lend itself to insitu density testing, such as with a Troxler nuclear density gauge. The specifications should therefore be directive in nature, specifying a compactor type and number of passes rather than a target density. This will be addressed as a part of the intermediate design.

Although target FS for global stability will generally be met, the currently exposed slopes of the perimeter dams show signs of gully erosion and will not establish vegetation. In order to minimize the potential for erosion and future destabilization of the slope, we recommend that the slopes be regraded to slopes of 2H:1V or shallower wherever practicable and seeded with a hearty mix of native vegetation. Where possible, this regrading should include cut near the top of the slope and fill near the toe to avoid further destabilization of the slope as shown in Case 6 for Pond 3. In addition, surface water controls, such as lined perimeter ditches, should be included in the design to prevent surface water infiltration into the perimeter dam material or large amounts of surface runoff flowing over the face of the perimeter dams. As grading plans are developed as a part of the intermediate design, we will conduct further stability analyses for these slopes as they are designed.

At this time, we have not completed any analysis regarding the placement sequence of the wastes. Temporary covers are not anticipated to be used during construction of the LBCR; therefore, stormwater will infiltrate through the wastes and into the existing STI prior to placement of the final cover system. Preliminary evaluations indicate that the volume of water will not be sufficient to saturate the STI; however, a more detailed evaluation of this infiltration and its impact on the slope stability will be conducted as a part of the intermediate design. Additionally, consideration will be given to blending waste types prior to placement in the LBCR as waste sources are identified. A more detailed analysis and recommendations for construction sequencing and waste placement will be completed as a part of the intermediate design.

Conclusions

Based on the geotechnical data collected and the slope stability analyses conducted, the computed FS generally meet the target FS for the critical sections of the LBCR. Therefore, it is our opinion that the design can proceed based on the currently anticipated slope geometry. Long-term consolidation of the underlying tailings may result in significant surface settlement on the order of several inches to a foot. The design of cover systems and ditch linings will need to consider this potential for future

settlement. Additional LBCR settlement analyses will be completed as a part of the intermediate design.

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cc: Todd Bragdon

Attachments:

Attachment 1 – Select Historic LBCR Data, Borings Logs, and Information (D&M 1980, CH2M Hill 2007 and 2012)

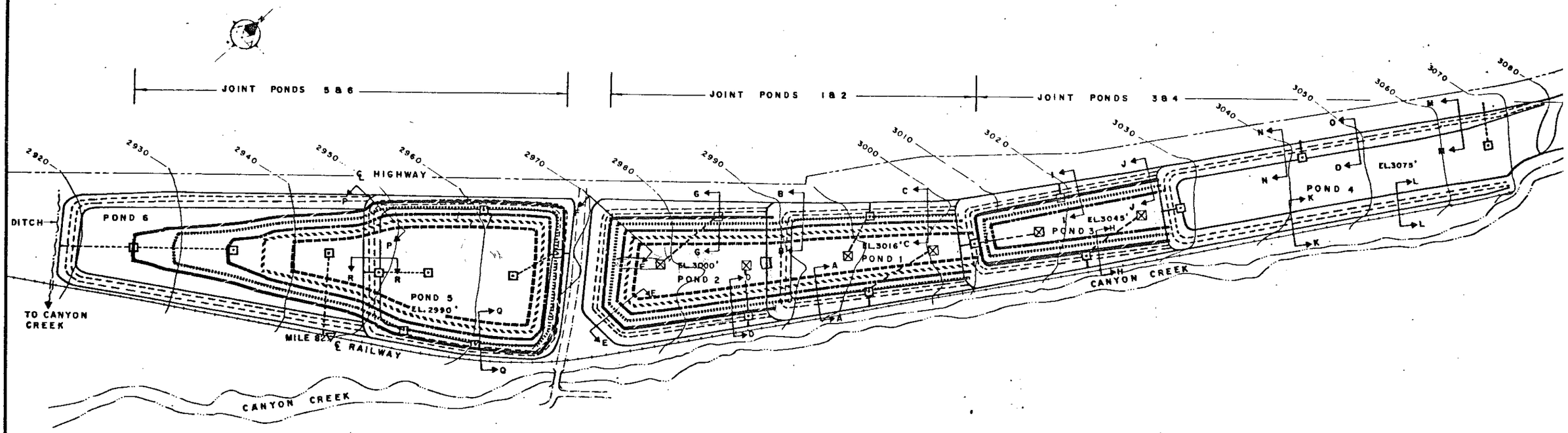
Attachment 2 – Select Geotechnical Data and Boring Logs from 2011 Geotechnical Investigations

Attachment 3 – Select Geotechnical Data and Boring Logs from 2012 Geotechnical Investigation

Attachment 4 - SLOPE/W Output

Attachment 1 – Select Historic LBCR Data, Borings Logs, and Information (D&M 1980, CH2M Hill 2007 and 2012)

- Plate 1: Site Plan – Layout of Tailings Impoundment Facility (D&M, 1980)
- Plate 11: Dike Profile – Pond 3 (Section H-H) (D&M, 1980)
- Plate 12: Dike Profile – Pond 3 (Section I-I) (D&M, 1980)
- Log of Boring – Pond 3 (D&M, 1980)
- Plate 14: Dike Profile – Pond 4 (Section K-K) (D&M, 1980)
- Plate 17: Dike Profile – Pond 4 (Section N-N) (D&M, 1980)
- Direct Shear Test Results (D&M, 1980)
- Figure 3: Saturated Alluvial Thickness (CH2M Hill, 2007)
- Figure 3-6: Cross Section – Woodland Park (CH2M Hill, 2012)



LEGEND:

PROPOSED 1ST. EXTENSION CREST (JOINT POND 1&2, ELEV. 3010 FT.
(JOINT POND 3&4, ELEV. 3055 FT.
(JOINT POND 5&6, ELEV. 2990 FT.

PROPOSED 2ND. EXTENSION CREST (JOINT POND 1&2, ELEV. 3020 FT.
(JOINT POND 3&4, ELEV. 3065 FT.
(JOINT POND 5&6, ELEV. 3000 FT.

PROPOSED 3RD. EXTENSION CREST (JOINT POND 1&2, ELEV. 3030 FT.
(JOINT POND 3&4, ELEV. 3075 FT.
(JOINT POND 5&6, ELEV. 3010 FT.

PROPOSED 4TH. EXTENSION CREST (JOINT POND 1&2, ELEV. 3040 FT.
(JOINT POND 5&6, ELEV. 3020 FT.

PROPOSED 5TH. EXTENSION CREST (JOINT POND 1&2, ELEV. 3050 FT.
(JOINT POND 5&6, ELEV. 3030 FT.

SECTION LINES (SEE PLATES 4 TO 21)

EXISTING DECANT TOWER

PROPOSED DECANT TOWER

PROPOSED DECANT LINE AND CAUSEWAY

REFERENCES:

1. DRAWING C-7e HECLA DTD. 9-2-'66
2. DRAWING 2469-3 HECLA.
3. MAP VALLEYS OF CANYON CREEK AND SOUTH FORK COEUR D'ALENE RIVER, HECLA.

FEET
100 0 100 200 300 400 500

SITE PLAN
LAYOUT OF TAILINGS IMPOUNDMENT FACILITY

DAMES & MOORE

PLATE 1

BY _____ DATE _____
CHECKED BY _____

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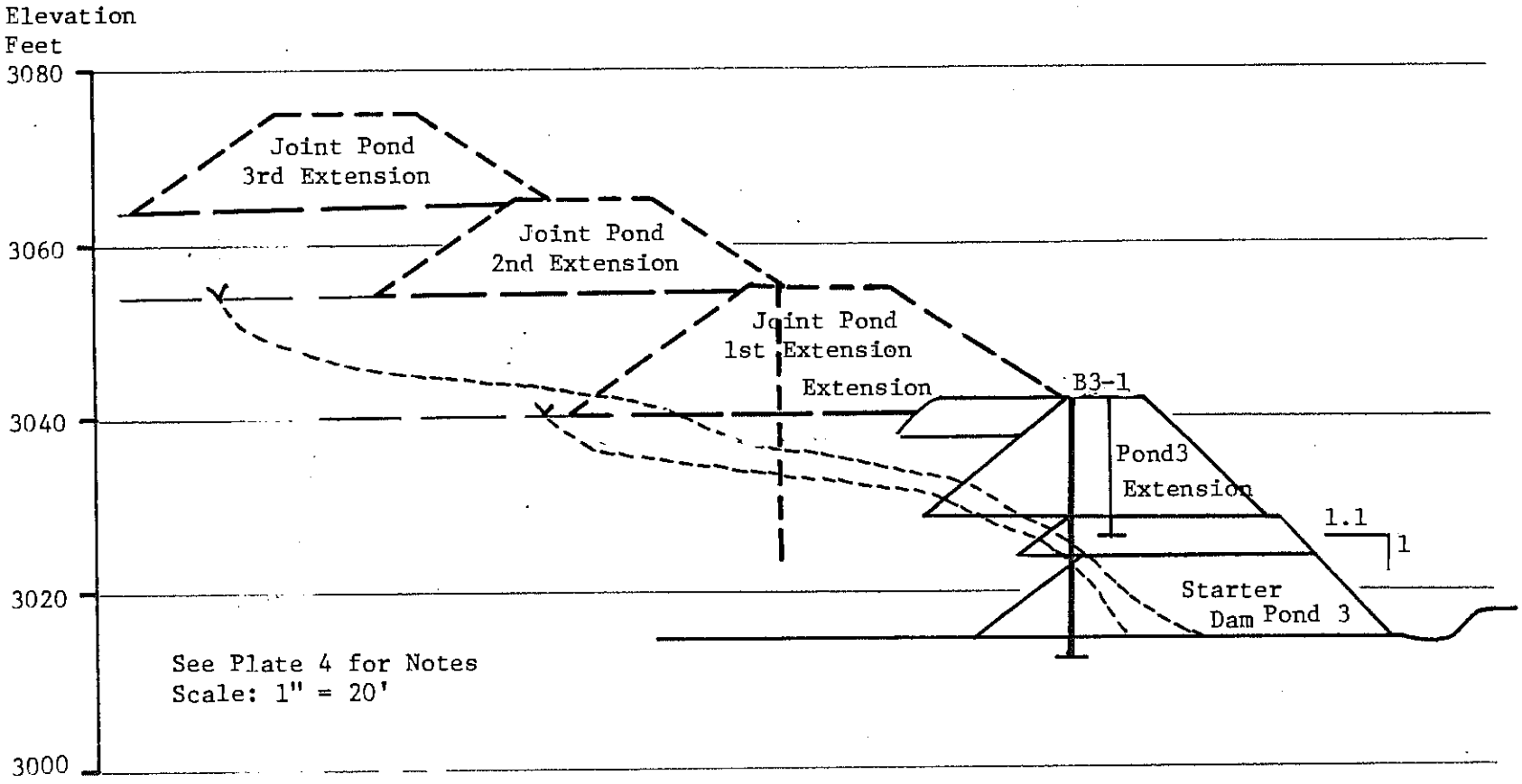

DIKE PROFILE — POND 3 (SECTION H-H)

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PLATE 11

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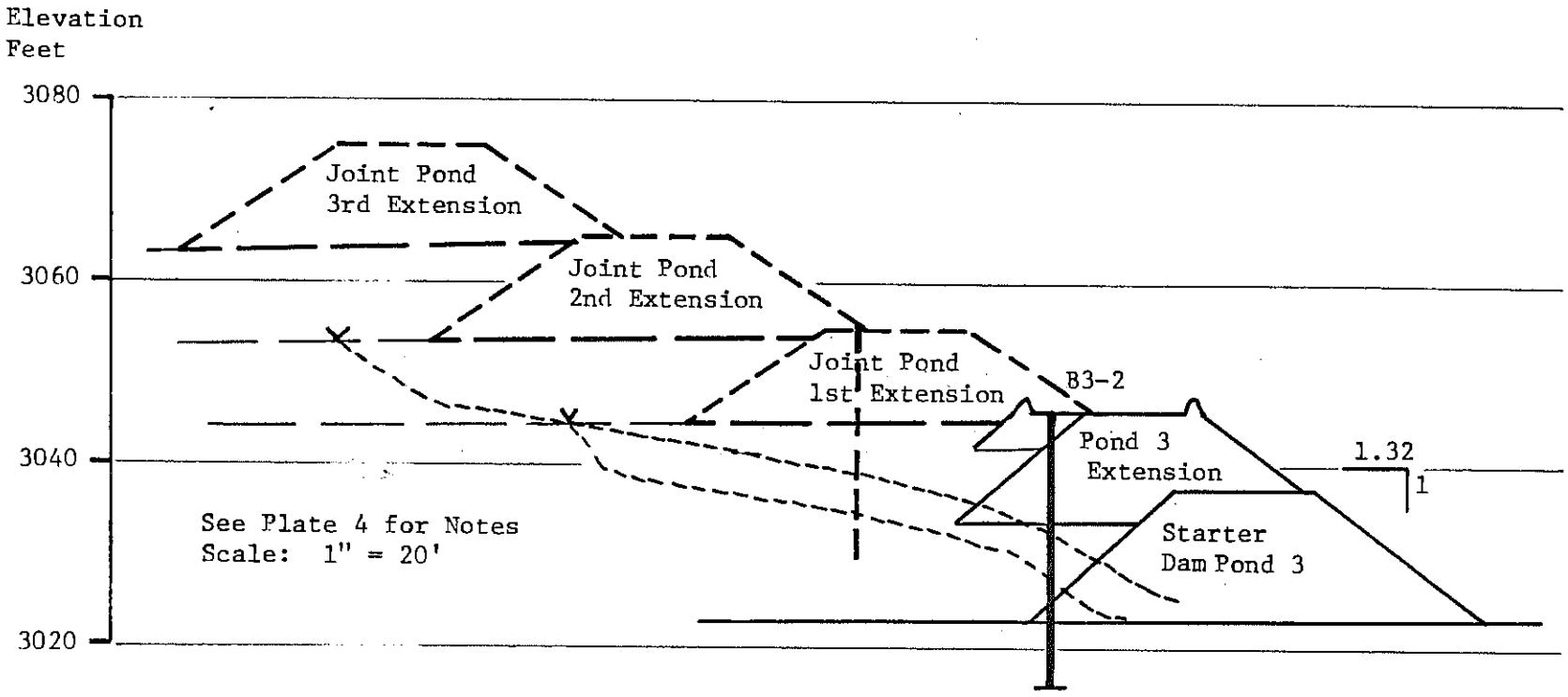
REVISIONS
BY CMU DATE Feb 4 80



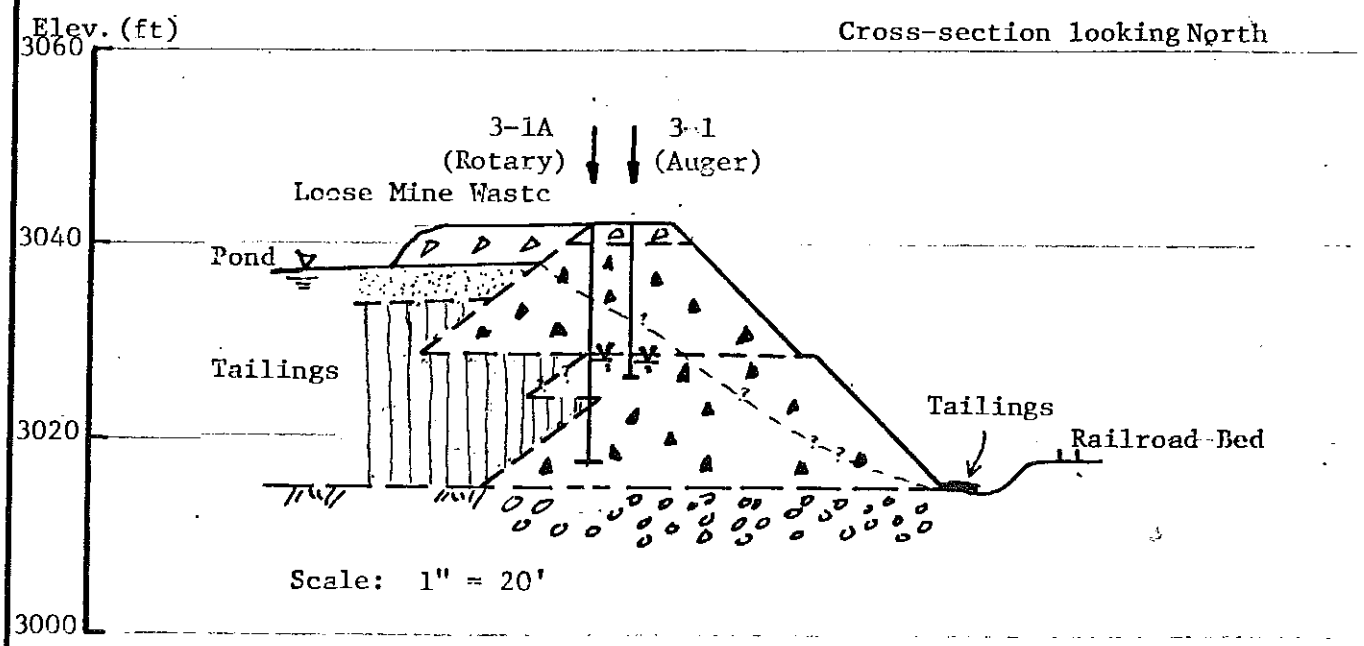
DIKE PROFILE – POND 3 (SECTION 1-1)

DAMES & MOORE

Boring B3-1
Date Drilled Oct. 2, 1979
Collar Elevation 3041
Borehole Depth 24 feet

Depth (ft)	Sample	Lab Test	Moisture Content %	Blow Count	% #200	Soil Strength TSF	Strength Test	Piezometer		
0									GM	Brown silty sand and gravel - mine waste (loose
	◪		5	7					GM	Brown silty and sandy gravel with trace of organics - hillside borrow (loose)
	◪	G	9	6	31					
	◪	G	10	4	34					- grades (medium dense)
10	◪		11	8						
	◪		14	18						
	◪		13	42					GM	Brown silty and sandy gravel - hillside borrow and mine waste (dense)
	◪			26						
20									ML	Dark grey sandy silt - tailings slimes (very soft)
	◪	G			24		2" PVC		GP	Brown sand, gravel, cobbles and boulders - river gravel (very dense)
30										
40										
50										

For Notes and Key see Plate A-1E



LOG OF BORING — POND 3

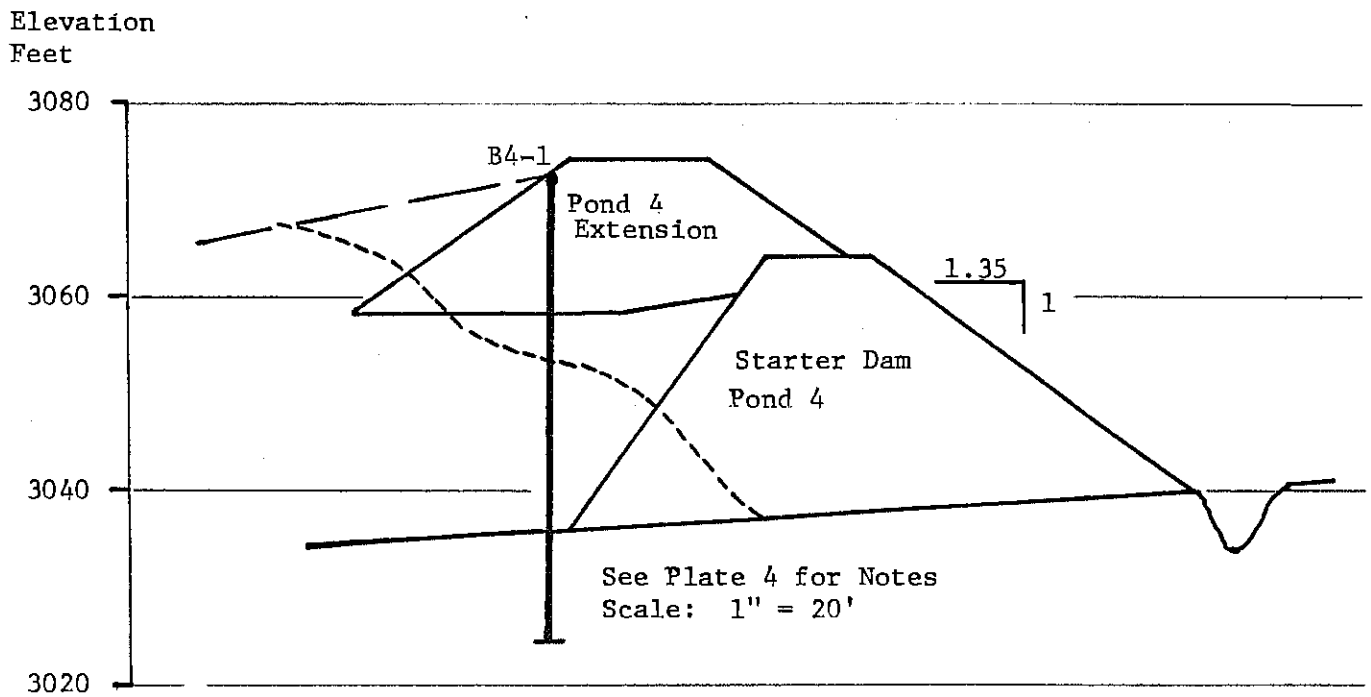
DAMES & MOORE

FILE HECLA MINING CO. 05457-012-32 REVISIONS BY DATE

CHECKED BY DATE

BY _____ DATE _____
CHECKED BY _____ FILE 05457-012-32

REVISIONS
BY CMU DATE Feb 4, 80

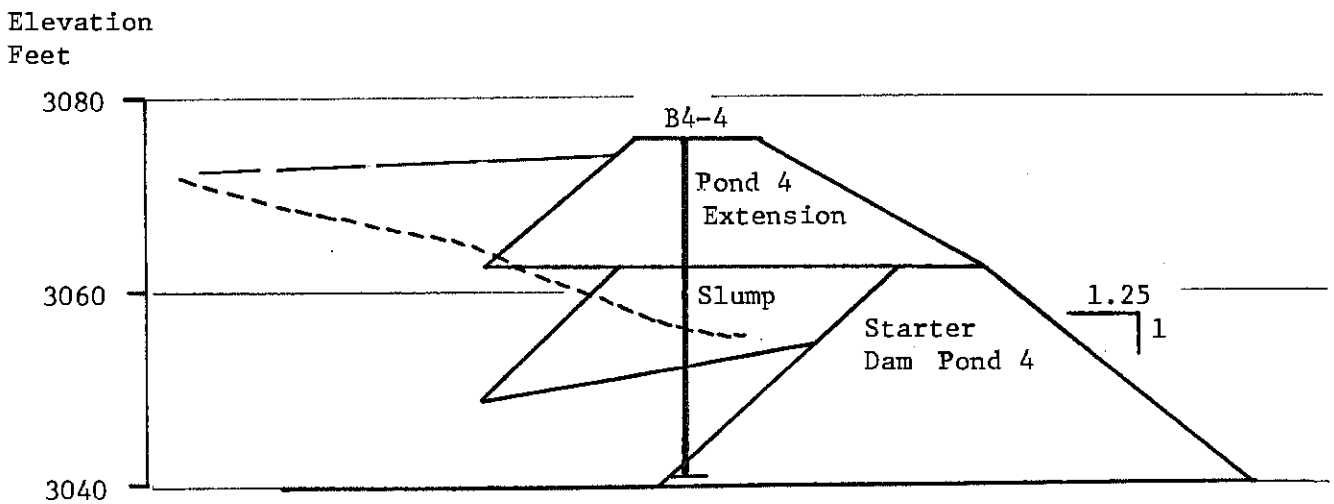


DIKE PROFILE — POND 4 (SECTION K-K)

DAMES & MOORE

BY _____ DATE _____ REVISIONS

CHECKED BY _____ FILE 05457-012-32 BY CMU DATE Feb 4 80

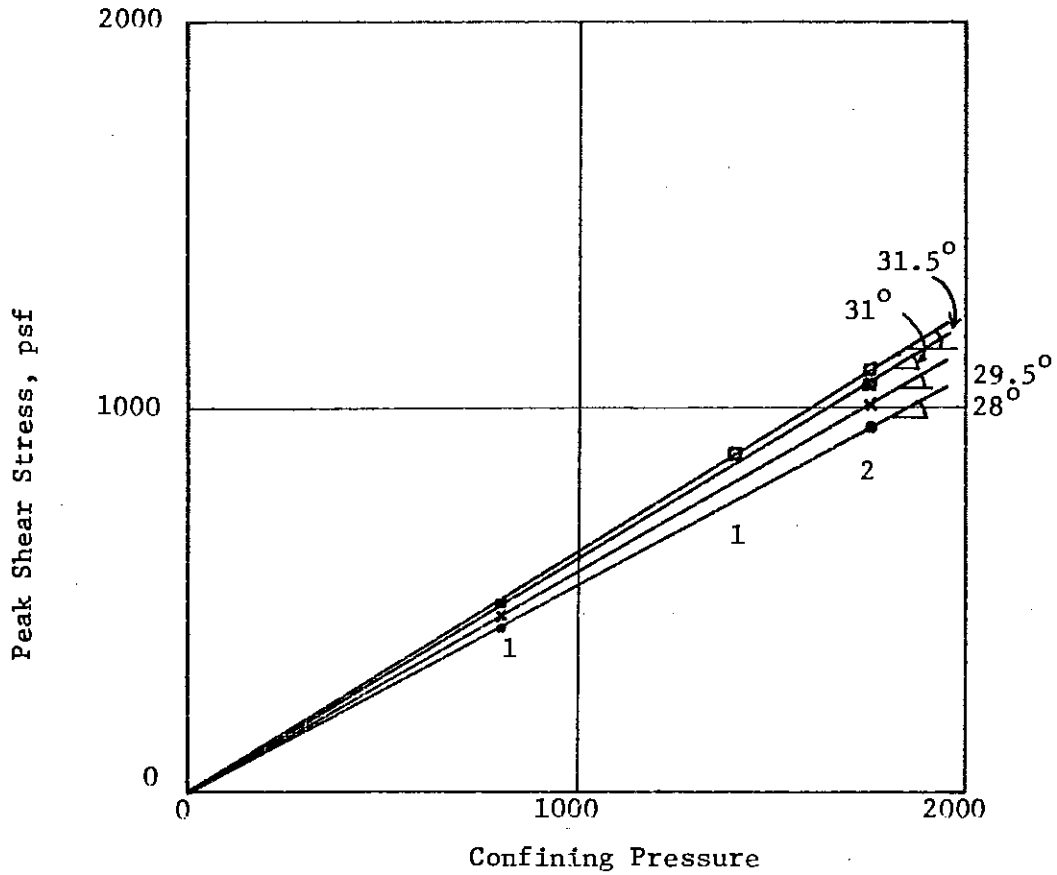


See Plate 4 for Notes
Scale: 1" = 20'

DIKE PROFILE—POND 4 (SECTION N-N)

DAMES & MOORE

PLATE 17



	Boring	Depth (feet)	Soil Description	Dry Density 1 (pcf)	2	Test Detail
□	B-4	17.5	Tailing Sand	87	86	Placed loose and dry
■	B-6	7.5	Tailing Sand	88	87	Placed loose and dry
×	B-8	7.5	Tailing Slimes	83	85	Placed as a slurry
○	B-6	17.5	Tailing Slimes	79	81	Placed as a slurry

DIRECT SHEAR TEST RESULTS

DAMES & MOORE

BY CMU DATE Sept 16, 77
CHECKED BY
FILE 5457-007-32
REVISIONS
BY DATE

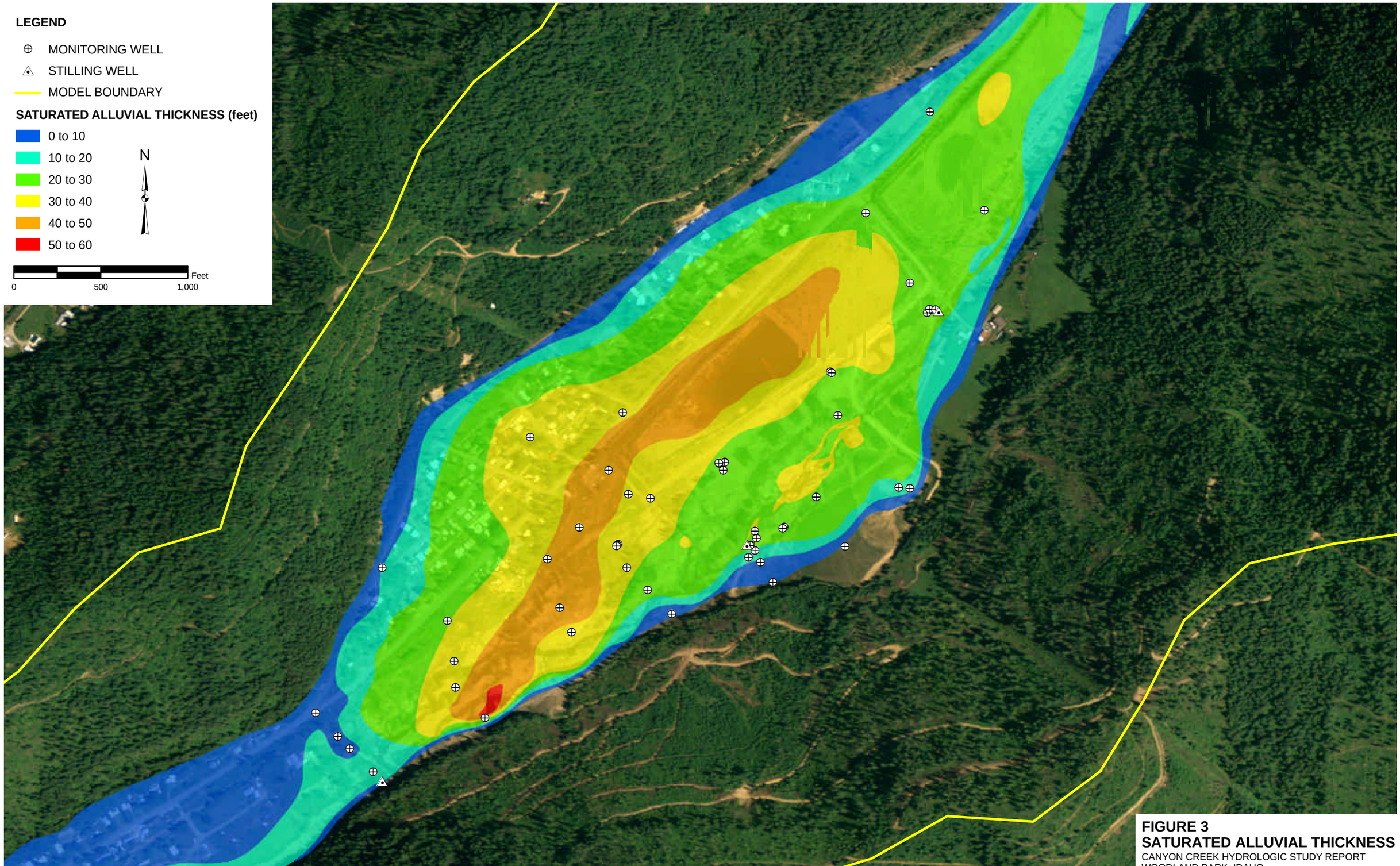
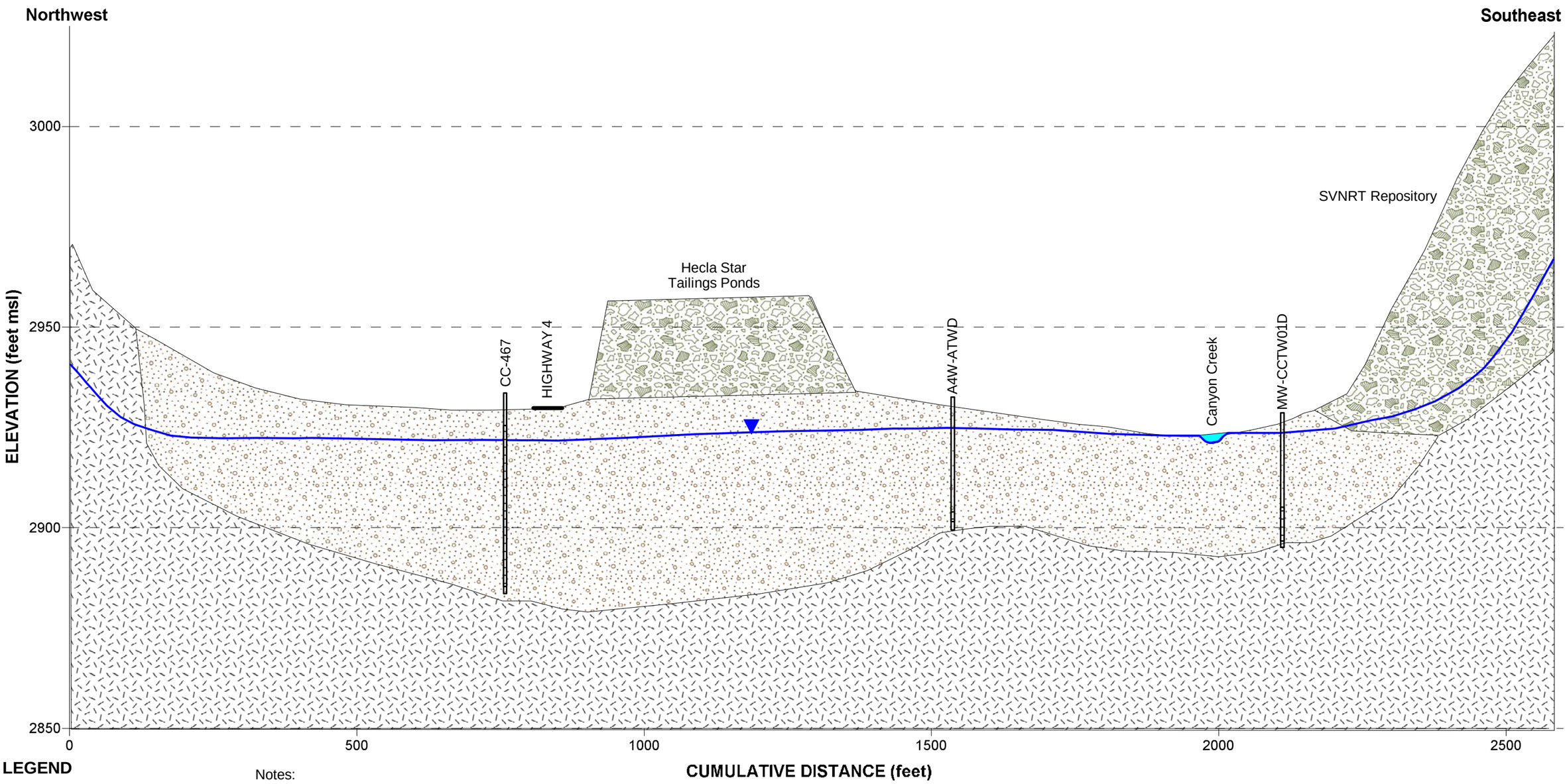


FIGURE 3
SATURATED ALLUVIAL THICKNESS
CANYON CREEK HYDROLOGIC STUDY REPORT
WOODLAND PARK, IDAHO

\\ODIN\PROJ\USEPA\323031\FIGURES\MXD\HYDRO_REPORT\FIGURE_03_SATALLUVIALTHICKNESS.MXD



LEGEND

- Contaminated Fill
- Alluvial Silty Gravel with Sand
- Bedrock
- Well Screen

Notes:

1. Contact between fill material and alluvial sediment is inferred.
2. A layer of tailings mixed with alluvium mantles the majority of the Canyon Creek floodplain in Woodland Park except where removal actions have occurred. This layer is not depicted on this figure.
3. This cross section is strictly conceptual, and monitoring wells are shown for reference only.
4. Cross section location is shown on Figure 3-5.

Scale 7:1 (V:H)
1 inch = 25 feet vertical

Figure 3-6
Cross Section – Woodland Park
Focused Feasibility Study
Upper Basin of the Coeur d'Alene River
BUNKER HILL SUPERFUND SITE

EPA

Attachment 2 – Select Geotechnical Data and Boring Logs from 2011 Geotechnical Investigations (Terragraphics 2012)

- Boring Log BH-2
- CPT Log CPT-3
- CPT Log CPT-6
- Report of CD Triaxial Shear Test – BH2, 20.5
- Table 1: Estimated Soil Properties

TEST PIT BH-2

Date: 12-9-10
Excavator: Budinger & Assoc., Inc.
Equipment: Mobile B-57 with automatic SPT hammer
Location: Middle of SW half
Surface: snow

Elevation: ft
Logged by: E. Hageman
Size of Hole: 6.5" O.D. (3-1/4" I.D.) hollow stem

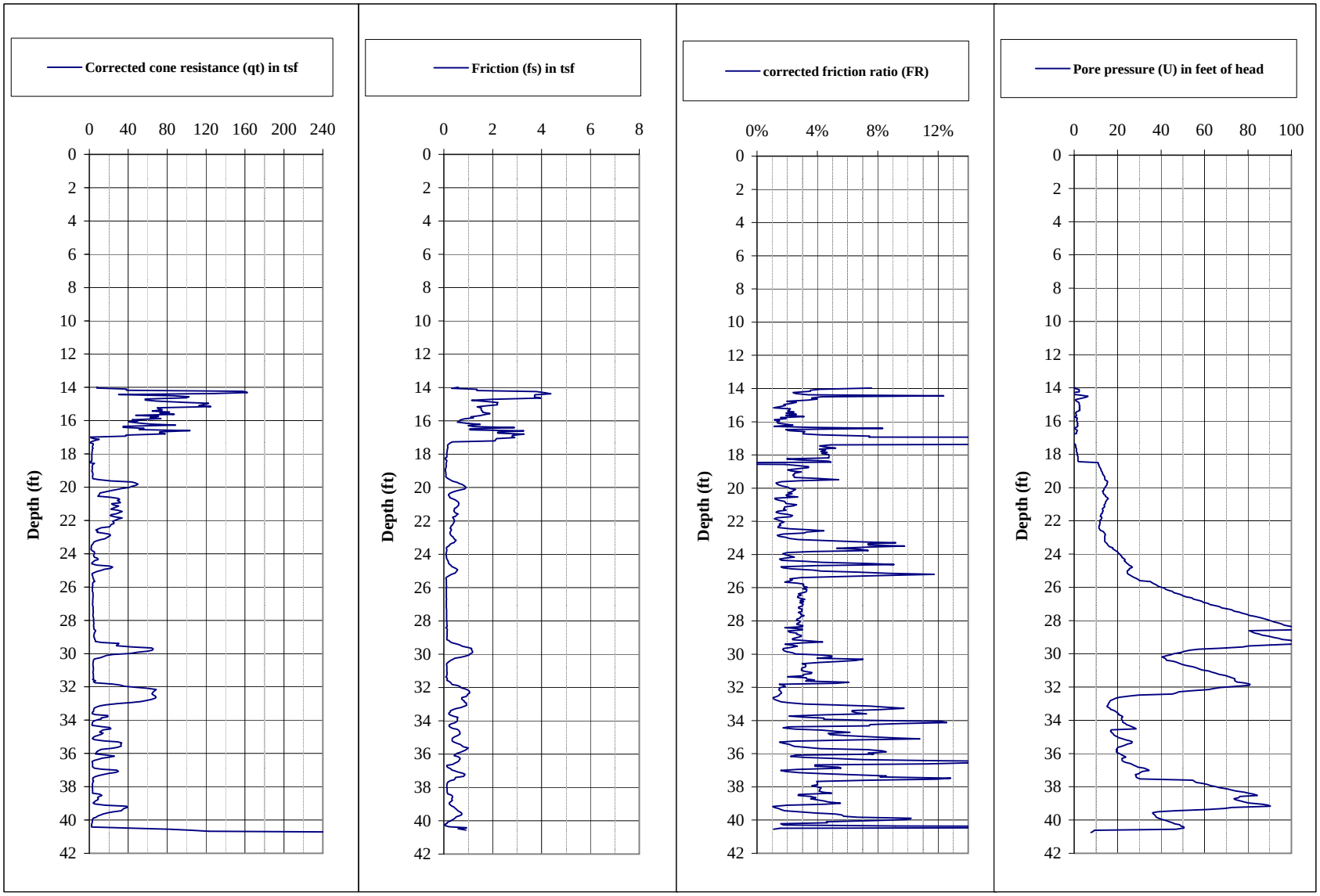
DEPTH	SAMPLE	MOISTURE, COLOR, CONDITION	DESCRIPTION
0		moist, brown, dense	SAND with Gravel, Silt, Clay and Cobbles, subrounded-angular, occasional debris: wood, (Fill)
5	10R (70%)	very dense	(more difficult advancement)
10	10R (20%)		(very difficult advancement, more coarse, auger refusal in offset hole)
			(easier advancement, fewer coarse parts)
15	19 (40%)		
		moist, brown to gray, medium dense	SAND (fine) to SILT, approximate 6-inch bedded, (Fill)
20	10 (90%)	slightly moist, light brown, medium dense	SILT with Sand and Clay, low plasticity
25		very moist, gray, very soft	SILT with Sand and Clay, low plasticity, (Fill)
30		moist, gray, medium dense	SAND, poorly graded (fine), (Fill)
	14 (100%)		
	8 (100%)	very moist, gray, soft	SILT, low plasticity, (Fill)
		moist, gray, medium dense	SAND, poorly graded (fine), (Fill)
35		very moist, gray, soft	SILT with Clay, low plasticity, (Fill)
40	10R (30%)	moist, brown, very dense	GRAVEL with Sand and Cobbles, subrounded-angular?, (Native?)
		no free groundwater observed	Refusal @ 41 ft
45			
50			

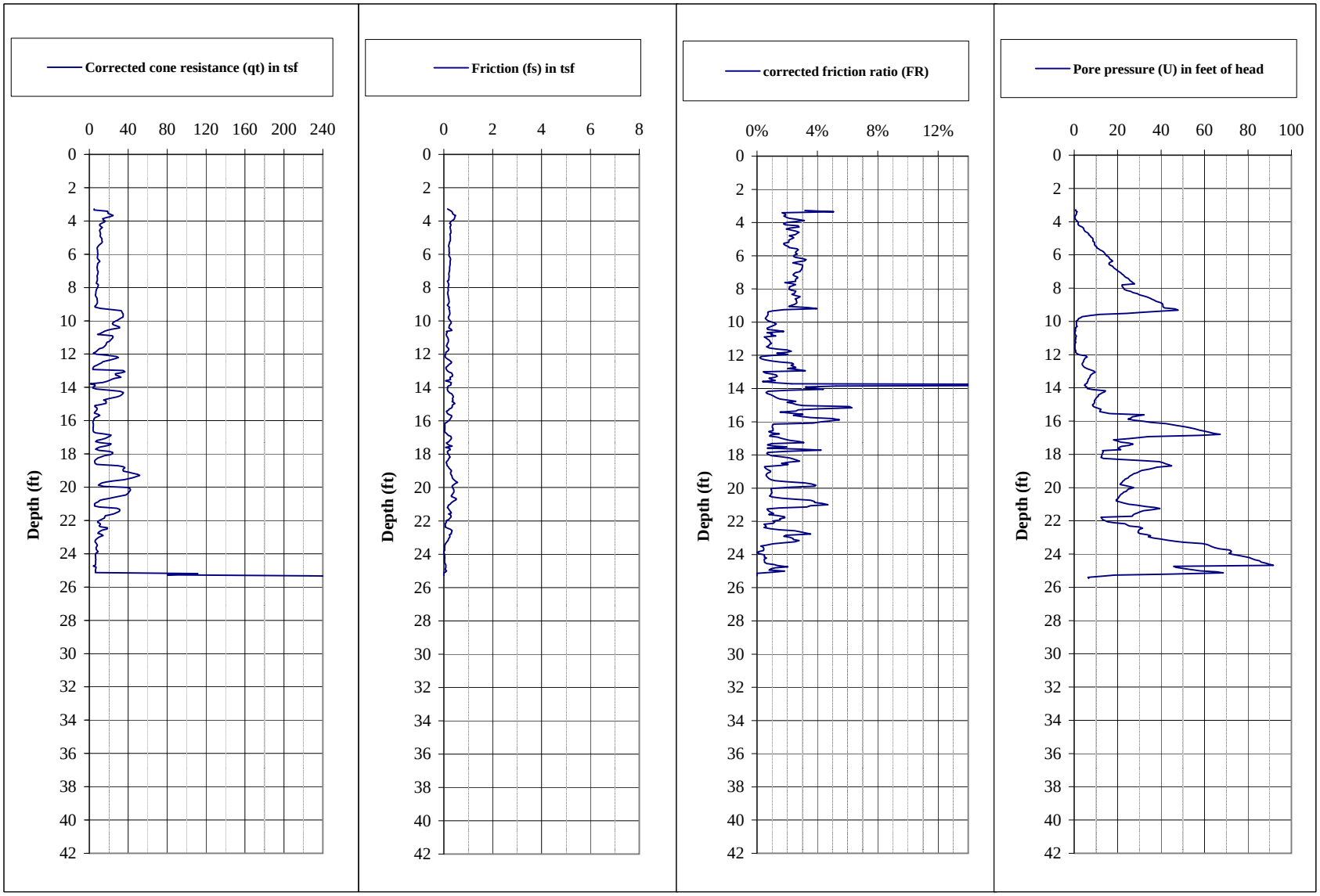
SOIL LOG

Budinger & Associates
1101 North Fancher Road
Spokane Valley, WA 99212

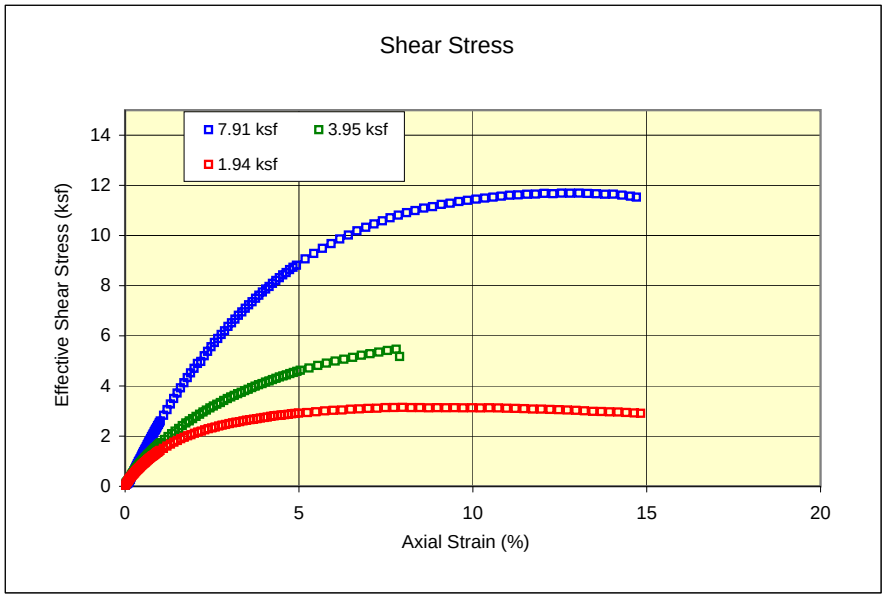
TEST PIT LOGS **FIGURE 1-2**

Project: Star Tailings Impoundment
Location: Wallace, ID
Number: G10502


Corrected cone resistance (qt) in tsf
0 40 80 120 160 200 240
Depth (ft)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42
Friction (fs) in tsf
0 2 4 6 8
Depth (ft)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42
corrected friction ratio (FR)
0% 4% 8% 12%
Depth (ft)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42
Pore pressure (U) in feet of head
0 20 40 60 80 100
Depth (ft)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42


Corrected cone resistance (qt) in tsf
0 40 80 120 160 200 240
Depth (ft)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42
Friction (fs) in tsf
0 2 4 6 8
Depth (ft)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42
corrected friction ratio (FR)
0% 4% 8% 12%
Depth (ft)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42
Pore pressure (U) in feet of head
0 20 40 60 80 100
Depth (ft)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42

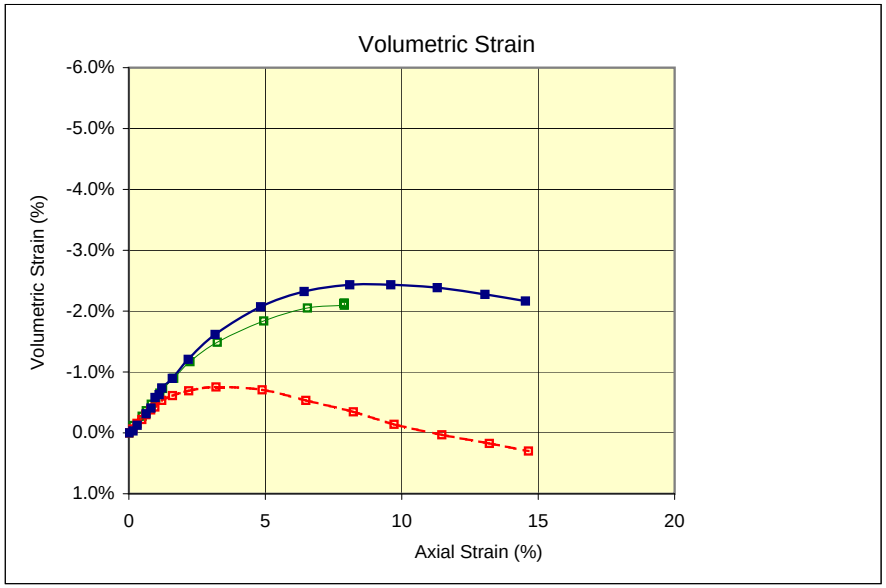
Report of CD Triaxial Shear Test

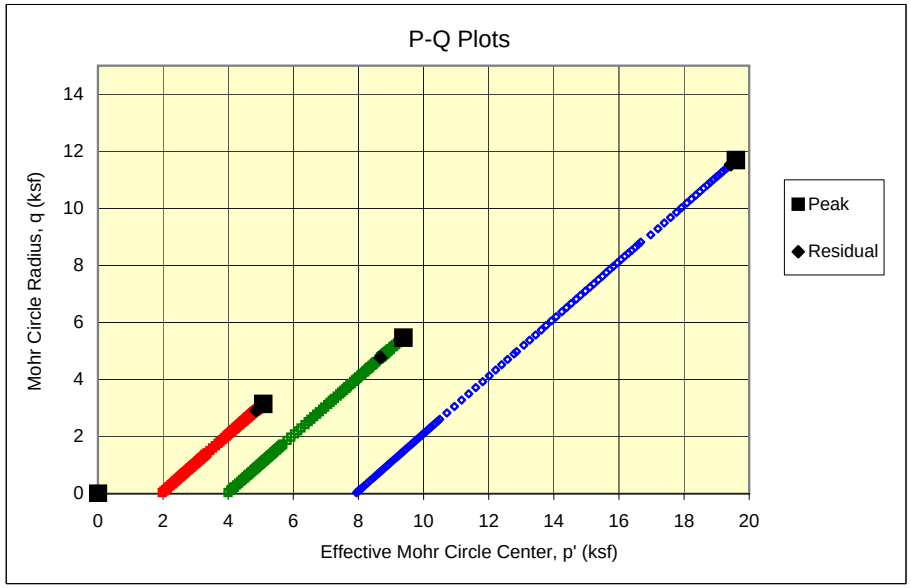


Undisturbed/shear rate 20%/hour	7.91 ksf	3.95 ksf	1.94 ksf
Initial dry unit weight (pcf)	96.4	95.0	87.3
Initial Wc (%)	13.2%	10.6%	22.0%
Final dry unit weight (pcf)	95.8	98.6	87.9
Final Wc (%)	28.3%	29.1%	30.0%

Consolidation Stress (ksf)	Peak Failure Stress p (ksf)	Peak Failure Stress q (ksf)	Residual Failure Stress p (ksf)	Residual Failure Stress q (ksf)
7.91	19.59	11.69	19.43	11.53
3.95	9.38	5.47	8.68	4.77
1.94	5.08	3.15	4.86	2.91

Above values are effective stresses





Budinger & Associates
1101 North Fancher Road
Spokane Valley, WA 99212

TRIAXIAL SHEAR TEST RESULTS
Project: Star Tailings Impoundment
Location: Wallace, ID
Number: G10502

Figure 5-2

Table 1. Estimated Soil Properties

Soil Stratum	Model Input	Test	2010 Tests	2011 Tests	Range	Design Value	Units	Data Source[2,3]	Data Use in Repository Design
Tailings	Shear Strength	Triaxial - CD	2	-	φ=35-36°, c=58-443	φ=30°, c=0	Deg., lb/ft^2	[B&A, Inc.] IncFig. 5-1, 5-2	Slope Stability, Lift Height
		Triaxial - CU	2	-	φ=30-39°, c=294-324			[B&A, Inc.] Fig. 5-1, 5-3	
		SHANSEP		-	S_u/σ_v= 0.56 - 0.65	S_u/σ_v= 0.45	Unitless	[B&A, Inc.] Fig. 5-1, 5-3	Slope Stability, Lift Height
	Compression & Recompression Index	Consolidation	5	-	C_c= 0.08 - 0.19 C_r= 0.03-0.058	Cc= 0.13 Cr= 0.05	Unitless	[B&A, Inc.] Fig. 4-1 to 4-5	Settlement
	Consolidation Coeff.	Consolidation [6] (Time-Rate)	0	1	c_v=0.18-2.8	2.0	ft^2/d	[STRATA] BH-4	Settlement, Lift height
	Water Content Function	Unsat. Conductivity[2]	4	-	-	See Reference	8-pt. Curve	[B&A, Inc.] DBS & Associates Attachment, P.25	Lift Height
	In-Situ Unit Weight	Total Unit Weight	17	1	101 - 139	120	lb/ft^3	[B&A, Inc.] Fig. 4-1 to 5-4	Stability, Lift Height
	-	Moisture Content[1]	7	1	9.1 - 35.2	-	%	[B&A, Inc.] Fig. 4-1 to 5-4	Stability, Lift Height
	-	Specific Gravity[1]	4	-	2.85 - 2.90	-	-	[B&A, Inc.] Fig. 3-1 to 3-2	Soil Classification
	-	Grainsize Distribution[1]	5	1	Cu= 7.9 - 14.6 Cc= 0.8 - 1.1	-	Unitless	[B&A, Inc.] Fig. 6-1 to 6-2	Soil Classification
	-	Atterberg Limits[1]	0	1	LL=33, PI=0	-	%	[STRATA] BH-4	Soil Classification
Embankment	Shear Strength	Direct Shear	0	2	φ=27.4-33.9°, c=0-700	φ=33°, c=0	Deg., lb/ft^2	[STRATA] BH-5,7	Stability, Lift Height
	In-Situ Unit Weight	Total Unit Weight	0	2	129-130	130	lb/ft^3	[STRATA] BH-5,7	Stability, Lift Height
	-	Moisture Content[1]	2	2	13.2-15.4	-	%	[STRATA] BH-5,7	Stability, Lift Height
	-	Grainsize Distribution[1]	2	2	Cu= 340.5 - 436.0 Cc= 5.5 - 49.3	-	Unitless	[B&A, Inc.] Fig. 6-1 to 6-2	Soil Classification
	-	Atterberg Limits[1]	0	2	LL=28, PI=9	-	%	[STRATA] BH-5,7	Soil Classification
Cover	Shear Strength	Direct Shear	0	1	φ=22.4-28.4°, c=0-575	φ=28°, c=0	Deg., lb/ft^2	[STRATA], BH-4	Stability, Lift Height
	In-Situ Unit Weight	Total Unit Weight	0	1	113.7	114	lb/ft^3	[STRATA], BH-4	Stability, Lift Height
	-	Moisture Content[1]	2	1	9.1 - 17.6	-	%	[B&A, Inc.] Fig. 3-1 to 3-2	Stability, Lift Height
	-	Grainsize Distribution[1]	2	1	Cu= 369.6 - 659.7 Cc= 2.7 - 3.8	-	Unitless	[B&A, Inc.] Fig. 6-1 to 6-2	Soil Classification
	-	Atterberg Limits[1]	0	1	-	-	%	[STRATA], BH-4	Soil Classification
Alluvium	Shear Strength	Direct Shear[4]	0	2	φ=30.8-35.6°, c=0-410	φ=32°, c=0	Deg., lb/ft^2	[STRATA] BH- 8	Stability, Lift Height
	In-Situ Unit Weight	Total Unit Weight[4]	0	2	127-134	130	lb/ft^3	[STRATA] BH- 8	Stability, Lift Height
	-	Moisture Content[1]	1	2	8.2	-	%	[B&A, Inc.] Fig. 3-1	Stability, Lift Height
	-	Grainsize Distribution[1]	1	1	Cu= 83.3, Cc= 4.8	-	Unitless	[B&A, Inc.] Fig. 6-1	Soil Classification
	-	Atterberg Limits[1]	0	1	LL=25, PI=6	-	%	[STRATA] BH-8	Soil Classification
New Waste	Shear Strength	-	0	-	-	φ=34°, c=0	Deg., lb/ft^2	See Note 5	Stability, Lift Height
	In-Situ Unit Weight	-	0	-	-	140	lb/ft^3	See Note 5	Stability, Settlement, Lift Height

Attachment 3 – Select Geotechnical Data and Boring Logs from 2012 Geotechnical Investigation (MFA 2012 – Pending)

- Boring Log B-101
- Boring Log B-102
- Boring Log B-103
- Test Pit Log TP-08
- Laboratory Grain Size Data – Sample B101-20120913-SB-3.5
- Laboratory Grain Size Data – Sample B103-20120912-SB-4.0
- Laboratory Grain Size Data – Sample TP-02-20120907-SB-4.0
- Laboratory Direct Shear Data – B101-20120913-SB-6.0
- Laboratory Direct Shear Data – B103-20120912-SB-19.0

TerraGraphics Environmental Engineering, Inc.

Project No.: 12068

Log of Boring No.: B-101

PROJECT: LBCR	Log of Boring No.: B-101
BORING LOCATION: B-101 POND 2 EMBANKMENT	ELEVATION AND DATUM: GROUND, TOP OF EMBANKMENT
DRILLING CONTRACTOR: MAJOR	STARTED - DATE: 9/13/2012 TIME: 13:30 / COMPLETED - DATE: 9/14/2012 TIME: 10:40
DRILLER: STEVE ZIMMERMAN	TOTAL DEPTH (ft): 40' / WELL DEPTH(ft): N/A / MEASURING POINT:
DRILLING METHOD: ROTOSONIC	DEPTH TO WATER (ft): DRY / TIME:
DRILLING EQUIPMENT: GEOPROBE 8140LS 6" AND *4 3/4" BIT	LOGGED BY: MIKE PROCSAL
SAMPLING METHOD: SPT, CORE BARREL, CALIFORNIA SAMPLER MODIFIED	REVIEWED BY: MELODY STUDER

Well Construction Detail	PID/FID (ppm)	SAMPLES Blows Per 6"	SAMPLES Sample ID and Time	DEPTH (feet)	GRAPHIC	CLASS	DESCRIPTION Group Symbol (e.g. SM), Color, Group Name (e.g. Silty Sand), Particle Size Range, Consistency (hard soft) , Moisture Content, and others
				1, 2		GM	SILTY GRAVEL WITH SAND AND COBBLES. WELL GRADED SUBANGULAR GRAVEL. ~5% SUBROUNDED QUARTZITE COBBLES UP TO 6", ~20% FINES AND ~25% WELL GRADED SAND. DENSE, DRY. EMBANKMENT.
		44 50/3.5"	B101-SB -3.5 14:45	3, 4			SPT HIT A COBBLE, 50% RECOVERY.
				4		GC	BROWN YELLOW CLAYEY GRAVEL WITH SAND. WELL GRADED SUBANGULAR GRAVEL, WELL GRADED SAND, ~20% FINES. EMBANKMENT.
			B101-SB -5.5 14:50	5			
		28 28 26	B101-SB -6.0 14:53	6			
				7		GM	RED BROWN CLAYEY GRAVEL WITH SAND. WELL GRADED ANGULAR GRAVEL, WELL GRADED SAND, ~5% QUARTZITE COBBLES <4". EMBANKMENT.
		24 21 19		8			61% SPT RECOVERY
			B101-SB -9.0 15:18	9		SM	~3" LENSE OF BROWN SILTY SAND, POORLY GRADED FINE SAND, 25% SILT, LOOSE, DRY, TAILINGS.
				10		SM	SILTY SAND WITH GRAVEL. WELL GRADED COARSE TO FINE SAND. ~25% ANGULAR GRAVEL, POORLY GRADED GRAVEL (WELL GRADED <3/4" AND FROM 1.5 TO 2.5"). ~35% FINES. TRACE COBBLES. DRY. EMBANKMENT.
		36 38 30	B101-SB -11.0 15:27	11			72% RECOVERY CALIFORNIA SAMPLER, 2 OF 3 BRASS RINGS COLLECTED.
				12		ML/CL	6" THICK LENS OF RED BROWN CLAYEY SILT, DRY, MEDIUM PLASTICITY, RAPID DILATANCY. TAILINGS.
		26 32 24	B101-SB -13.5 15:51	13			
				14		ML	SILT WITH SAND TAILINGS..
				15		SM	LIGHT GRAY SILTY SAND. POORLY GRADED FINE SAND. ~45% SILT. LOOSE, DRY. TAILINGS.
		14 16 17	B101-SB -16.0 16:02	16			SAND SIZE INCREASES FINE TO MEDIUM AT 17' BGS.
				17			80% CALIFORNIA SAMPLER RECOVERY, 2 OF 3 BRASS RINGS COLLECTED.
				18		ML/CL	GRAY GREEN CLAYEY SILT, LOOSE, DRY, MEDIUM PLASTICITY, RAPID DILATANCY, LOW DRY STRENGTH, LOW TOUGHNESS, TAILINGS.
		4 5 6	B101-SB -19.0 16:32	19			83% SPT RECOVERY
				20		SP	LIGHT GRAY SAND, POORLY GRADED FINE TO MEDIUM, LOOSE, DRY, TAILINGS. 52% CALIFORNIA SAMPLER RECOVERY; 1 OF 3 BRASS RINGS COLLECTED.

Legend:

Bentonite Chips: 0'-40', 3/8" chips

California Sampler

SPT Interval

Notes:

SPT SAMPLER 2" BY 18" SPLIT SPOON
CALIFORNIA SAMPLER 3" BY 18" WITH 6" BRASS SLEEVES
ABANDONED WITH 16 50 LB BAGS OF BENTONITE CHIPS
*4 3/4" BIT USED TO ADVANCE THROUGH DENSE MATERIAL ONLY

TerraGraphics Environmental Engineering, Inc.

Project No.: 12068

PROJECT: LBCR	Log of Boring No.: B-101
BORING LOCATION: B-101 POND 2 EMBANKMENT	ELEVATION AND DATUM: GROUND, TOP OF EMBANKMENT
DRILLING CONTRACTOR: MAJOR	STARTED - DATE: 9/13/2012 TIME: 13:30 / COMPLETED - DATE: 9/14/2012 TIME: 10:40
DRILLER: STEVE ZIMMERMAN	TOTAL DEPTH (ft): 40' / WELL DEPTH(ft): N/A / MEASURING POINT:
DRILLING METHOD: ROTOSONIC	DEPTH TO WATER (ft): DRY / TIME:
DRILLING EQUIPMENT: GEOPROBE 8140LS 6" AND *4 3/4" BIT	LOGGED BY: MIKE PROCSAL
SAMPLING METHOD: SPT, CORE BARREL, CALIFORNIA SAMPLER MODIFIED	REVIEWED BY: MELODY STUDER

Well Construction Detail	PID/FID (ppm)	SAMPLES Blows Per 6"	SAMPLES Sample ID and Time	DEPTH (feet)	GRAPHIC	CLASS	DESCRIPTION Group Symbol (e.g. SM), Color, Group Name (e.g. Silty Sand), Particle Size Range, Consistency (hard soft) , Moisture Content, and others
		7 7 7	B101-SB -21.0 16:48	20 21 22		SP	LIGHT GRAY SAND FINE TO MEDIUM, WET, LOOSE, TAILINGS. 52% CALIFORNIA SAMPLER RECOVERY, 1 OF 3 BRASS RINGS COLLECTED.
				23 24		ML/ CL	DARK GRAY CLAYEY SILT, VERY SOFT, WET, MEDIUM PLASTICITY, SLOW DILATANCY, LOW TOUGHNESS, STICKY LIKE SLIMES, TAILINGS.
		0 2 1	B101-SB -26.0 08:58 9/14/2012	25 26		SP	BROWN SAND, FINE POORLY GRADED, VERY SOFT, MOIST, LOOSE, NO PLASTICITY, SLOW DILATANCY, TAILINGS. 44% SPT RECOVERY
			B101-SB -28.0 09:10 9/14/2012	27 28 29 30		ML/ CL	ALTERNATING DARK GRAY CLAYEY SILT & BROWN FINE SAND LENSES (SP), DARK GRAY CLAYEY SILT, VERY SOFT, VERY WET, HIGH PLASTICITY, RAPID DILATANCY, TAILINGS.
		20 34 50/3.5"		31 32 33 34		GM	58% SPT RECOVERY FROM 30 TO 31.5 '. RED BROWN SILTY GRAVEL WITH SAND AND COBBLES. WELL GRADED, SUBROUNDED GRAVEL. ~15% SUBROUNDED QUARTZITE COBBLES TO ~5", 25% WELL GRADED SAND, 10% FINES. WET. FINES HAVE COHESION. SAME TO 40'; CASING ONLY ADVANCED TO 35'. ALLUVIUM.
		50/0.5"	B101-SB -35.0 10:10 9/14/2012	35 36 37 38 39 40			<3% SPT RECOVERY FROM 35' TO 36.5'.

Legend:

Bentonite Chips: 0'-40', 3/8" chips

California Sampler

SPT Interval

Notes:

SPT SAMPLER 2" BY 18" SPLIT SPOON
CALIFORNIA SAMPLER 3" BY 18" WITH 6" BRASS SLEEVES
ABANDONED WITH 16 50 LB BAGS OF BENTONITE CHIPS
*4 3/4" BIT USED TO ADVANCE THROUGH DENSE MATERIAL ONLY

TerraGraphics Environmental Engineering, Inc.

Project No.: 12068

Log of Boring No.: B-102

PROJECT: LBCR	
BORING LOCATION: B-102 POND 4	ELEVATION AND DATUM: GROUND, TOP OF EMBANKMENT
DRILLING CONTRACTOR: MAJOR	STARTED - DATE: 9/14/2012 TIME: 13:58 / COMPLETED - DATE: 9/15/2012 TIME: 10:15
DRILLER: STEVE ZIMMERMAN	TOTAL DEPTH (ft): 40' / WELL DEPTH(ft): N/A / MEASURING POINT:
DRILLING METHOD: ROTOSONIC	DEPTH TO WATER (ft): 36.25 / TIME: 10:10
DRILLING EQUIPMENT: GEOPROBE 8140LS 6" AND *4 3/4" BIT	LOGGED BY: MIKE PROCSAL/CLAY LARKINS
SAMPLING METHOD: SPT. CORE BARREL, CALIFORNIA SAMPLER	REVIEWED BY: MELODY STUDER

Well Construction Detail	PID/FID (ppm)	SAMPLES Blows Per 6"	SAMPLES Sample ID and Time	DEPTH (feet)	GRAPHIC	CLASS	DESCRIPTION Group Symbol (e.g. SM), Color, Group Name (e.g. Silty Sand), Particle Size Range, Consistency (hard soft) , Moisture Content, and others
				1, 2		GM	BROWN YELLOW SILTY GRAVEL, WELL GRADED, ANGULAR DENSE, DRY, SOME COHESION, ARGILLITE & QUARTZITE ROCK. EMBANKMENT.
		11 11 10	**B102-SB -3.5 14:30	3, 4		GM	YELLOW RED SILTY GRAVEL WITH SAND, WELL GRADED, ANGULAR GRAVEL, ~30% WELL GRADED SAND & 25% FINES. SOME COHESION, MEDIUM DRY STRENGTH. EMBANKMENT. 66% SPT RECOVERY
		14 14 14	B102-SB -6.0 14:12	5, 6, 7			66% CALIFORNIA SAMPLER RECOVERY, 2 OF 3 BRASS RINGS COLLECTED
		22 22 25	B102-SB -6.0 14:47	8, 9		GM	YELLOW RED SILTY GRAVEL, POORLY GRADED FINE GRAVEL, 10% COARSE SAND, SUBROUNDED. EMBANKMENT. 30% SPT RECOVERY - QUARTZITE ROCK STUCK IN TIP
		48 37 14	B102-SB -11.0 14:55	10, 11, 12		GM-GC	YELLOW RED GRAVEL WITH CLAY AND SAND. WELL GRADED ANGULAR WITH SOME COHESION. EMBANKMENT. 55% CALIFORNIA SAMPLER RECOVERY, 2 OF 3 BRASS RINGS COLLECTED
		4 4 3	B102-SB -14.0 15:20	13, 14		ML	DARK GRAY SILT, VERY SOFT, WET, HIGH PLASTICITY, RAPID DILATANCY LOW TOUGHNESS, TAILINGS. 88% SPT RECOVERY
		4 4 3	B102-SB -16.0 15:30	15, 16, 17		SP	LIGHT BROWN FINE SAND, POORLY GRADED, TRACE SILT, VERY SOFT, MOIST, TAILINGS. 72% CALIFORNIA SAMPLER RECOVERY, 2 OF 3 BRASS RINGS COLLECTED
		0 2 3	B102-SB -19.0 16:00	18, 19, 20		ML/CL	DARK GRAY CLAYEY SILT, VERY SOFT, WET, HIGH PLASTICITY, RAPID DILATANCY, LOW TOUGHNESS, TAILINGS. 44% SPT RECOVERY

Legend:

- Bentonite Chips: 0'-40', 3/8" chips
- California Sampler
- Approximate Depth to Groundwater in Bore Hole
- SPT Interval

Notes: SPT SAMPLER 2" BY 18" SPLIT SPOON
CALIFORNIA SAMPLER 3" BY 18" WITH 6" BRASS SLEEVES
ABANDONED WITH 18 50 LB BAGS OF BENTONITE CHIPS
*4 3/4" BIT USED TO ADVANCE THROUGH DENSE MATERIAL ONLY
**B-102-SB-3.5 TAKEN 1' SOUTH OF BORE HOLE B-102 AFTER ADVANCING TO 6.0 FT.

Log of Boring No.: B-102

PROJECT: LBCR	
BORING LOCATION: B-102 POND 4	ELEVATION AND DATUM: GROUND, TOP OF EMBANKMENT
DRILLING CONTRACTOR: MAJOR	STARTED - DATE: 9/14/2012 TIME: 13:58 / COMPLETED - DATE: 9/15/2012 TIME: 10:15
DRILLER: STEVE ZIMMERMAN	TOTAL DEPTH (ft): 40' / WELL DEPTH(ft): N/A / MEASURING POINT:
DRILLING METHOD: ROTOSONIC	DEPTH TO WATER (ft): 36.25 / TIME: 10:10
DRILLING EQUIPMENT: GEOPROBE 8140LS 6" AND *4 3/4" BIT	LOGGED BY: MIKE PROCSAL/CLAY LARKINS
SAMPLING METHOD: SPT. CORE BARREL, CALIFORNIA SAMPLER	REVIEWED BY: MELODY STUDER

Well Construction Detail	PID/FID (ppm)	SAMPLES Blows Per 6"	SAMPLES Sample ID and Time	DEPTH (feet)	GRAPHIC	CLASS	DESCRIPTION Group Symbol (e.g. SM), Color, Group Name (e.g. Silty Sand), Particle Size Range, Consistency (hard soft) , Moisture Content, and others
		0 0 4	B102-SB -21.0 16:14	20 21		ML/ CL	DARK GRAY CLAYEY SILT, VERY SOFT, WET HIGH PLASTICITY, RAPID DILATANCY, LOW TOUGHNESS, TAILINGS. 47% CALIFORNIA RECOVERY, 1 OF 3 BRASS RINGS COLLECTED 21.0'-21.5.
				22 23 24			
		5 7 9		25			50% SPT RECOVERY
				26 27		GM	YELLOW RED SILTY FINE GRAVEL, WITH SAND AND COBBLES, POORLY GRADED (WELL GRADED <3/4") SUBANGULAR GRAVEL, ~10% SUBROUNDED QUARTZITE COBBLES, ~15% COHESIVE FINES, TRACE ORGANICS, MOIST. EMBANKMENT.
			B102-SB -28.0 08:19	28 29			
		8 15 36		30 31		ML	DARK BROWN SANDY SILT WITH GRAVEL. MEDIUM AND FINE GRAINED SAND, POORLY GRADED (WELL GRADED <3/4") SUBANGULAR GRAVEL. WET, HIGH ORGANICS (SPLINTERED WOOD) FROM 30' TO 31'. TAILINGS/ALLUVIUM. 47% SPT RECOVERY
			B102-SB -32.0 09:03	32			
				33 34		GC	LIGHT BROWN CLAYEY GRAVEL WITH COBBLES. WELL GRADED GRAVEL UP TO 5" COBBLES, ALL COARSE FRACTION SUBROUNDED TO ROUNDED. 15% QUARTZITE COBBLES, 15% MOIST TO WET COHESIVE FINES WITH MODERATE DILATANCY, LENSE OF MEDIUM SAND (SP) AT 38'.ALLUVIUM.
		47 50/2"	B102-SB -35.0 09:54	35 36 37			44% SPT RECOVERY
				38 39 40		GC	YELLOW BROWN CLAYEY GRAVEL. WELL GRADED SUBROUNDED WITH COARSE SUBANGULAR QUARTZITE, MOIST, ~50% COHESIVE FINES. ALLUVIUM.

Legend:

Bentonite Chips: 0'-40', 3/8" chips

California Sampler

Approximate Depth to Groundwater in Bore Hole

SPT Interval

Notes: SPT SAMPLER 2" BY 18" SPLIT SPOON
CALIFORNIA SAMPLER 3" BY 18" WITH 6" BRASS SLEEVES
ABANDONED WITH 18 50 LB BAGS OF BENTONITE CHIPS
*4 3/4" BIT USED TO ADVANCE THROUGH DENSE MATERIAL ONLY
**B-102-SB-3.5 TAKEN 1' SOUTH OF BORE HOLE B-102 AFTER ADVANCING TO 6.0 FT.

TerraGraphics Environmental Engineering, Inc.

Project No.: 12068

Log of Boring No.: B-103

PROJECT: LBCR	Log of Boring No.: B-103
BORING LOCATION: B-103 POND 2	ELEVATION AND DATUM: GROUND, POND SURFACE
DRILLING CONTRACTOR: MAJOR	STARTED - DATE: 9/12/2012 TIME: 12:14 / COMPLETED - DATE: 9/13/2012 TIME: 11:25
DRILLER: STEVE ZIMMERMAN	TOTAL DEPTH (ft): 46.5' / WELL DEPTH(ft): N/A / MEASURING POINT:
DRILLING METHOD: ROTOSONIC	DEPTH TO WATER (ft): DRY / TIME:
DRILLING EQUIPMENT: GEOPROBE 8140LS 6" AND *4 3/4" BIT	LOGGED BY: MIKE PROCSAL
SAMPLING METHOD: SPT, CORE BARREL, SHELBY	REVIEWED BY: MELODY STUDER

Well Construction Detail	PID/FID (ppm)	SAMPLES Blows Per 6"	SAMPLES Sample ID and Time	DEPTH (feet)	GRAPHIC	CLASS	DESCRIPTION Group Symbol (e.g. SM), Color, Group Name (e.g. Silty Sand), Particle Size Range, Consistency (hard soft) , Moisture Content, and others
				1, 2		GM	BROWNISH YELLOW SILTY GRAVEL. WELL GRADED SUBROUNDED TO SUBANGULAR GRAVEL. ~5% COARSE ROUNDED SAND, <5% COBBLES. WOOD DEBRIS AT 2'; DENSE BROWN SILT WITH ANGULAR COBBLES FROM 2' TO 2.5'. FILL MATERIAL.
		50/0	B103-SB -4.0 13:00	3, 6		GM	DARK BROWN SILTY GRAVEL WITH SAND. WELL GRADED, SUBROUNDED TO SUBANGULAR. ~30% WELL GRADED SAND, 18% FINES, AND TRACE COBBLES. DRY TO MOIST AT 5'. BOULDER FROM 5' TO 6'. FILL MATERIAL. <5% SPT RECOVERY, 2.5' TO 4' BGS
				7		GM	YELLOWISH RED SILTY GRAVEL, POORLY GRADED, ANGULAR. 10% COBBLES, DENSE, DRY. LENS OF BLACK SILTY SAND AT 7.5', MOIST. FILL MATERIAL. ATTEMPT TO COLLECT SHELBY TUBE AT 6'. 16% RECOVERY WITH END OF TUBE CRUMPLED FROM SAMPLING; SAMPLE UNACCEPTABLE FOR ANALYSIS.
		25 18 15	B103-SB -9.0 14:50	8, 9		GW-GM	RED BROWN GRAVEL WITH SILT, SAND & COBBLES. WELL GRADED, ANGULAR. 10% SILT, 10% SUBROUNDED COBBLES. LESS DENSE THAN ABOVE, FINES ARE MOIST. FILL MATERIAL. <10% RECOVERY FROM SPT FROM 8' TO 9.5' BGS.
				10, 11, 12		GW-GM	SAME AS ABOVE, WITH MORE ROUNDED GRAVEL, & WOOD DEBRIS. FILL MATERIAL. 25% RECOVERY FROM 10' TO 11.5' WITH SHELBY TUBE. END OF SAMPLE TUBE CRUMPLED; SAMPLE UNACCEPTABLE FOR ANALYSIS.
		12 16 1	B103-SB -13.5 15:27	13, 14		ML	BROWN YELLOW TO GRAY SILT WITH SAND. SOFT TO VERY SOFT CONSISTENCY, WET, HIGH PLASTICITY, RAPID DILATANCY, LOW TOUGHNESS. TAILINGS.
		SHELBY TUBE	B103-SB -16.0 16:00	15, 16, 17			27% SHELBY TUBE RECOVERY
		SHELBY TUBE	B103-SB -19.0 16:51	18, 19, 20			100% SHELBY TUBE RECOVERY
		8 10 10	B103-SB -21.5 17:10	21, 22		ML	GRAY SILT INTERBEDDED WITH LIGHT BROWN FINE SAND WITH SILT. WET. TAILINGS. 100% SPT RECOVERY, 20.5' TO 22' BGS

Legend:

- Bentonite Chips: 0'-46.5', 3/8" chips
- California Sampler
- SPT Interval

Notes:

2" BY 18" SPLIT SPOON
SHELBY TUBE 3" BY 30"
ABANDONED WITH 24 50LB BAGS OF 3/8" BENTONITE CHIPS
*4 3/4" BIT USED TO ADVANCE THROUGH DENSE MATERIAL ONLY

TerraGraphics Environmental Engineering, Inc.

Project No.: 12068

Log of Boring No.: B-103

PROJECT: LBCR	Log of Boring No.: B-103
BORING LOCATION: B-103 POND 2	ELEVATION AND DATUM: GROUND, POND SURFACE
DRILLING CONTRACTOR: MAJOR	STARTED - DATE: 9/12/2012 TIME: 12:14 / COMPLETED - DATE: 9/13/2012 TIME: 11:25
DRILLER: STEVE ZIMMERMAN	TOTAL DEPTH (ft): 46.5' / WELL DEPTH(ft): N/A / MEASURING POINT:
DRILLING METHOD: ROTOSONIC	DEPTH TO WATER (ft): DRY / TIME:
DRILLING EQUIPMENT: GEOPROBE 8140LS 6" AND *4 3/4" BIT	LOGGED BY: MIKE PROCSAL
SAMPLING METHOD: SPT, CORE BARREL, SHELBY	REVIEWED BY: MELODY STUDER

Well Construction Detail	PID/FID (ppm)	SAMPLES Blows Per 6"	SAMPLES Sample ID and Time	DEPTH (feet)	GRAPHIC	CLASS	DESCRIPTION Group Symbol (e.g. SM), Color, Group Name (e.g. Silty Sand), Particle Size Range, Consistency (hard soft) , Moisture Content, and others
		4 5 6	B103-SB -27.5 08:15 9/13/2012	22–29		ML	GRAY SILT INTERBEDDED WITH LIGHT BROWN FINE SAND WITH SILT (SM). WET. TAILINGS. 100% RECOVERY 25' TO 26.5' BGS
		0	B103-SB -32.5 08:50 9/13/2012	30–32		ML/ CL	GRAY CLAYEY SILT, VERY SOFT, WET, HIGH PLASTICITY. RAPID DILATANCY. TAILINGS. 100% RECOVERY FROM 30' TO 30.5' WEIGHT OF TOOLING DROVE SPLIT SPOON THROUGH SAMPLE INTERVAL. 0 BLOW COUNTS.
				33		SM	LENS OF OLIVE GRAY SILTY SAND, FINE, MOIST, NO PLASTICITY, RAPID DILATANCY. TAILINGS.
		0	B103-SB -37.5 09:18 9/13/2012	34–36		ML/ CL	GRAY CLAYEY SILT TAILINGS (SAME AS AT 32 FT BGS) INTERBEDDED IN ALTERNATING, <6" LAYERS WITH OLIVE GRAY TO BLACK SILTY SAND (SAME AS ABOVE). 100% RECOVERY FROM 35 TO 36.5 SPT. WEIGHT OF TOOLING DROVE SPLIT SPOON THROUGH SAMPLE INTERVAL. 0 BLOW COUNTS.
		0 0 24	B103-SB -40.5 10:10 9/13/2012	39–41			100% RECOVERY FROM SPT FROM 40' TO 41.5'
		50/2.5"	B103-SB -44.0 10:40 9/13/2012	41–47		GM	DARK BROWN SILTY GRAVEL WITH SAND AND COBBLES. WELL GRADED, SUBROUNDED. ~5% SUBROUNDED COBBLES. ~25% FINES,~ 25% WELL GRADED SAND. VERY DENSE, DRY, MEDIUM DRY STRENGTH. ALLUVIUM. 22% RECOVER FROM SPT FROM 45' TO 46.5'

Legend:

Bentonite Chips: 0'-46.5', 3/8" chips

California Sampler

SPT Interval

Notes:

2" BY 18" SPLIT SPOON
SHELBY TUBE 3" BY 30"
ABANDONED WITH 24 50LB BAGS OF 3/8" BENTONITE CHIPS
*4 3/4" BIT USED TO ADVANCE THROUGH DENSE MATERIAL ONLY

TerraGraphics Environmental Engineering, Inc.	Project No.: 12068	Page 1 of 1

PROJECT: LBCR	Log of Boring No.: TP-08
BORING LOCATION: TP-08 POND 4 EMBANKMENT	ELEVATION AND DATUM: GROUND AT POND SURFACE
DRILLING CONTRACTOR: NORTHWIND	STARTED - DATE: 9/5/2012 TIME: 15:30 / COMPLETED - DATE: 9/5/2012 TIME: 16:28
DRILLER: MATT	TOTAL DEPTH (ft): 15' / WELL DEPTH(ft): N/A / MEASURING POINT:
DRILLING METHOD: EXCAVATION	DEPTH TO WATER (ft): N/A / TIME: -
DRILLING EQUIPMENT: VOLVO EC220DL	LOGGED BY: CLAY LARKINS
SAMPLING METHOD: GRAB & COMPOSITE	REVIEWED BY: MELODY STUDER

Well Construction Detail	PID/FID (ppm)	SAMPLES: Blows Per 6"	SAMPLES: Sample ID and Time	DEPTH (feet)	GRAPHIC	CLASS	DESCRIPTION Group Symbol (e.g. SM), Color, Group Name (e.g. Silty Sand), Particle Size Range, Consistency (hard soft) , Moisture Content, and others
			TP08-SS -0.5 & *TP08-SD -0.5 15:30	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11		GM	LIGHT BROWN SILTY GRAVEL WITH COBBLES & SAND. WELL GRADED, ANGULAR GRAVEL, ~5% COBBLES & 40% FINES, DRY, COARSE COMPONENT QUARTZITE & ARGILLITE. EMBANKMENT MATERIAL.
				3			OCCASIONAL LENSES OF GRAVEL WITH NOTABLY GRAY SILT FINES
				4			TRANSITION TO BROWN SILT FINES, SLIGHTLY MOIST
			TP-08 SB 11.5 16:05	11, 12, 13, 14		GM-GW	LIGHT GRAY AND BROWN GRAVEL WITH SILT ROUNDED TO ANGULAR, WELL GRADED GRAVEL. COARSE FRACTION SCHISTOSE ARGILLITE & QUARTZITE ~10% FINES. EMBANKMENT MATERIAL.
				14		ML	GRAY SILT, MOIST, SAME AS GRAY SILT IN TP6 AT >8'. TAILINGS.
				15, 16, 17, 18, 19, 20			

Legend:

- Concrete: N/A
- Filter Sand: N/A
- Bentonite Chips: N/A
- Slotted Well Screen: N/A

Notes:

*TP08-SD-0.5 COMPOSITED IN POND4-COMP-SD-090612, 17:24

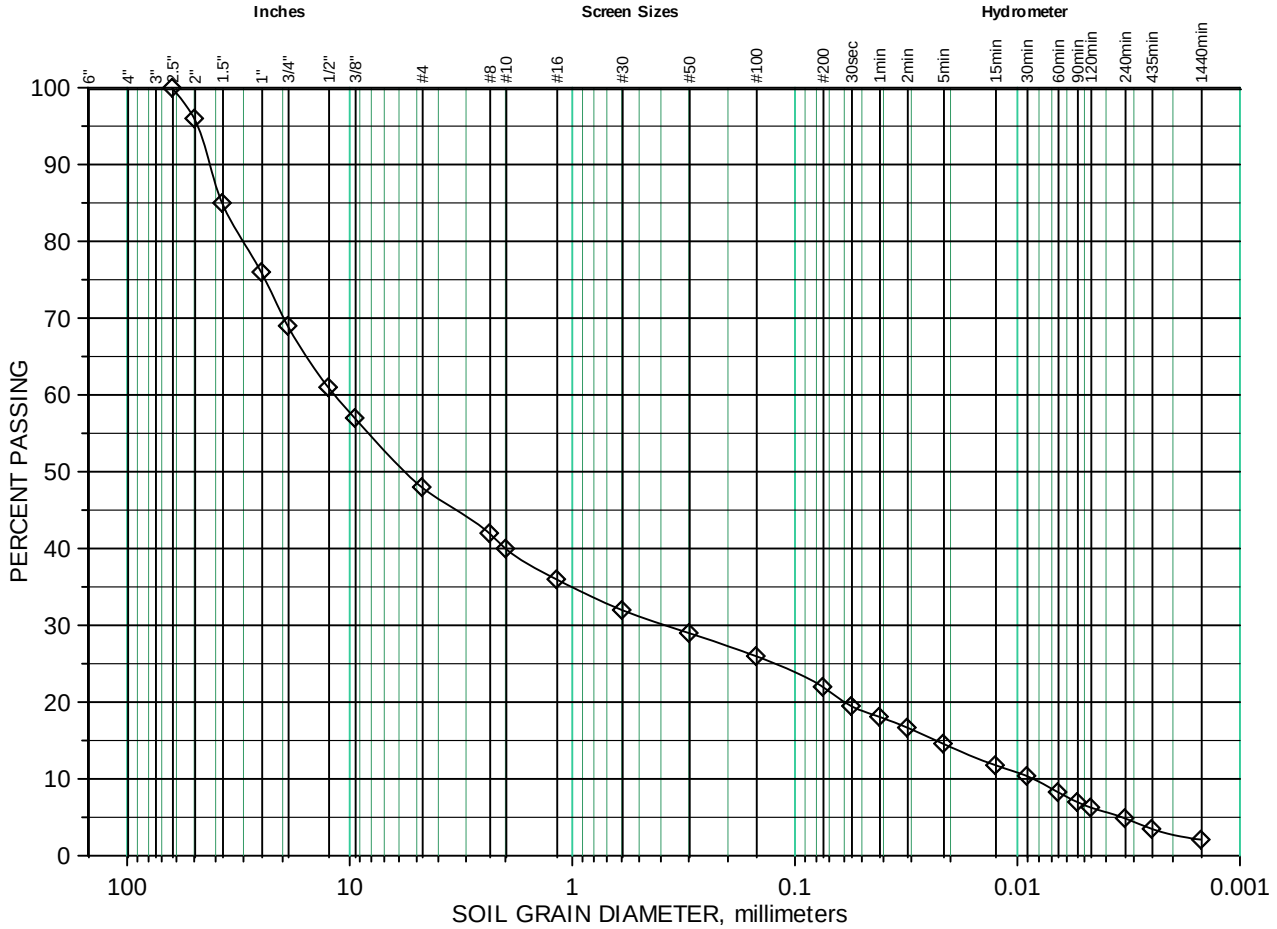
EAST SLOPING EMBANKMENT RISER CONTACT WITH TAILING ON EAST END OF PIT

HYDROMETER ANALYSIS

ASTM D 422

Project: 2012 LBCR Pre-Design Investigations
Client: Maul Foster and Alongi, Inc.
File: MAUFOS AL12008A
Sample Location: B-101-20120913-SB-3.5
Description: Silty Gravel with Sand Atterberg Limits: LL=24, PI=4
Moisture Content: 3.5 %
Date Received: September 17, 2012
Date Tested: October 31, 2012 By: R. Matteson

Cobbles	Gravel		Sand			Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



Reviewed by: Angela Lemmeman

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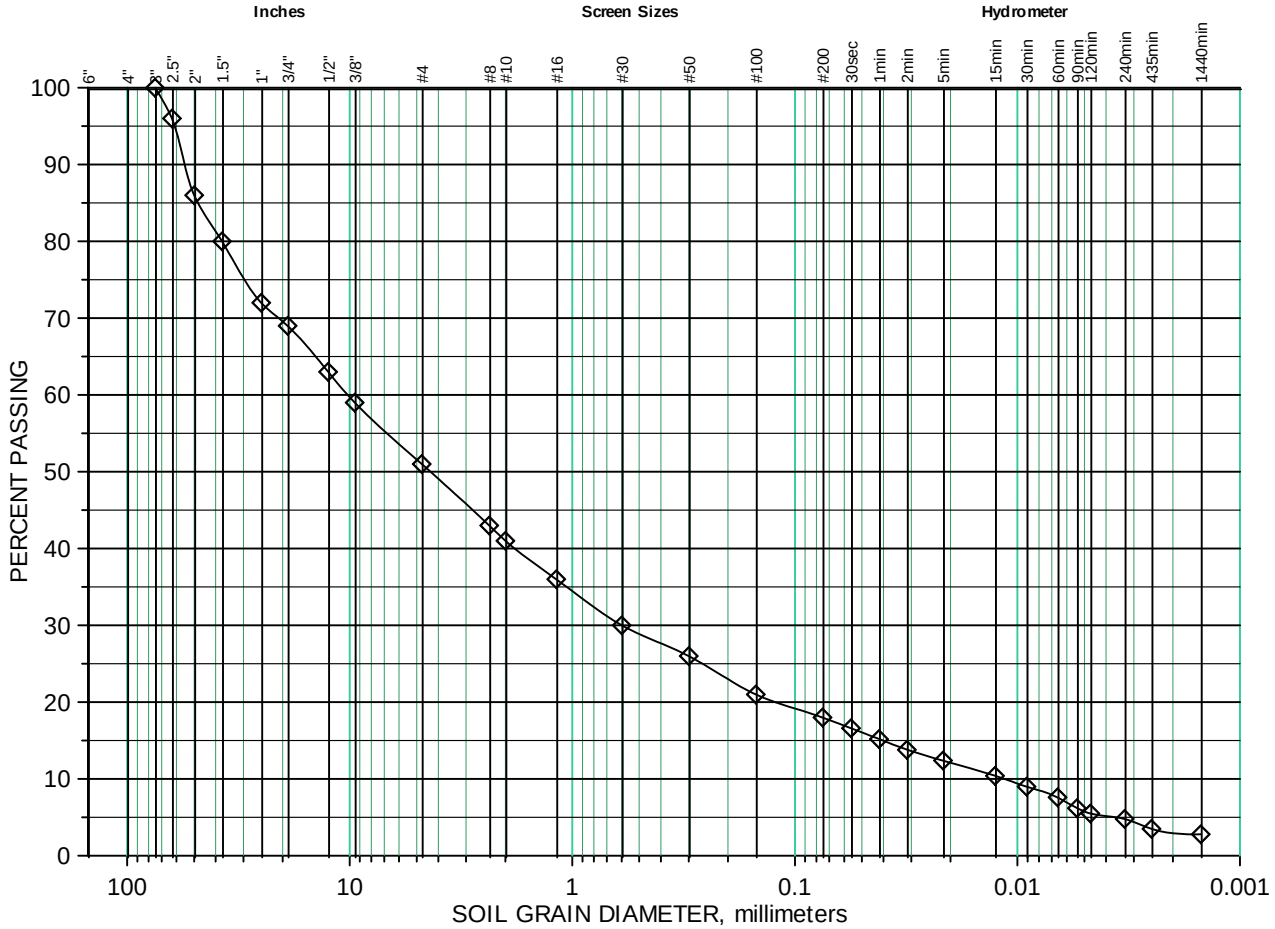
HYDROMETER ANALYSIS

ASTM D 422

Project: 2012 LBCR Pre-Design Investigations
Client: Maul Foster and Alongi, Inc.
File: MAUFOS AL12008A
Sample Location: B-103-20120912-SB-4.0
Description: Silty Gravel with Sand Atterberg Limits: Non-Plastic
Moisture Content: 4.4 %
Date Received: September 17, 2012
Date Tested: October 31, 2012 By: R. Matteson

Cobbles	Gravel		Sand			Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



Reviewed by: Angela Lemmeman

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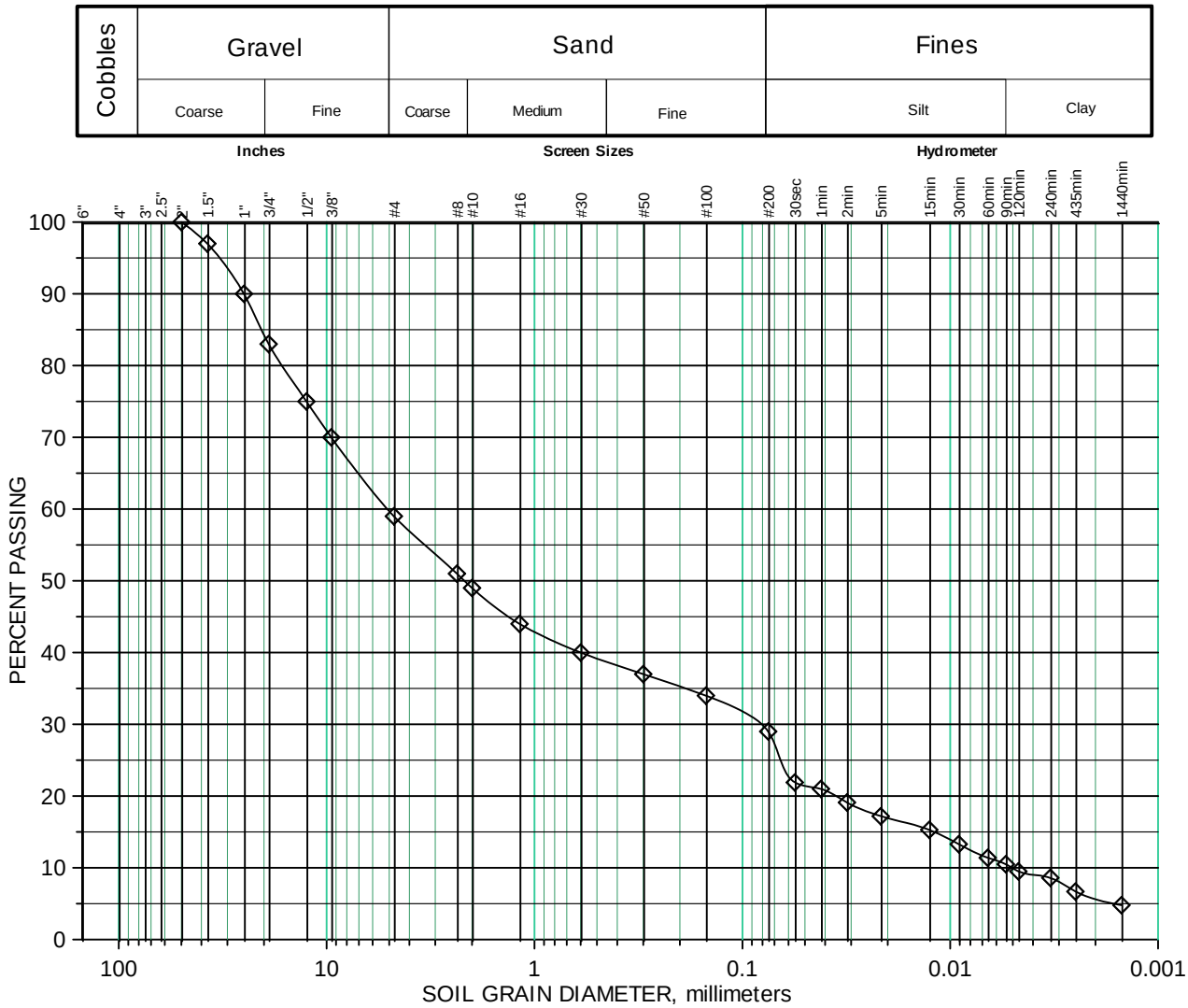
HYDROMETER ANALYSIS

ASTM D 422

Project: 2012 LBCR Pre-Design Investigations
Client: Maul Foster and Alongi, Inc.
File: MAUFOS AL12008A
Sample Location: TP-02-20120907-SB-4.0
Description: Silty Gravel with Sand
Moisture Content: N/A
Date Received: September 7, 2012
Date Tested: October 25, 2012 By: R. Matteson



Reviewed by: Angela Lemmeman

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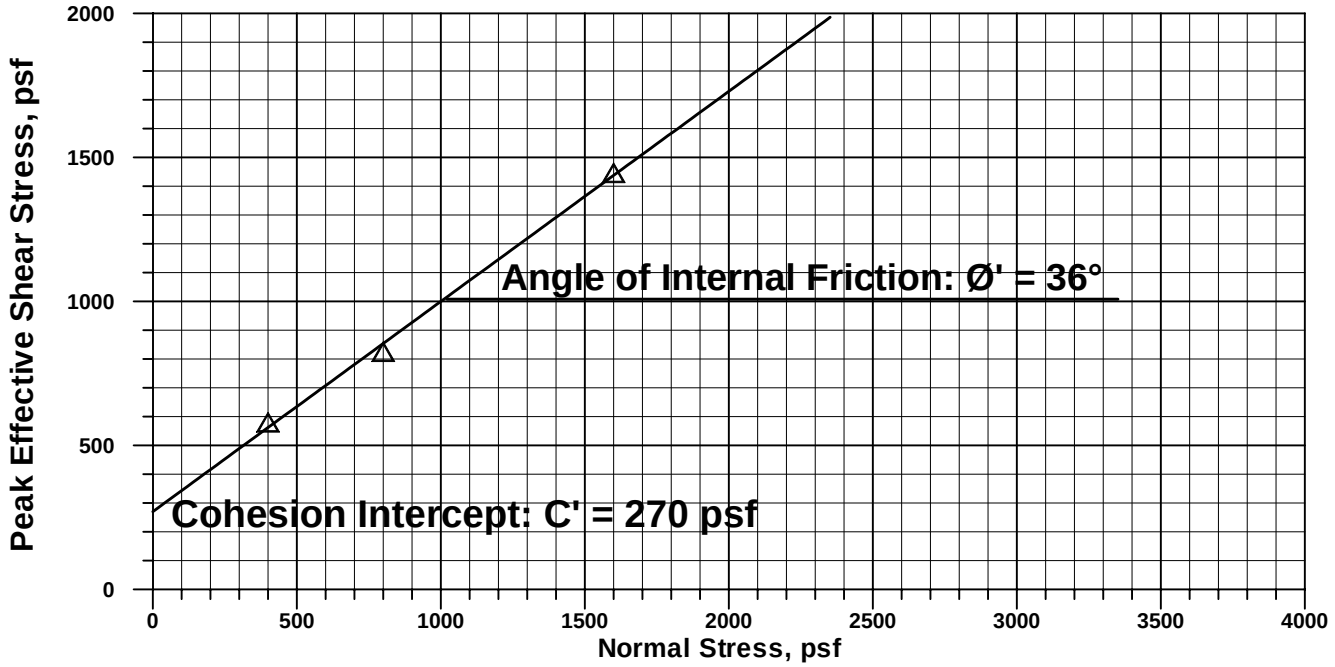
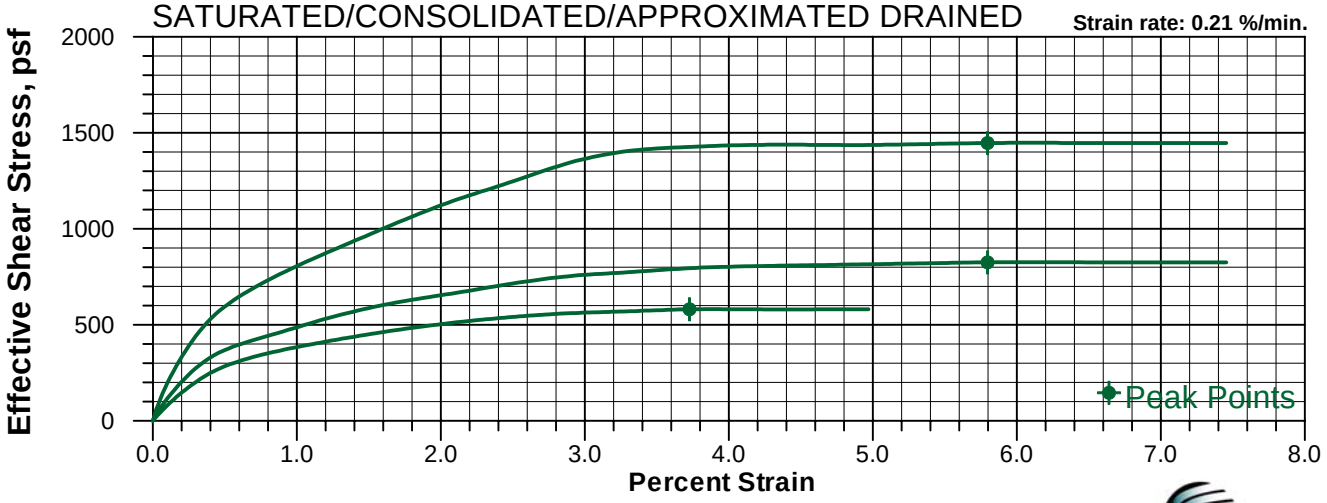
DIRECT SHEAR
ASTM D 3080

Project: LBCR Predesign
Client: Maul, Foster & Alongi
File Name: AL12008A
Lab Number: B12L1595B
Sample Identification: B101-20120913-SB-6.0
Sample Classification: Clayey Sand with Trace Gravel
Date Tested: 10/17-18/12 By: IR
Dry Unit Weight = 123.9 pcf @ 9.0% moisture
Atterberg Limits: LL = 25, PI = 8
Passing No. 200 Screen = 28%



SATURATED/CONSOLIDATED/APPROXIMATED DRAINED

Strain rate: 0.21 %/min.



Reviewed By: Adrian Vasconez

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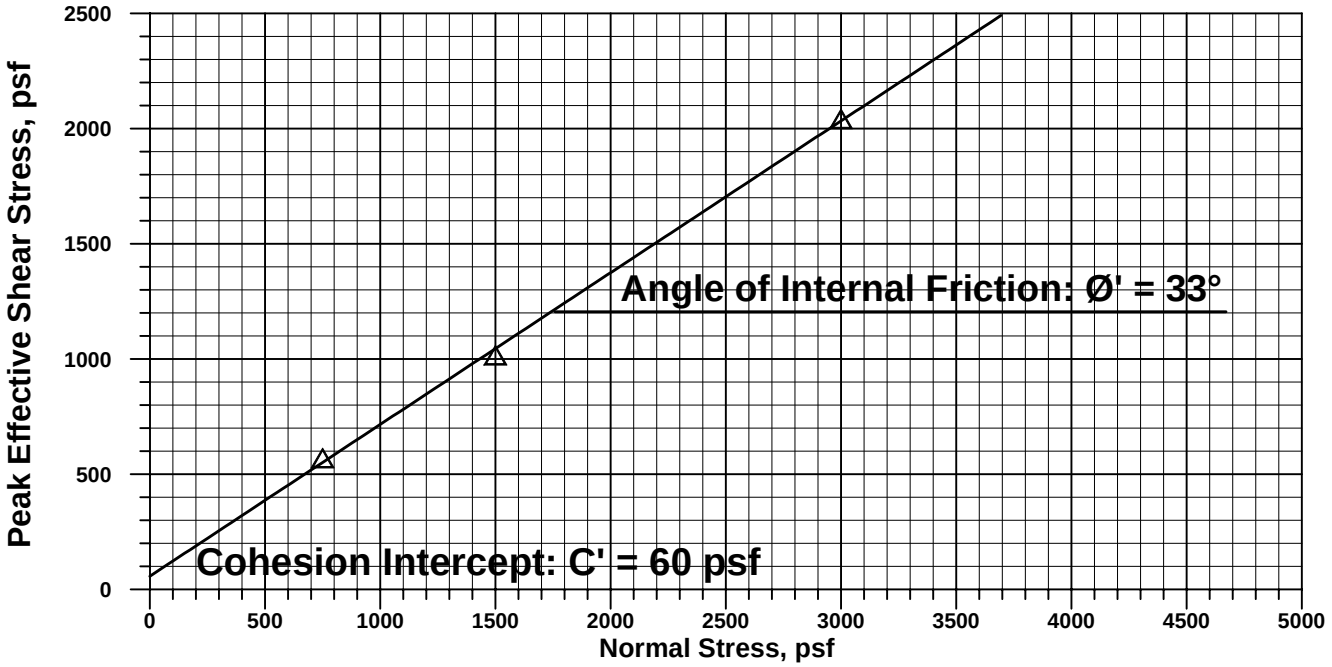
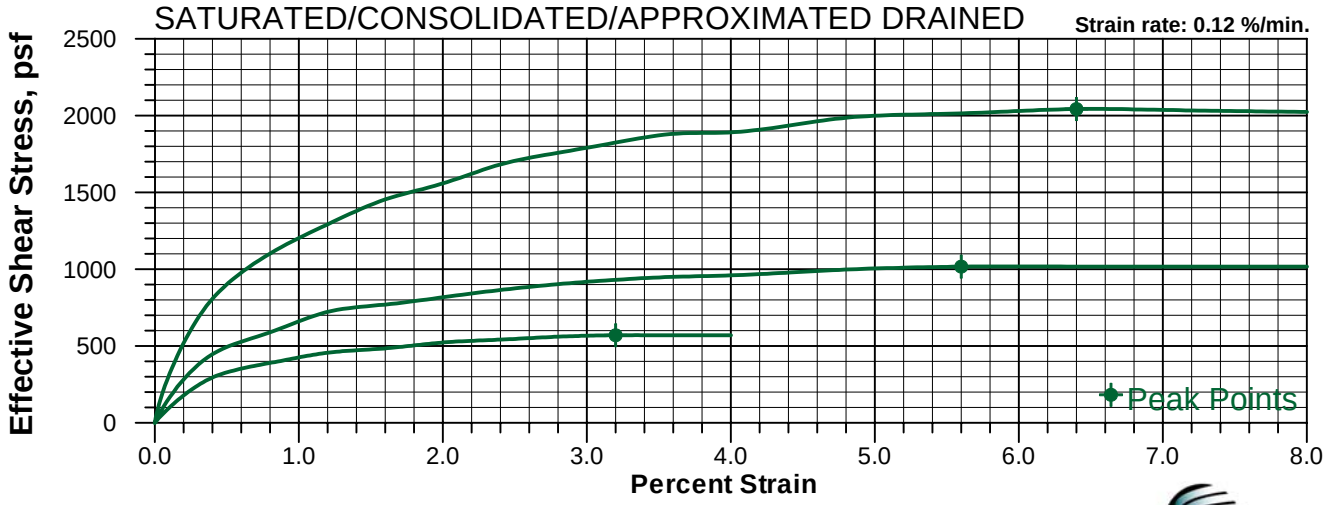
D I R E C T S H E A R
ASTM D 3080

Project: LBCR Predesign
Client: Maul, Foster & Alongi
File Name: AL12008A
Lab Number: B12L1595A
Sample Identification: B103-20120912-SB-19.0
Sample Classification: Silt
Date Tested: 10/16-17/12 By: IR
Dry Unit Weight = 107.3 pcf @ 25.6% moisture
Atterberg Limits: LL = 25, PI = 3
Passing No. 200 Screen = 94%



SATURATED/CONSOLIDATED/APPROXIMATED DRAINED



Reviewed By: _____

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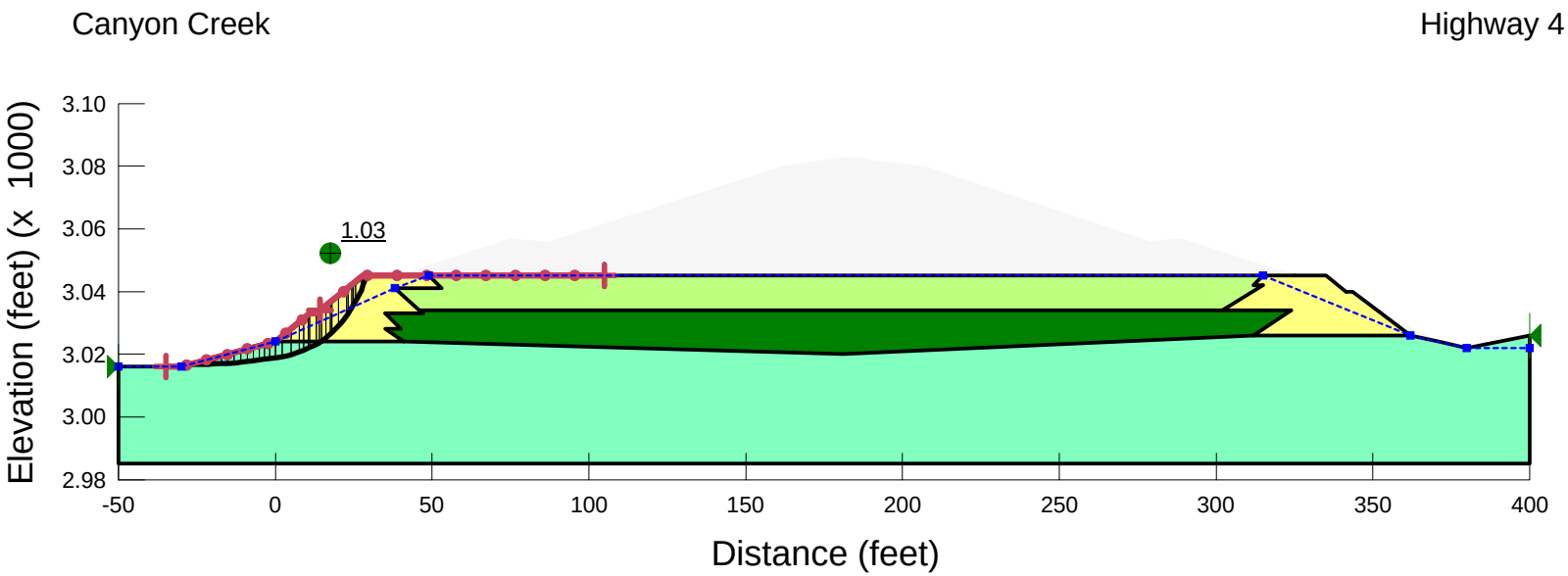
Integrity from the Ground Up

Attachment 4 – SLOPE/W Output (18 Pages)

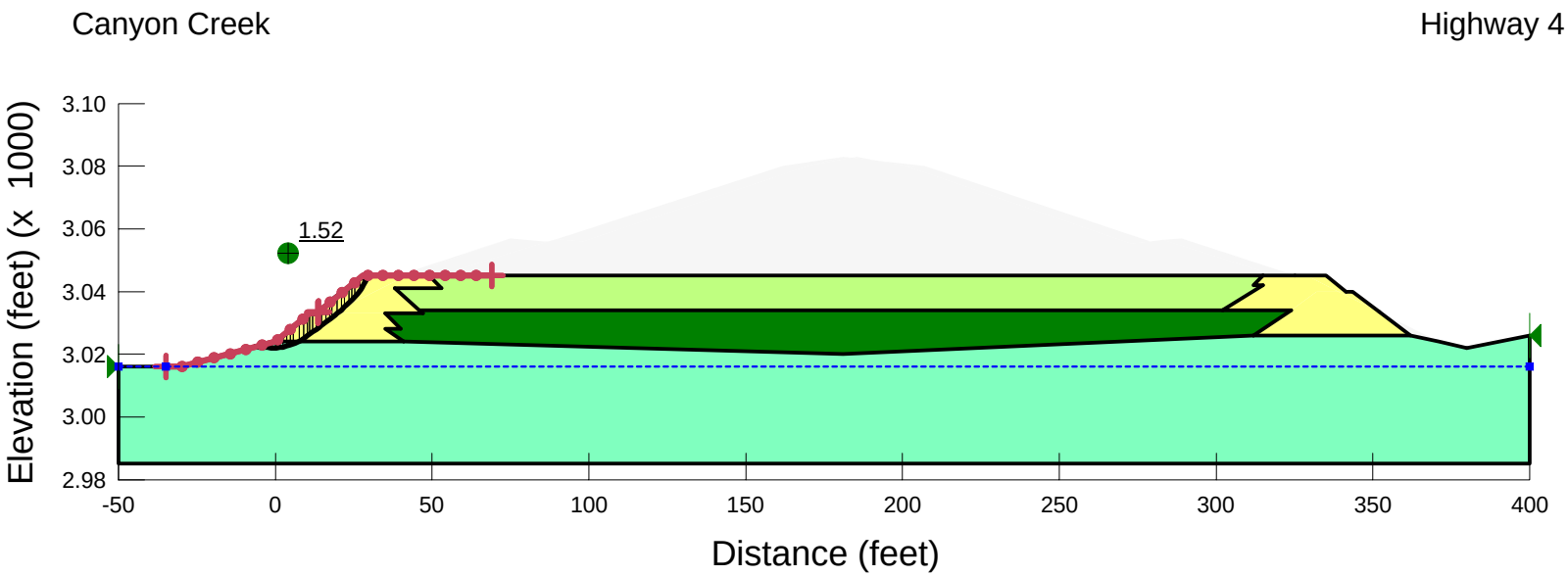
MATERIAL PROPERTIES:
Name: Starter Dams Model: Shear/Normal Fn. Unit Weight: 125 pcf Strength Function: Embankment
Name: Tailings Sands Model: Mohr-Coulomb Unit Weight: 110 pcf Cohesion: 0 psf Phi: 31 °
Name: Native Alluvium Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion: 0 psf Phi: 34.5 °
Name: Tailings Silts Model: Mohr-Coulomb Unit Weight: 110 pcf Cohesion: 0 psf Phi: 14 °



Stability Analysis, Pond 3

Case 1

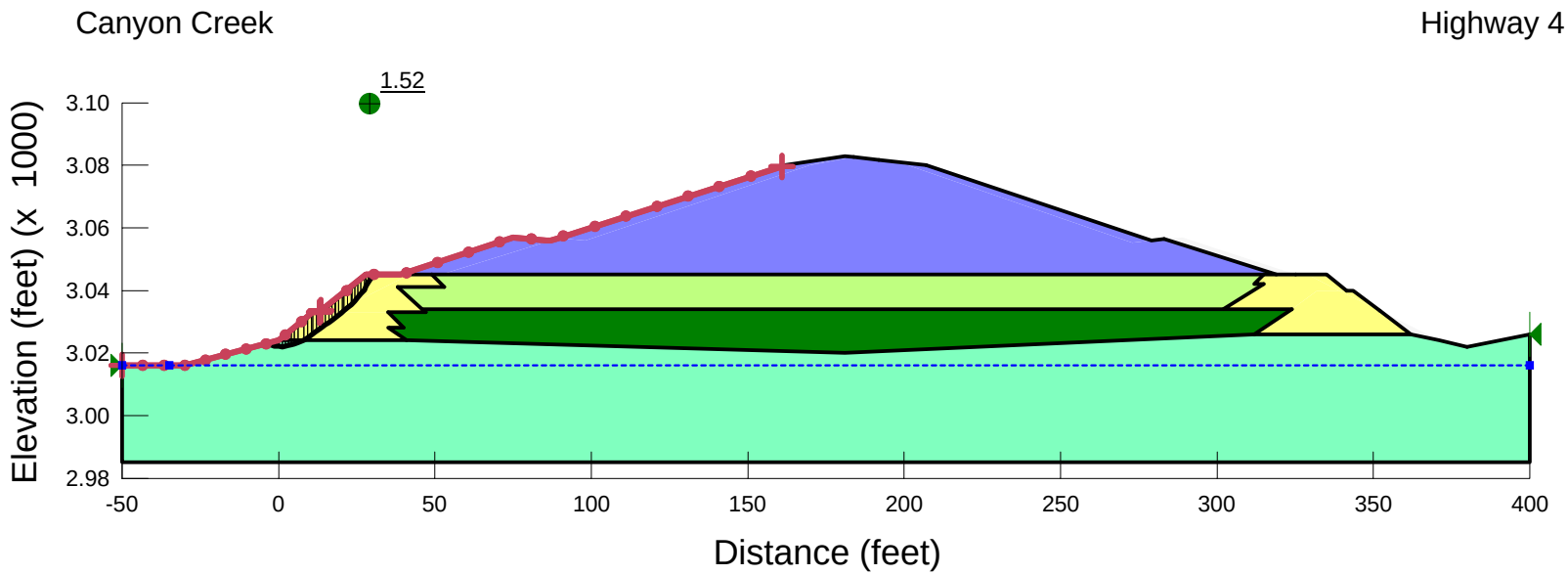
MATERIAL PROPERTIES:
Name: Starter Dams Model: Shear/Normal Fn. Unit Weight: 125 pcf Strength Function: Embankment
Name: Tailings Sands Model: Mohr-Coulomb Unit Weight: 110 pcf Cohesion: 0 psf Phi: 31 °
Name: Native Alluvium Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion: 0 psf Phi: 34.5 °
Name: Tailings Silts Model: Mohr-Coulomb Unit Weight: 110 pcf Cohesion: 0 psf Phi: 14 °



Stability Analysis, Pond 3

Case 2

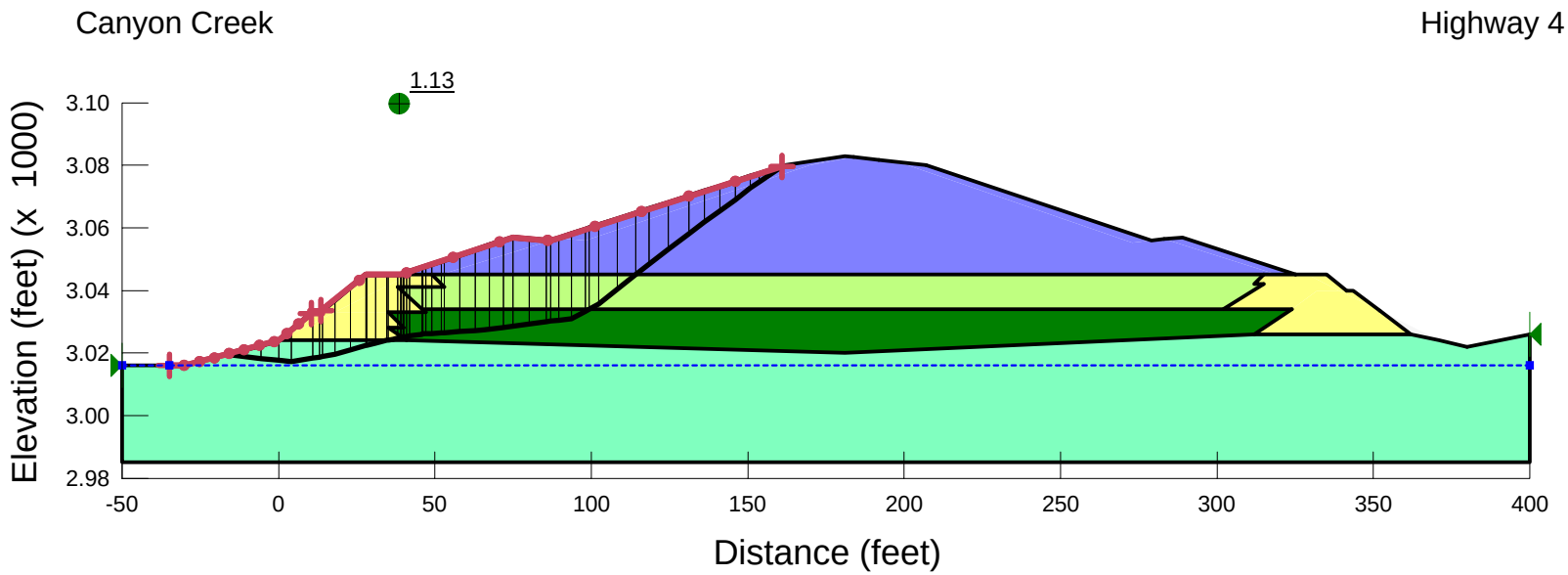
MATERIAL PROPERTIES:
Name: Starter Dams Model: Shear/Normal Fn. Unit Weight: 125 pcf Strength Function: Embankment
Name: Tailings Sands Model: Mohr-Coulomb Unit Weight: 110 pcf Cohesion: 0 psf Phi: 31 °
Name: Native Alluvium Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion: 0 psf Phi: 34.5 °
Name: Repository Material Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion: 0 psf Phi: 31 °
Name: Tailings Silts Model: Mohr-Coulomb Unit Weight: 110 pcf Cohesion: 0 psf Phi: 14 °



Stability Analysis, Pond 3

Case 3 - Static

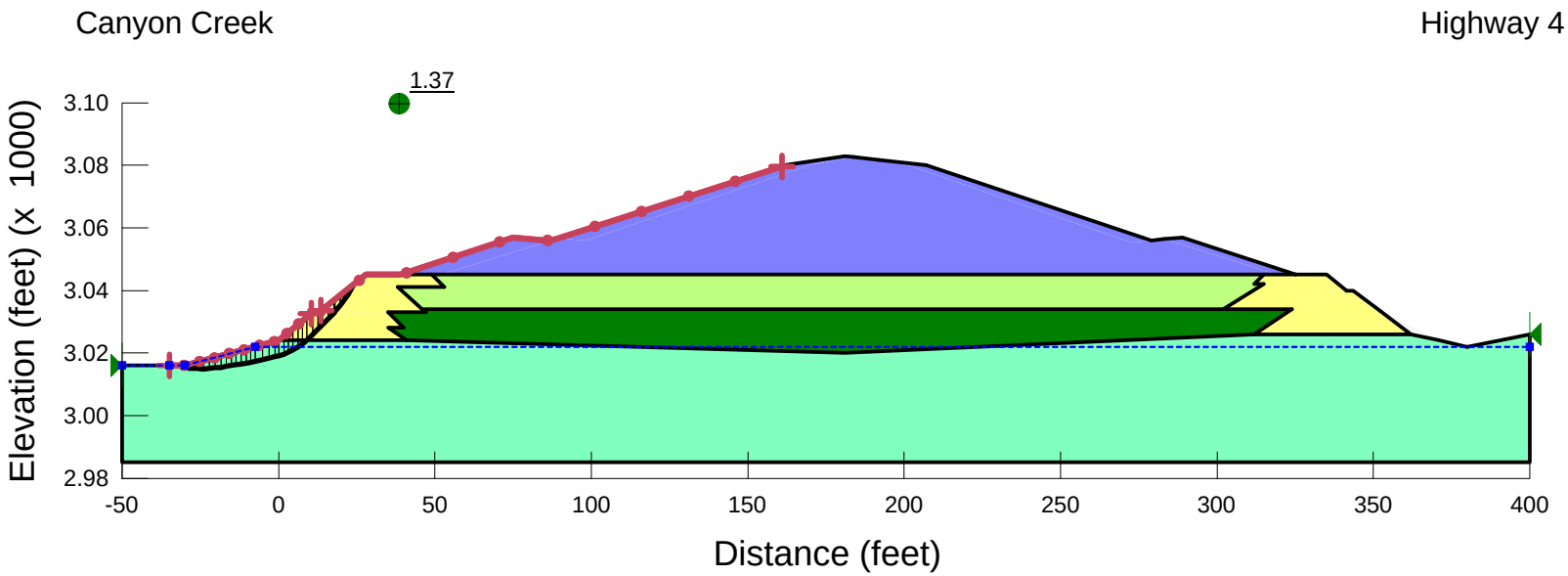
MATERIAL PROPERTIES:
Name: Starter Dams Model: Shear/Normal Fn. Unit Weight: 125 pcf Strength Function: Embankment
Name: Tailings Sands Model: Mohr-Coulomb Unit Weight: 110 pcf Cohesion: 0 psf Phi: 31 °
Name: Native Alluvium Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion: 0 psf Phi: 34.5 °
Name: Repository Material Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion: 0 psf Phi: 31 °
Name: Tailings Silts Model: Mohr-Coulomb Unit Weight: 110 pcf Cohesion: 0 psf Phi: 14 °



Stability Analysis, Pond 3

Case 3 - Seismic

MATERIAL PROPERTIES:
Name: Starter Dams Model: Shear/Normal Fn. Unit Weight: 125 pcf Strength Function: Embankment
Name: Tailings Sands Model: Mohr-Coulomb Unit Weight: 110 pcf Cohesion: 0 psf Phi: 31 °
Name: Native Alluvium Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion: 0 psf Phi: 34.5 °
Name: Repository Material Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion: 0 psf Phi: 31 °
Name: Tailings Silts Model: Mohr-Coulomb Unit Weight: 110 pcf Cohesion: 0 psf Phi: 14 °



Stability Analysis, Pond 3

Case 4

MATERIAL PROPERTIES:
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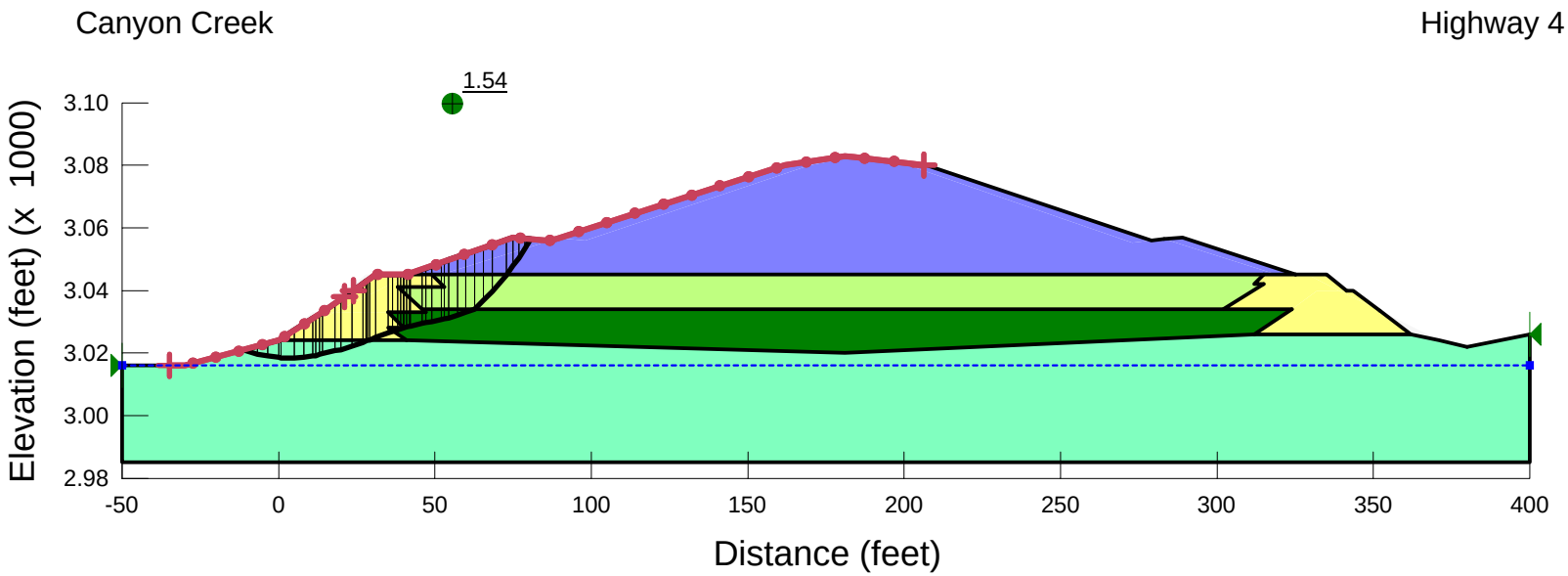
Name: Native Alluvium Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion: 0 psf Phi: 34.5 °
Name: Repository Material Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion: 0 psf Phi: 31 °
Name: Tailings Silts Model: Mohr-Coulomb Unit Weight: 110 pcf Cohesion: 0 psf Phi: 14 °



Stability Analysis, Pond 3

Case 5 - Static

MATERIAL PROPERTIES:
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Name: Tailings Sands Model: Mohr-Coulomb Unit Weight: 110 pcf Cohesion: 0 psf Phi: 31 °
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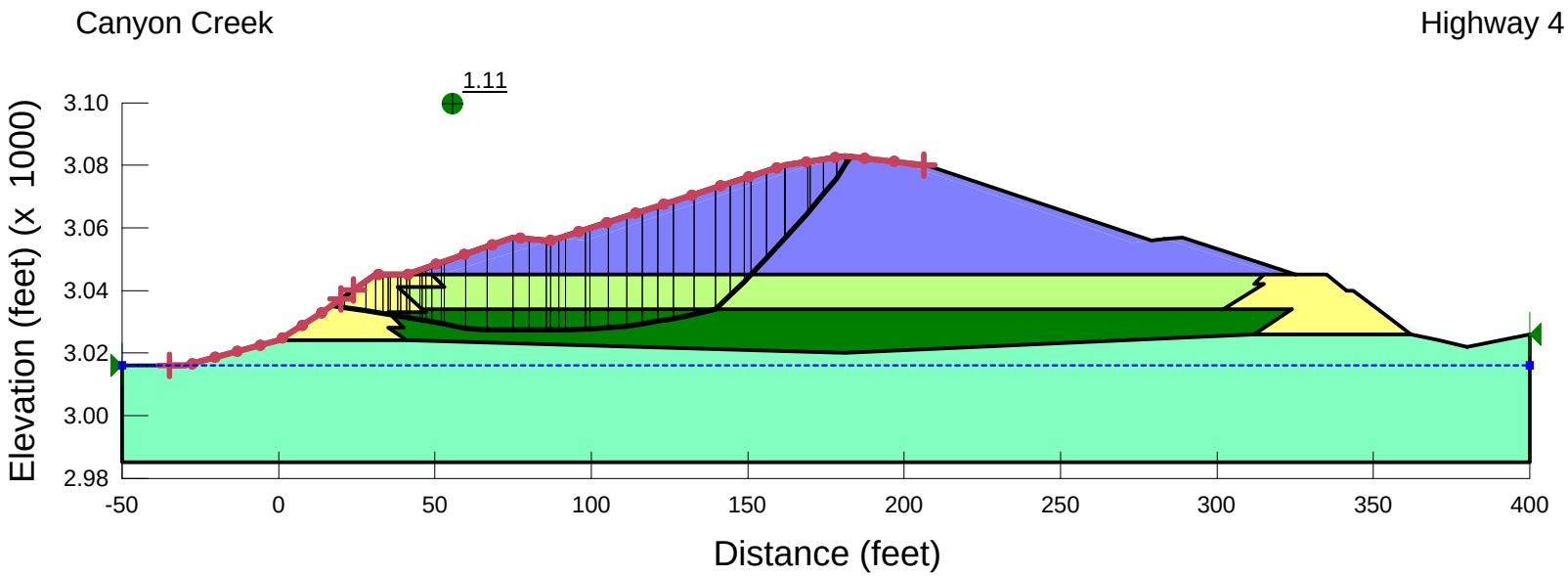
Name: Tailings Silts Model: Mohr-Coulomb Unit Weight: 110 pcf Cohesion: 0 psf Phi: 14 °



Stability Analysis, Pond 3

Case 5 - Seismic

MATERIAL PROPERTIES:
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Name: Tailings Sands Model: Mohr-Coulomb Unit Weight: 110 pcf Cohesion: 0 psf Phi: 31 °
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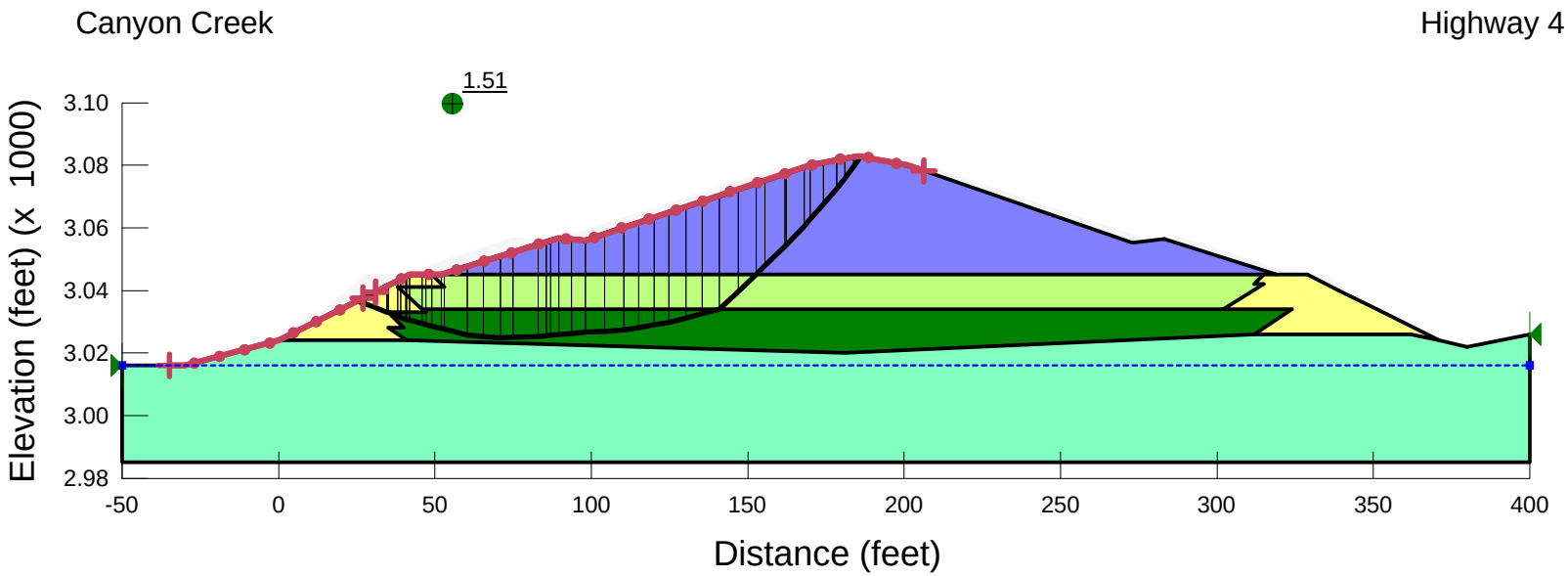
Name: Tailings Silts Model: Mohr-Coulomb Unit Weight: 110 pcf Cohesion: 0 psf Phi: 14 °



Stability Analysis, Pond 3

Case 6 - Static

MATERIAL PROPERTIES:
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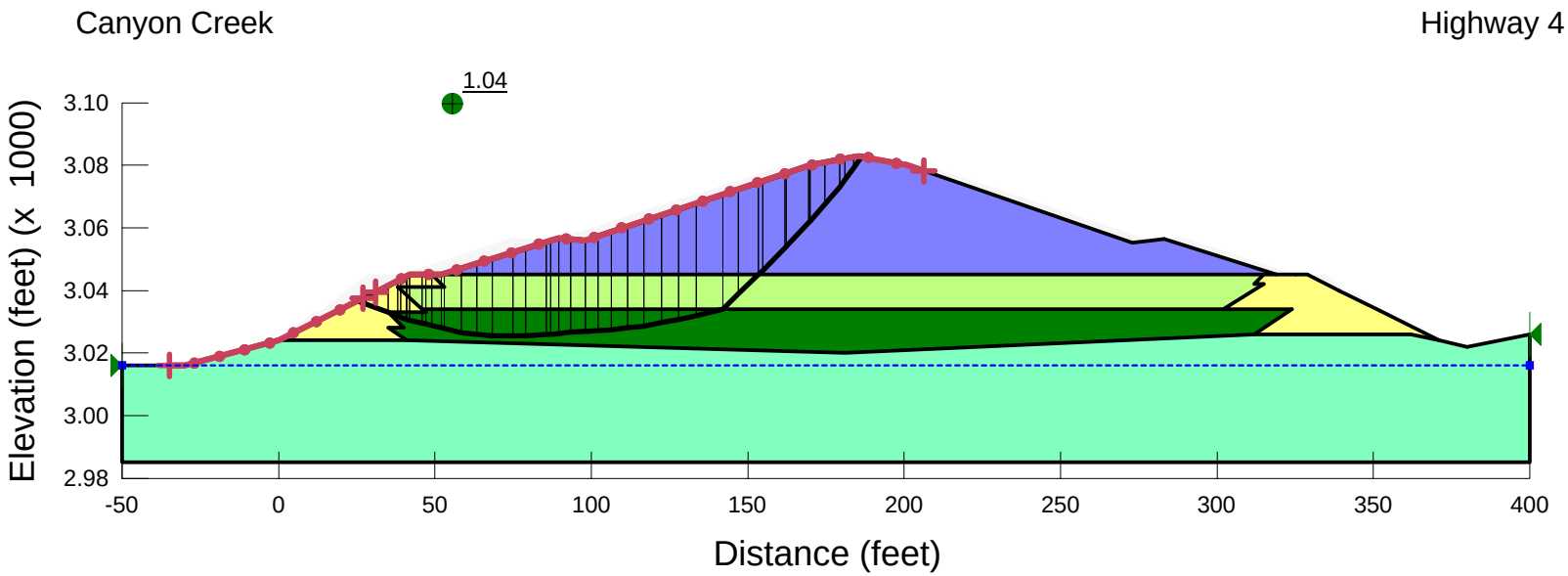

Stability Analysis, Pond 3

Case 6 - Seismic

MATERIAL PROPERTIES:
Name: Starter Dams Model: Shear/Normal Fn. Unit Weight: 125 pcf Strength Function: Embankment
Name: Tailings Sands Model: Mohr-Coulomb Unit Weight: 110 pcf Cohesion: 0 psf Phi: 31 °
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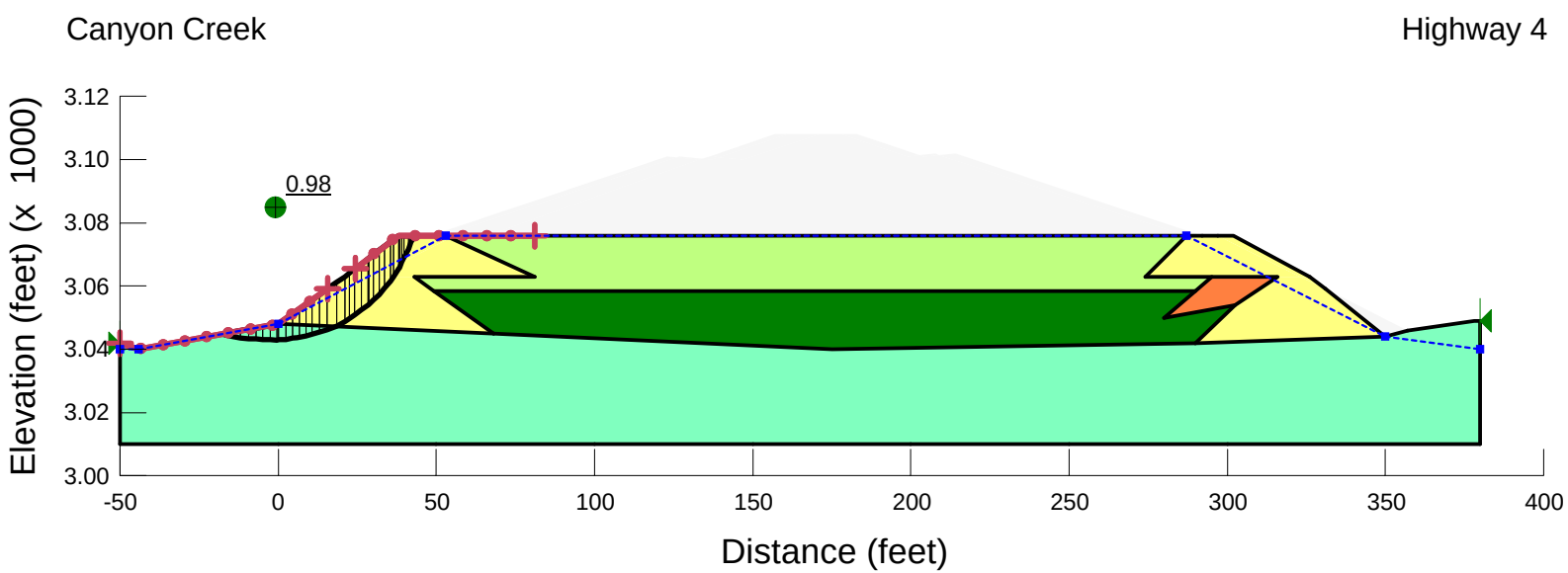
Name: Tailings Slimes Model: Mohr-Coulomb Unit Weight: 110 pcf Cohesion: 0 psf Phi: 14 °



Stability Analysis, Pond 4

Case 1

MATERIAL PROPERTIES:
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Name: Tailings Sands Model: Mohr-Coulomb Unit Weight: 110 pcf Cohesion: 0 psf Phi: 31 °
Name: Sloughed Embankment Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion: 0 psf Phi: 30 °
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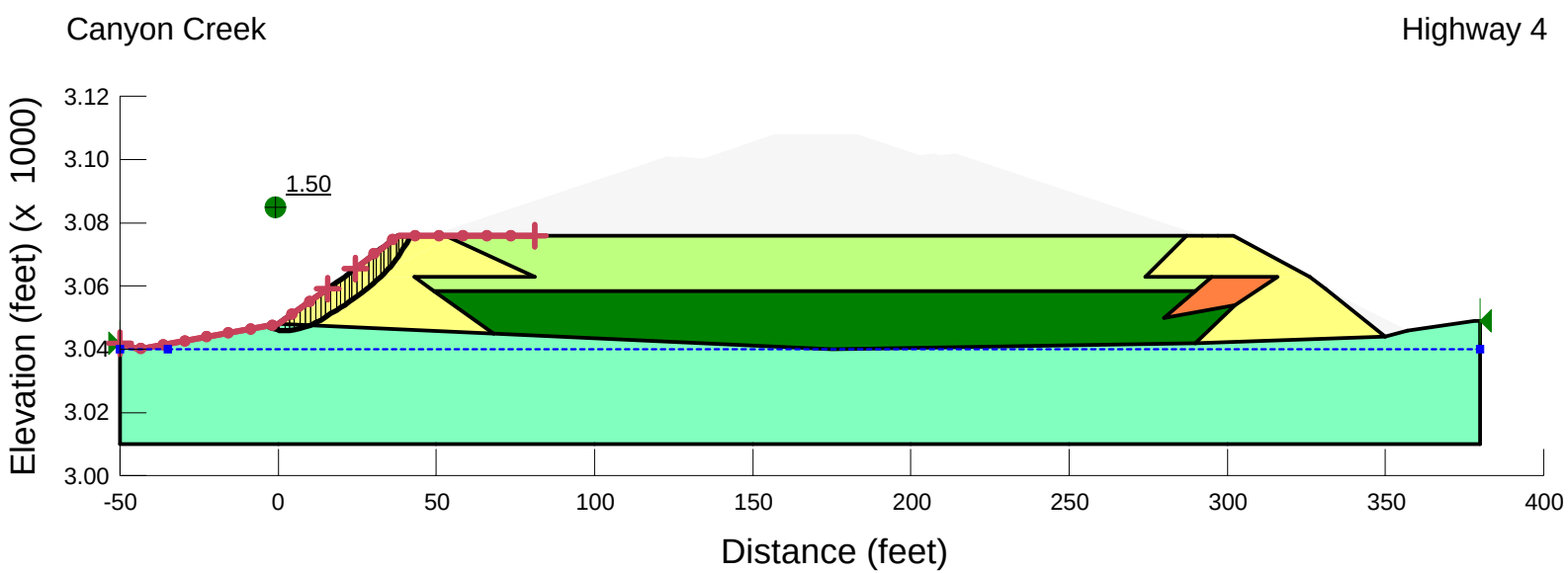
Name: Tailings Slimes Model: Mohr-Coulomb Unit Weight: 110 pcf Cohesion: 0 psf Phi: 14 °



Stability Analysis, Pond 4

Case 2

MATERIAL PROPERTIES:
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Name: Sloughed Embankment Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion: 0 psf Phi: 30 °
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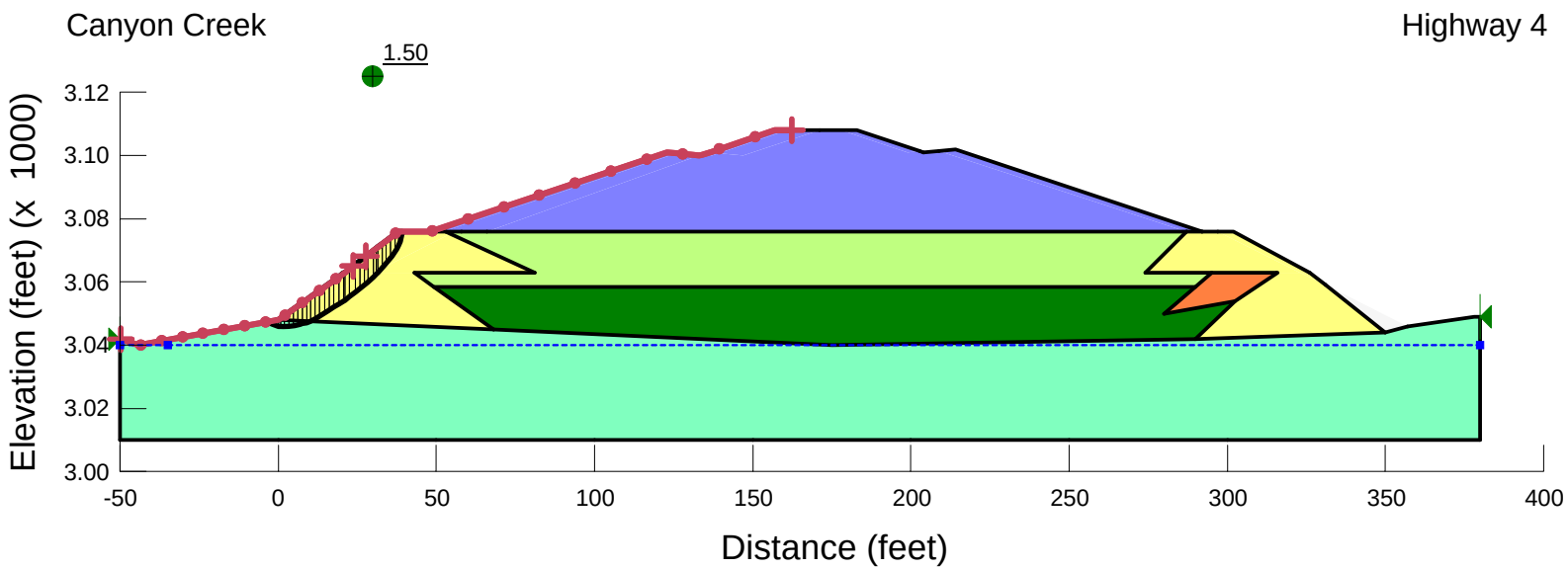
Name: Repository Material Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion: 0 psf Phi: 31 °
Name: Tailings Slimes Model: Mohr-Coulomb Unit Weight: 110 pcf Cohesion: 0 psf Phi: 14 °



Stability Analysis, Pond 4

Case 3 - Static

MATERIAL PROPERTIES:
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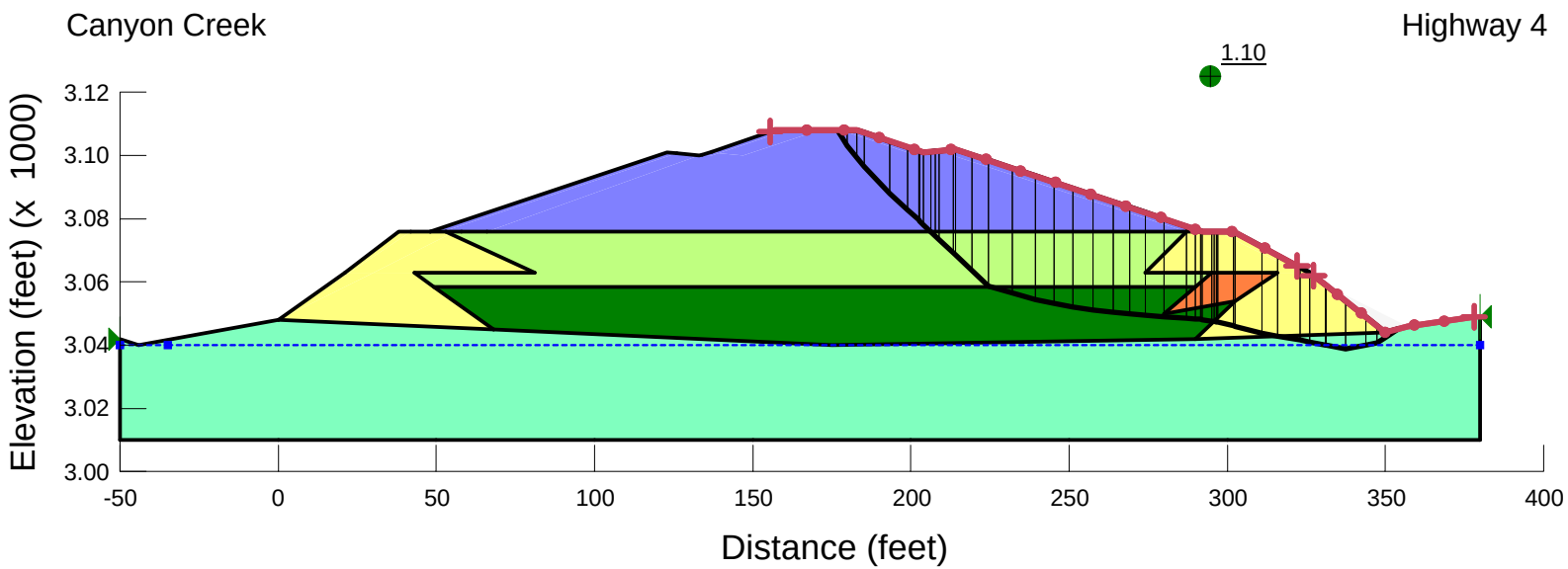

Stability Analysis, Pond 4

Case 3 - Seismic

MATERIAL PROPERTIES:
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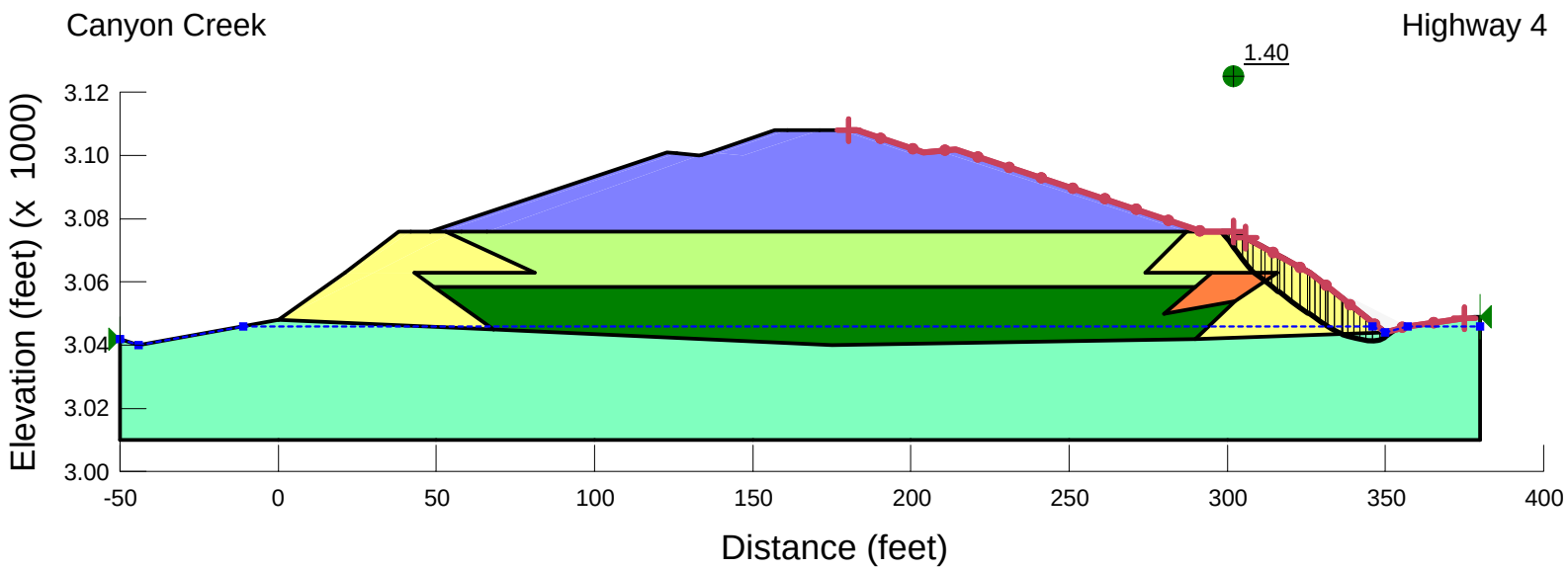
Name: Tailings Slimes Model: Mohr-Coulomb Unit Weight: 110 pcf Cohesion: 0 psf Phi: 14 °



Stability Analysis, Pond 4

Case 4

MATERIAL PROPERTIES:
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Name: Sloughed Embankment Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion: 0 psf Phi: 30 °
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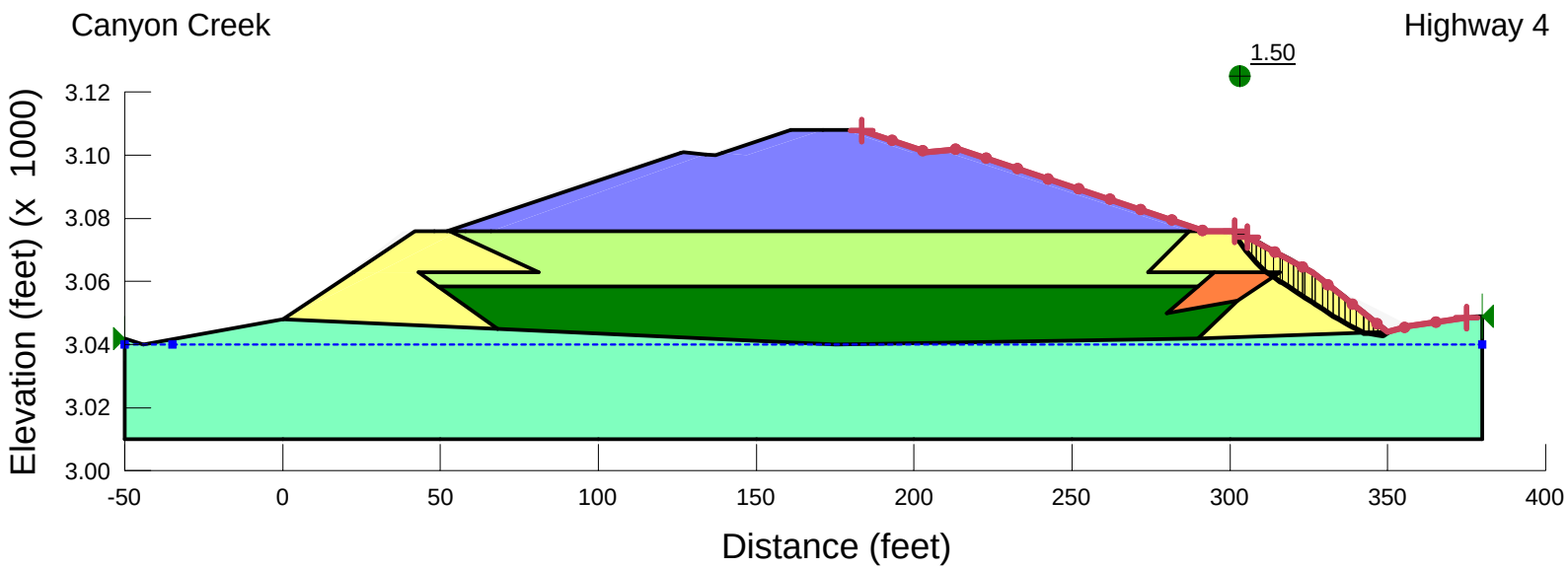
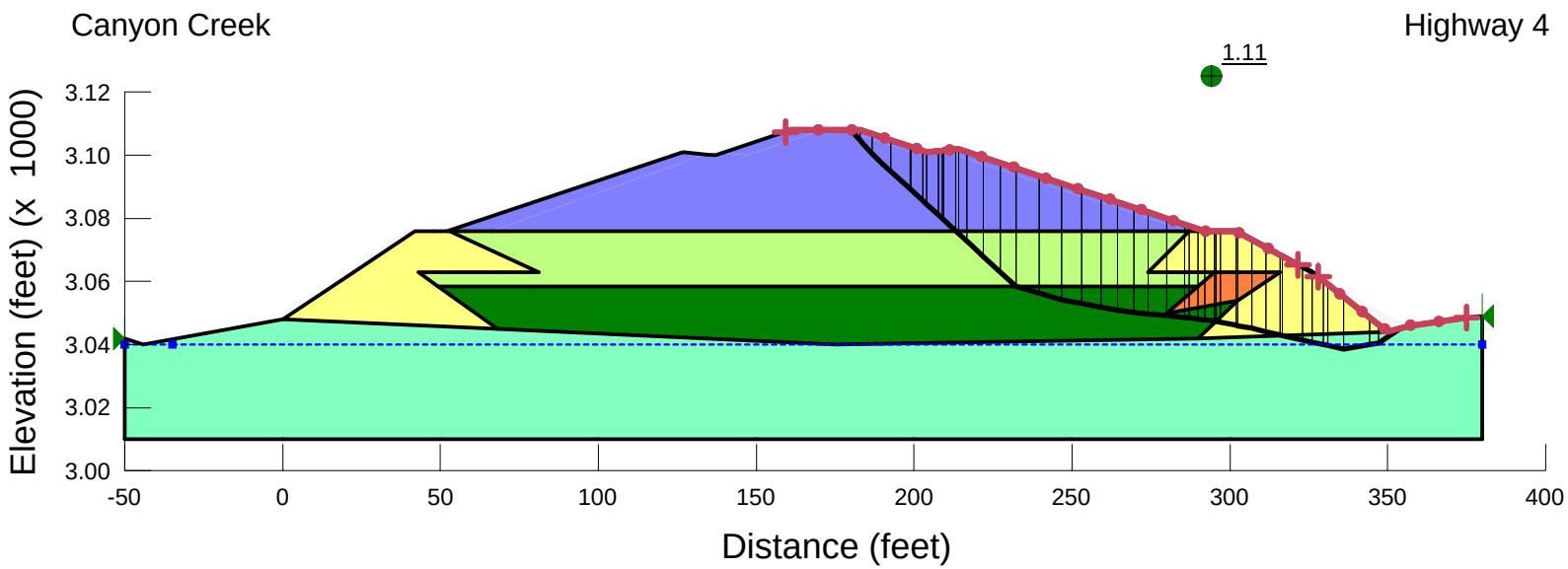
Name: Tailings Slimes Model: Mohr-Coulomb Unit Weight: 110 pcf Cohesion: 0 psf Phi: 14 °



Stability Analysis, Pond 4

Case 5 - Static

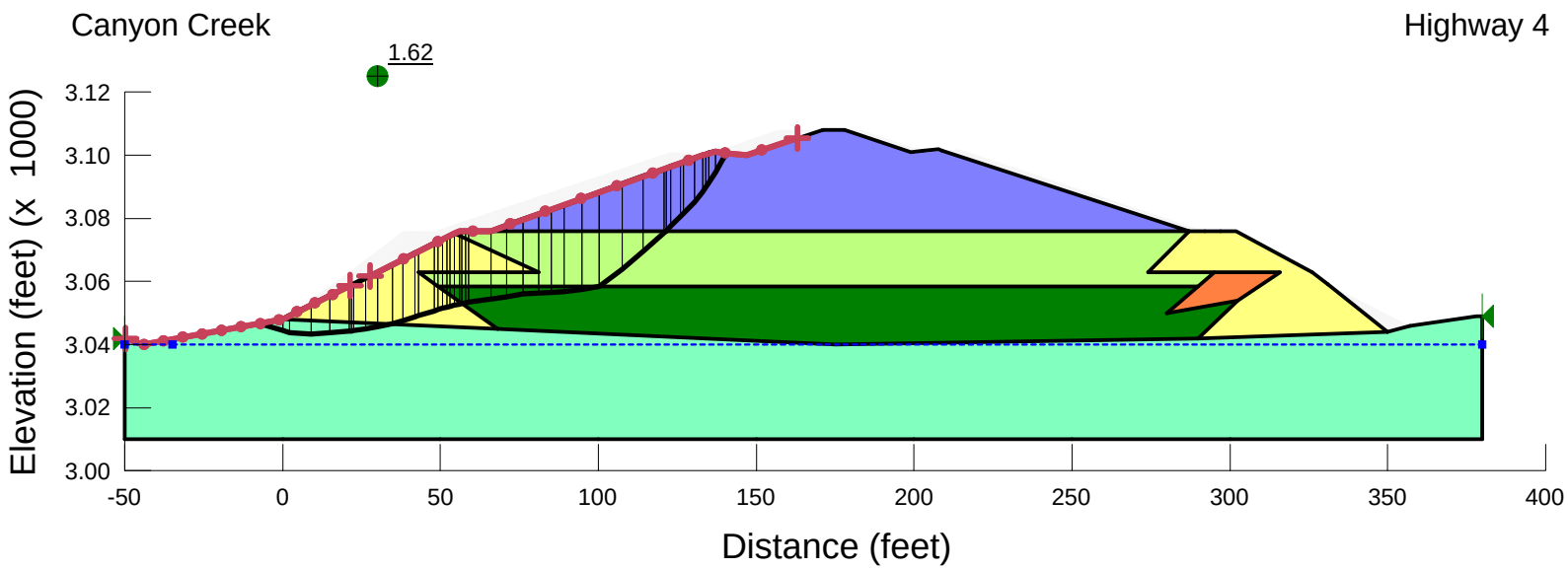
MATERIAL PROPERTIES:
Name: Starter Dams Model: Shear/Normal Fn. Unit Weight: 125 pcf Strength Function: Embankment
Name: Tailings Sands Model: Mohr-Coulomb Unit Weight: 110 pcf Cohesion: 0 psf Phi: 31 °
Name: Sloughed Embankment Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion: 0 psf Phi: 30 °
Name: Alluvium Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion: 0 psf Phi: 34.5 °
Name: Repository Material Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion: 0 psf Phi: 31 °
Name: Tailings Slimes Model: Mohr-Coulomb Unit Weight: 110 pcf Cohesion: 0 psf Phi: 14 °



Stability Analysis, Pond 4

Case 5 - Seismic

MATERIAL PROPERTIES:
Name: Starter Dams Model: Shear/Normal Fn. Unit Weight: 125 pcf Strength Function: Embankment
Name: Tailings Sands Model: Mohr-Coulomb Unit Weight: 110 pcf Cohesion: 0 psf Phi: 31 °
Name: Sloughed Embankment Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion: 0 psf Phi: 30 °
Name: Alluvium Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion: 0 psf Phi: 34.5 °
Name: Repository Material Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion: 0 psf Phi: 31 °
Name: Tailings Slimes Model: Mohr-Coulomb Unit Weight: 110 pcf Cohesion: 0 psf Phi: 14 °



Stability Analysis, Pond 4

Case 6 - Static

MATERIAL PROPERTIES:
Name: Starter Dams Model: Shear/Normal Fn. Unit Weight: 125 pcf Strength Function: Embankment
Name: Tailings Sands Model: Mohr-Coulomb Unit Weight: 110 pcf Cohesion: 0 psf Phi: 31 °
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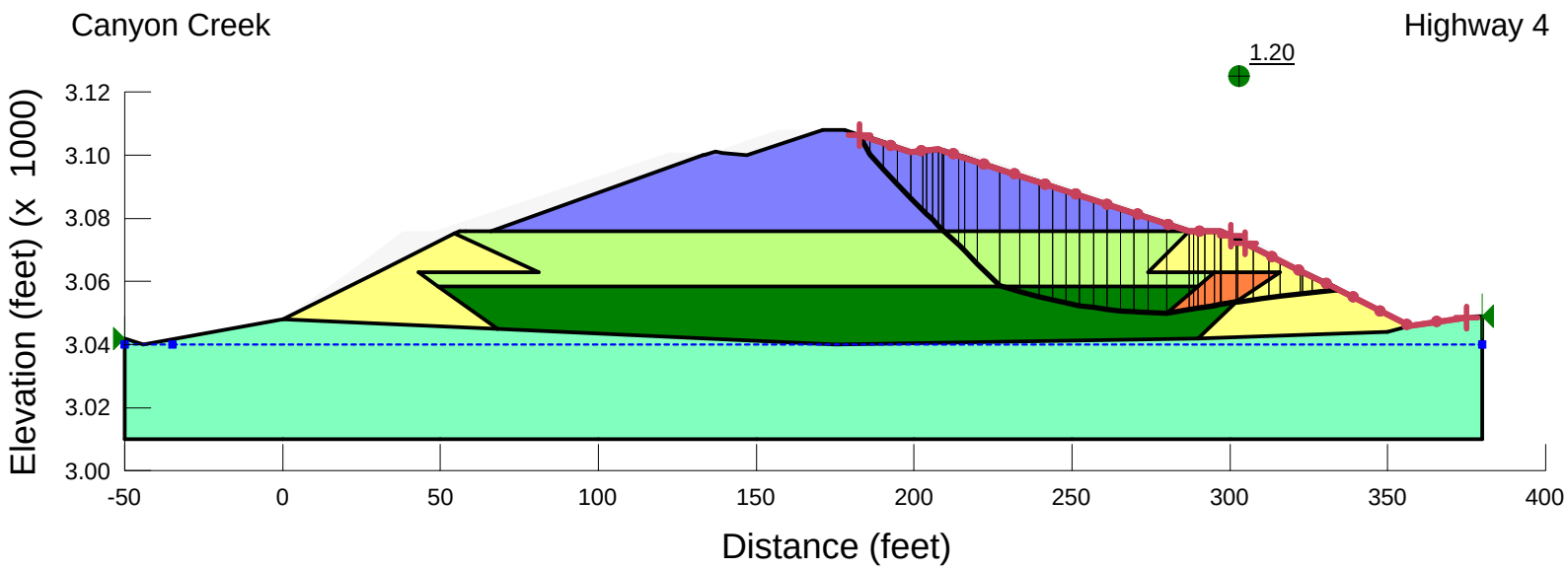
Name: Repository Material Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion: 0 psf Phi: 31 °
Name: Tailings Slimes Model: Mohr-Coulomb Unit Weight: 110 pcf Cohesion: 0 psf Phi: 14 °



Stability Analysis, Pond 4

Case 6 - Seismic

Appendix E

Canyon Creek Remedial Action Work Plan

CDM Smith

4.2.3
AR 4.2

CANYON CREEK-WOODLAND PARK RESPONSE ACTION 1995-1996 TAILINGS REMOVAL AND STREAM - FLOODPLAIN STABILIZATION WORK PLAN

Dated: June 7, 1995

151169
USEPA SF
1125788

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5.3.2 Repository Cap

After the repository base has been completed, the tailings will be placed in horizontal lifts and compacted to achieve adequate stability. After the tailings have been placed, the outside slopes and top of the repository will be finished graded to the appropriate slopes. It is anticipated that one of the two following alternatives will be performed prior to placement of the top one foot of growth medium; the top foot of mine tailings will be amended with either apatite or kiln-dust or that one foot of soil will be placed and compacted on the tailings. A one foot thick layer of soil from the southeast hillside adjacent to the repository will then be placed over the top and side slopes of the repository to act as a growth medium. This layer will then be revegetated to minimize erosion and to enhance run-off and evapotranspiration. An evaluation of the repository configuration and cap was done using the Hydrologic Evaluation of Landfill Performance (HELP) computer model. The current area of tailings planned for removal is 64.4 acres. The repository plan view area is approximately 7.05 acres. Consolidation of the wastes into the repository pile will reduce the area available for infiltration of precipitation by approximately 88 percent. Infiltration through the proposed cap should be on the order of 50% of precipitation. If the current interaction of groundwater with tailings and run-on from hillsides is ignored, the reduction from the present situation will be on the order of 94 percent. It should be noted that construction of the repository, with the presently proposed cap, will not preclude installation of a more efficient cap at a later time if monitoring indicates it is necessary and funds are available.

5.3.3 Drainage

In order to prevent run-on from the hillside east of the repository, a run-on diversion ditch will be constructed along the hillside at the top of the repository. Drainage from the flat top of the repository will also drain to this ditch. The ditch will be sized to convey the 100 year flood and riprap will be installed to prevent erosion in the steeper areas where the ditch comes from the hillside.

5.3.4 Erosion Control

The major components of the repository that will provide permanent control of erosion are the repository cap vegetation and a run-on control ditch. A run-on diversion ditch will be constructed upgradient of the repository to direct any surface flow around the structure and onto the Canyon Creek flood plain. This will limit erosion of the cap to that caused by incident rainfall and snowmelt on the cap itself. An eight foot wide bench will be constructed at the mid-point of the Woodland Park repository 3:1 slopes and graded at approximately 0.5% to the run-on control ditches. Upon establishment of the vegetation, which will be selected for its ability to effectively control erosion and runoff from the repository, surface erosion can be controlled.

5.4 STAR POND #2 REPOSITORY

The Star Pond #2 repository is situated north of Gray's bridge road, north of the Star Pond #5. It has been estimated that there is enough space available in Star Pond #2 to contain approximately 70,000 cubic yards of mine waste. The pond will be filled with excavated materials to the elevation of the perimeter dike, with the surface crowned to a minimum 2% grade from the center of the pond to the dike. Tailings in the center of the pond would be approximately 6 feet higher than the dike. The crowned surface will disperse precipitation evenly around the perimeter of the pond and prevent erosion due to concentrated flows.

A stability analysis of the Star Pond #2 indicated that it was capable of supporting at least two more lifts, so the material placed in the pond will not compromise the integrity of the structure.

The first lift of excavated materials will be placed only as thick as necessary to allow equipment to operate on the pond surface. Subsequent lifts will be a maximum of 2 feet thick with compaction by vehicular traffic only.

After the tailings have been placed and graded to elevation, a one-foot cap of growth medium material from the Woodland Park repository borrow area will be placed over the surface of the tailings and mine waste in the pond. The area will then be seeded with the same seed mix proposed for the Woodland Park repository. The location of Star Pond #2 is situated in close proximity to the Formosa and Upper Pond Reaches.

5.5 STREAM CHANNEL - FLOODPLAIN STABILIZATION CONCEPTUAL STABILIZATION AND REVEGETATION PLAN

5.5.1 Purpose and Goals

The entire Canyon Creek drainage has been impacted by nearly a century of mining activities. The purpose of this plan is to stabilize the channel as the first step towards encouraging reestablishment of a healthy riparian zone. Long-term stability will depend primarily on the reestablishment of suitable healthy plant communities. This plan will address the first step towards reaching this goal. In practical terms there is no stability within this system. Alluvium is continually destabilized, mobilized and redeposited.

In the lower half of the site, deposition will routinely fill a main channel, forcing the enlargement of a secondary channel. In the upper half of the site, straightening of the channel causes excessive water velocities which are continually eroding bed and banks. To reduce the effects of this erosion process, the construction of meanders, weir structures, revetment structures and revegetation is proposed. Encouraging a self-sustaining riparian and wetlands plant community is a key component of the long-term benefits and reduction of the metals loading from this site.

Goals include:

- Consolidate the flow into a single, stable low-flow channel which will pass a higher proportion of the steady state bed load. While the design will improve bed load conveyance, it is likely that a 10-year (or larger) flood event may still result in excess deposition within the site. Unstable conditions upstream from the site may contribute bed load which is beyond the conveyance capacity of the channel. This excess bed load could negatively impact portions of stabilization efforts at this site.

- Stabilize numerous active head cuts throughout the site. Head cuts cause stream bed erosion and mobilize excess bed load. Excess bed load may promote lateral instablilty or cause a channel to jump to a new channel at a downstream location.

- Stabilize secondary channels to discourage enlargement and potential capture of the primary flow.

Appendix F

Canyon Creek Waste Volume Estimate Memorandum- TerraGraphics

CDM Smith

TerraGraphics Environmental Engineering, Inc.

www.terragraphics.com

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3501 W. Elder St., Ste. 301, Boise, ID 83705
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10905 E. Montgomery Dr., Ste. 3
Spokane Valley, WA 99206-6606
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Phone: (406) 441-5441; Fax: (406) 441-5443

7000 Smoke Ranch Rd., Las Vegas, NV 89128
Phone: (702) 685-2229; Fax: (702) 685-2223

M E M O R A N D U M

To: Don Carpenter, IDEQ, Boise

From: Don Vernon, TerraGraphics, Boise

Date: February 23, 2012

Project Code: 11048

Subject: Estimated Waste Volume from Canyon Creek

TerraGraphics Environmental Engineering, Inc. (TerraGraphics) was tasked to estimate the amount of waste that would be generated from various sites in Canyon Creek. This memorandum provides the background, methodology, and estimated waste volume.

Background:

At the start of 2012 contract year, it was anticipated that the focus of the repository design effort may change. In September 2011, programmatic redirection occurred and necessitated the shifting of design activities from Osburn to the Star site. Since that time, the repository design efforts have shifted in coordination with Idaho Department of Environmental Quality (IDEQ) and U.S. Environmental Protection Agency (EPA)[i].

EPA is in the process of selecting more cleanup actions for the Upper Basin and Box, and preparing an amendment to the Record of Decision (ROD). Part of this ROD amendment process has identified numerous sites for remedial action within Canyon Creek as part of Alternative 3+. TerraGraphics was asked to assume that the sites in this alternative would generate the waste to be disposed of at the Canyon Creek Repository. The Canyon Creek Repository will be designed for disposal of these wastes and constructed at the Star Tailings Impoundment site.

TerraGraphics received the 2010 light detection and ranging (LIDAR) survey information from Kent Galloway, CRITIGEN, on October 13, 2011. This survey information contained the area that included the remedial action sites for Alternative 3+, for Canyon Creek Watershed.

Methodology:

Figure 7-3 Overview of Remedial Actions, Alternative 3+, Canyon Creek Watershed[ii] depicts the sites being addressed by this alternative, and a copy from the Focused Feasibility Study is included in Appendix A. The Canyon Creek remedial sites listed in Table 6-8[ii] for Alternative 3+ that contained any of the following waste types were assumed to be the sites that would generate waste to be disposed of in the Canyon Creek Repository.

- Upland waste rock,
- Floodplain waste rock,
- Floodplain sediments, and
- Upland tailings.

Two sites were excluded from further analysis because the proposed remedial action at these sites does not include waste removal and the waste will remain in place. The first site WAL009, Hecla-Star Tailings Ponds, was excluded because the proposed stream lining and French drain groundwater collection remedial action does not necessitate the removal and disposal of waste in another waste disposal unit. At the second site WAL042, only the floodplain tailings previously disposed of in the Silver Valley Natural Resources Trustee repository were excluded, with the same rationale as WAL009 because the proposed stream lining and French drain groundwater collection remedial action does not necessitate the removal of waste.

Additional characterization of several sites within the Canyon Creek Watershed was completed in 2011. These results were summarized on the September 22, 2011 Upper Basin Project Focus Team Subcommittee conference call. Figure 2 that was presented at that conference call is included in Appendix A[ii]. This figure indicates that the following sites were either characterized as having metal concentrations below decision criteria, or no mining activity was observed. Thus, the following sites were excluded from further analysis:

- BUR089,
- BUR132,
- BUR133,
- BUR134,
- BUR166,
- BUR187, and
- THO023.

Then each site boundary as provided by EPA to TerraGraphics was added to or superimposed on the LIDAR survey to provide an initial location of each site. Each site boundary was reviewed based upon a visual assessment of the topographic alignment with the topography in the LIDAR survey. An area of calculation boundary was drawn based upon adjustments resulting from the visual assessment. The waste volume for the sites that contain upland wastes was estimated for each site where materials above the estimated continuation of the topography outside of the area of calculation were assumed to be waste. For a floodplain waste site, it was assumed that the waste was two feet thick and the waste was a consistent thickness of two feet underneath the area of calculation. During November 2011, sites that were accessible via Burke Road were visited and area of calculation boundaries were adjusted to account for natural terrain features that could have been misinterpreted to be waste. Appendix B contains the area of calculation boundaries for each site, as identified by the site identification number.

Estimated Waste Volume:

Each site's volume was tabulated in Table 1 of Appendix B. Table 1 includes the site ID, site name, trait description, the estimated volume (labeled volume-EPA), and the typical conceptual design for the site[ii] from the Focus Feasibility Study. Table 1 also includes the updated estimated volume (labeled volume-TG), the difference between the two volumes and the area calculation sheet number. The total volume is displayed on the third sheet of Table 1. The updated volume was estimated using the previously described process and sheet number depicts the site-specific information used to estimate the waste volume. Appendix B contains a sheet index and all the area calculations sheets listed in Table 1.

The updated volume labeled [Volume (CY)-TG] is approximately 1.7 million cubic yards compared to the EPA estimated volume of 1.9 million cubic yards. The estimated uncertainty in the EPA estimated volume was not provided. Based upon the methodology used to calculate the updated waste volume, the methodology uncertainty is approximately 10%. Thus, the projected waste disposal volume is approximately 1.8 million cubic yards. Until more detailed understanding of the site-specific removal plans and extent of contamination, 10% uncertainty should be included in projected waste disposal volume requirements.

Waste Consolidation Area Candidates:

The pre-conceptual design volume for the Canyon Creek Repository is 800,000 cubic yards[iii]. Based upon the updated volume estimates for the Canyon Creek sites in Table 1, other disposal areas are needed to dispose of the approximately one million cubic yards. Two waste consolidation areas (WCA) candidates are identified in Appendix C. These two WCAs were identified from the LIDAR survey information and are provided for further consideration and evaluation. The potential WCAs are approximately two miles upstream of the proposed Canyon Creek Repository site.

---

[i] State of Idaho, Department of Environmental Quality Bunker Hill "BOX"/Coeur d'Alene "Basin" (operable Units 1, 2, and 3) Cooperative Agreement for Remedial Design/Management Assistance Support, June 2011.
[ii] *Upper Basin Project Focus Team, Subcommittee Conference Call*, September 22, 2011.
[iii] *Pre-Conceptual Cost Analysis, Upper Basin Repository*, TerraGraphics Environmental Engineering, January 11, 2009.

Table 1	Estimated Canyon Creek Waste Volumes and Comparison with Alterntive 3+ Volumes						
Site ID	**Site Name**	**Trait Description**	**Volume (CY)-EPA**	**Volume (CY)-TG**	**Volume Diff.**	**Area Calculation Sheet Number**	**TYPICAL CONCEPTUAL DESIGN**
BUR105	OOM PAUL NO. 2	Upland waste rock (erosion potential)	6,500	5,700	800	2	Excavation/Cap
BUR109	OOM PAUL NO. 1	Upland waste rock (erosion potential)	27,400	21,400	6,000	3	Excavation/Cap
BUR185	WEST MAMMOTH MINE	Upland waste rock (erosion potential)	200	700	(500)	4	Excavation/Cap
BUR107	AJAX NO. 3	Upland waste rock (erosion potential)	139,000	38,600	100,400	6	Excavation/Cap
BUR130	MARSH MINE	Upland waste rock (erosion potential)	3,000	13,200	(10,200)	7	Excavation/Cap
BUR135	SONORA MINE	Upland waste rock (erosion potential)	200	2,300	(2,100)	11	Excavation/Cap
BUR145	ONEILL GULCH UNNAMED ROCK DUMP	Upland waste rock (erosion potential)	56,000	43,000	13,000	12	Excavation/Local Waste Consolidation Area
BUR150	CANYON CREEK GARBAGE DUMP	Floodplain waste rock	32,600	16,600	16,000	13	Excavation/Cap
BUR153	CANYON CREEK IMPACTED FLOODPLAIN	Floodplain sediments	35,000	13,000	22,000	14	Excavation/Regional Repository
BUR087	HERCULES NO. 3	Upland waste rock (erosion potential)	25,000	17,100	7,900	15	Excavation/Cap
BUR090	HERCULES NO. 4	Upland waste rock-Upland tailings	85,000	75,000	10,000	17	Excavation/Cap/Local Waste Consolidation Area
BUR146	GORGE GULCH IMPACTED RIPARIAN	Floodplain sediments	51,000	36,800	14,200	18	Excavation/Regional Repository
BUR149	AJAX NO. 2 ADJACENT ROCK DUMP	Upland waste rock (erosion potential)	10,400	6,500	3,900	19	Excavation/Cap
BUR180	STANLEY MINE	Upland waste rock (erosion potential)	5,500	1,200	4,300	21	Excavation/Cap
BUR066	MOONLIGHT MINE	Upland waste rock (erosion potential)	7,000	2,200	4,800	22	Excavation/Cap
BUR067	TAMARACK NO. 7 (1200 LEVEL) UPLAND WASTE ROCK	Upland waste rock (potential intermixed tailings)	350,000	327,000	23,000	23	Excavation/Local Waste Consolidation Area
BUR067	TAMARACK NO. 7 (1200 LEVEL) UPLAND TAILINGS	Upland tailings	2,500	2,600	(100)	23	Excavation/Local Waste Consolidation Area
BUR068	HEADLIGHT MINE	Upland waste rock (erosion potential)	12,000	11,700	300	24	Excavation/Local Waste Consolidation Area
BUR072	STANDARD-MAMMOTH NO. 4	Upland waste rock (erosion potential)	14,300	5,400	8,900	25	Cap
BUR073	STANDARD-MAMMOTH CAMPBELL ADIT	Upland waste rock (erosion potential)	126,000	57,000	69,000	26	Excavation/Cap
BUR075	SHERMAN 1000 LEVEL	Upland tailings	3,500	1,600	1,900	27	Excavation/Local Waste Consolidation Area
BUR094	SHERMAN 600 LEVEL	Upland waste rock (erosion potential)	34,000	30,700	3,300	28	Regrade/Consolidate/Revegetate
BUR096	ANCHOR MINE	Upland waste rock	34,000	12,000	22,000	29	Regrade/Consolidate/Revegetate
BUR097	HIDDEN TREASURE MINE	Upland waste rock	20,900	4,700	16,200	30	Regrade/Consolidate/Revegetate
BUR098	HERCULES NO. 5	Upland waste rock (potential intermixed tailings)	55,000	24,000	31,000	31	Excavation/Local Waste Consolidation Area
BUR117	FRISCO MILLSITE	Upland waste rock (potential intermixed tailings)	145,000	3,000	142,000	32	Excavation/Cap/Local Waste Consolidation Area
BUR117	FRISCO MILLSITE	Upland tailings	1,800	-	1,800	32	Excavation/Local Waste Consolidation Area
BUR118	FRISCO NO. 1 & NO. 2	Upland waste rock (erosion potential)	33,000	14,000	19,000	33	Excavation/Local Waste Consolidation Area
BUR119	BLACK BEAR NO. 4	Upland waste rock	44,000	27,000	17,000	34	Regrade/Consolidate/Revegetate

Table 1	Estimated Canyon Creek Waste Volumes and Comparison with Alterntive 3+ Volumes						
Site ID	**Site Name**	**Trait Description**	**Volume (CY)-EPA**	**Volume (CY)-TG**	**Volume Diff.**	**Area Calculation Sheet Number**	**TYPICAL CONCEPTUAL DESIGN**
BUR120	SILVER MOON MINE	Upland waste rock (erosion potential)	22,000	11,000	11,000	35	Regrade/Consolidate/Revegetate
BUR121	BLACK BEAR FRACTION	Upland waste rock (erosion potential)	103,000	49,000	54,000	36	Excavation/Cap
BUR122	FLYNN MINE	Upland waste rock (erosion potential)	27,000	23,000	4,000	37	Excavation/Cap
BUR124	OMAHA MINE	Upland waste rock (erosion potential)	24,000	21,000	3,000	38	Regrade/Consolidate/Revegetate
BUR125	MIDWAY SUMMIT MINE	Upland waste rock (erosion potential)	8,000	600	7,400	39	Regrade/Consolidate/Revegetate
BUR128	HECLA-STAR MINE & MILLSITE	Upland tailings	43,400	140,000	(96,600)	40	Excavation/Local Waste Consolidation Area
BUR129	TIGER-POORMAN MINE	Upland tailings	5,250	4,000	1,250	41	Excavation/Local Waste Consolidation Area
BUR141	CANYON CREEK IMPACTED FLOODPLAIN	Floodplain sediments	22,000	23,000	(1,000)	42	Excavation/Regional Repository
BUR142	GEM MILLSITE	Upland waste rock (potential intermixed tailings)	39,000	47,000	(8,000)	43	Excavation/Cap/Local Waste Consolidation Area
BUR143	CANYON CREEK IMPACTED RIPARIAN	Floodplain sediments	32,000	89,000	(57,000)	44	Excavation/Regional Repository
BUR144	STANDARD-MAMMOTH LOADING AREA	Upland waste rock (erosion potential)	39,000	16,000	23,000	45	Excavation/Cap
BUR176	UNNAMED ADIT	Upland waste rock (erosion potential)	200	200	-	46	Excavation/Cap
BUR177	JOE MATT MINE	Upland waste rock (erosion potential)	200	5,000	(4,800)	47	Excavation/Cap
BUR178	WEST HECLA MINE	Upland waste rock (erosion potential)	11,000	9,200	1,800	48	Excavation/Cap
BUR189	DULUTH MINE CANYON CREEK	Upland waste rock (erosion potential)	200	700	(500)	49	Excavation/Cap
BUR191	FRISCO NO. 3	Upland waste rock	-	18,000	(18,000)	50	Regrade/Consolidate/Revegetate
BUR192	BLACK BEAR MILLSITE	Floodplain tailings (discrete site)	3,100	4,000	(900)	51	Excavation/Cap
BUR192	BLACK BEAR MILLSITE	Upland waste rock (erosion potential)	27,000	-	27,000	51	Excavation/Cap
BUR204	UNNAMED ROCK DUMP	Upland waste rock (erosion potential)	200	200	-	52	Excavation/Cap
OSB047	CANYON CK FORMOSA REACH SVNRT REHAB	Floodplain sediments	17,000	49,000	(32,000)	53	Excavation/Regional Repository/Hydraulic Isolation
WAL010	CANYON CK POND REACH SVNRT REHAB	Floodplain sediments	15,000	120,000	(105,000)	54	Excavation/Regional Repository/Hydraulic Isolation
WAL011	CANYON CREEK (FORMOSA) MINE	Floodplain sediments	8,800	17,000	(8,200)	55	Excavation/Regional Repository/Hydraulic Isolation
WAL039	STANDARD-MAMMOTH MILLSITE	Upland tailings	12,500	12,000	500	56	Excavation/Regional Repository
WAL040	CANYON CREEK IMPACTED FLOODPLAIN	Floodplain sediments	18,000	29,000	(11,000)	57	Excavation/Regional Repository
WAL041	CANYON CK REPOSITORY REACH SVNRT REHAB	Floodplain sediments	61,000	146,000	(85,000)	58	Excavation/Regional Repository/Hydraulic Isolation
WAL081	WALLACE OLD PRIVATE LANDFILL	Floodplain artificial fill	5,700	8,000	(2,300)	59	Excavation/Regional Repository
WAL042	CANYON CK TAILINGS REPOSITORY SVNRT	Floodplain sediments	8,100	-	8,100	61	Excavation/Cap
					-		
		Totals	1,912,450	1,655,900	256,550		

Appendix G

Wetland Investigation Memorandum - TerraGraphics

CDM Smith

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INTERNAL MEMORANDUM

To: Don Vernon, Boise

From: Susan Firor, Moscow

Date: October 29, 2009

Project Code: 5030-30

Subject: Field Trip Report, October 28, 2009

On October 28, 2009 I visited two potential Upper Basin repository sites, Osburn Ponds and HECLA Star Ponds to assess the hydrologic site conditions as they pertain to repository siting. The results of that trip are presented here in two sections, one for each site.

SECTION 1. Osburn Ponds

This site is situated on the top and along the hill slope edge of a large tailings pile. The pile is currently used for active water and tailings retention and is being extended upward along the edge of the active pond. However, the potential repository site is an open field along the hill slope and not adjacent to the active pond. I have drawn the approximate locations of features that I observed in Figure 1.

The site consists of a relatively flat but undulating field of approximately 17 acres bordered along the north and east side by a steep hillside. A bench in the hillside, roughly 10-30 ft in width, originates about 500 feet from the southern site boundary and extends northward until it opens up into a much wider bench comprising about 3 acres. The 3-acre area is shown as Area 1 in Figure 1. South of the bench, water from hill slope runoff flows in a channel at the level of the lower 17 acres (Figure 2). The beginning of the bench is shown in Figure 3.

The top of Area 1 was mostly wet from hill slope runoff on the day I was there. Upslope from Area 1 are two denuded and extremely eroded hill slopes, which are clearly visible on the areal photo. The primary source of the runoff that day was the southern denuded hill slope (Figure 4).

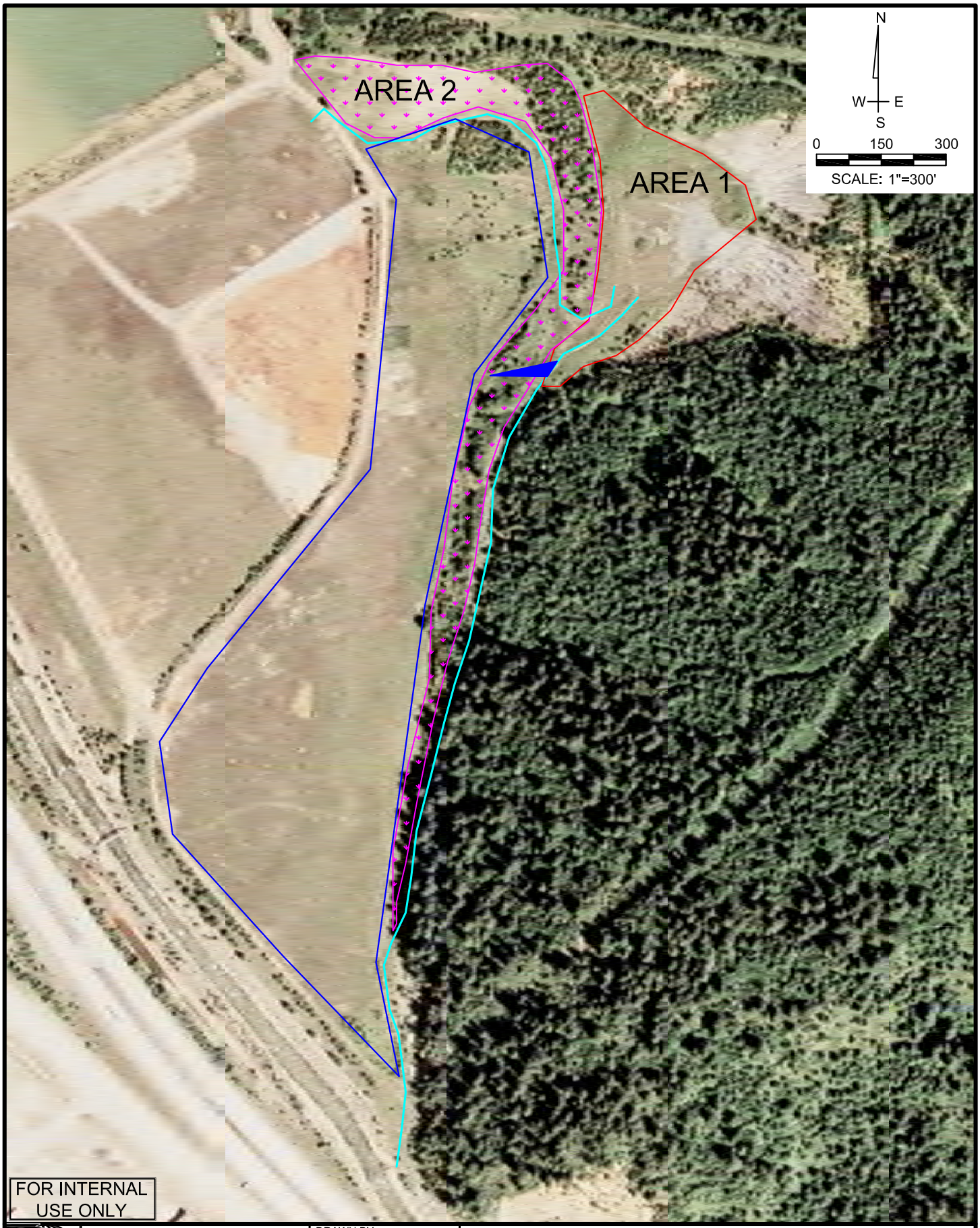
The region shown as Area 2 is fairly steep hill slope. I estimate that it is 30-40 vertical feet from Area 1 to the17 acre flats.

Generally water flows out of Area 1 by two routes: the small channel along the bench flowing to the south and another channel that flows off the hillside then to the north and west along the northern end of the site. These flow routes are shown in Figure 1. In addition, high flows have clearly created a significant channel off the steep edge just south of Area 1, shown as a blue wedge on Figure 1. The northern channel flows along the toe of the slope and exits the site through a 12 inch culvert under the road. It is also clear that significant flow infiltrates along the

bench south of Area 1, as there is less flow in the lower elevations of this channel than that draining out of Area 1.
There are no wetlands of any kind at this site. Although a number of areas of standing water exist during parts of the growing season, very few wetland plant species are found. In addition, as the site is entirely constructed of mine tailings, hydric soils are not likely to be found anywhere at this site.

The forb vegetation at the site is generally sparse, and several invasive species are prevalent including tansy and knapweed. Native evergreen tree species are found along the east and north borders. The hillside on the north end has been planted with ponderosa and lodgepole pine. A few healthy white pines are found throughout the site.

An additional point of interest at the site is along the southwestern edge of the site (bordering the SF Coeur d'Alene River) where two parallel roads are clearly shown on the aerial photo. The orientation of these two roads (now mostly overgrown) is shown in Figure 5. Power lines border the site along the northern boundary, and may intersect the site. A fault is apparent in the hillside near the center of the site.



TerraGraphics
Environmental Engineering, Inc.

DRAWN BY:	S. FIROR
PROJECT NO:	5030-30
DATE:	10/29/09

FIGURE 1:

OSBURN PONDS
POTENTIAL REPOSITORY SITE

Figure 2. Hill slope drainage canal as it comes off the slope. Looking south.

Figure 3. The southern terminus of the bench. Looking north.

Figure 4. Area 1 and denuded slopes.

Figure 5. Upper and Lower “Roads” along the River. Looking west.

SECTION 2. **HECLA Star Ponds**

This site is a series of old tailings pond cells that have been dewatered and filled with tailings. The entire site is elevated a minimum of 10-15 feet above the surrounding ground surface. There is no opportunity for run-on from surrounding hill slopes, as the entire site is free-standing. And flood potential is very low except in an almost unimaginable flood event. In some places the existing pile is over 30 feet tall. Canyon Creek flows on the east side of the site, and Idaho State Highway 4 borders the site to the west. The small town of Woodland Park is near the south end of the site.

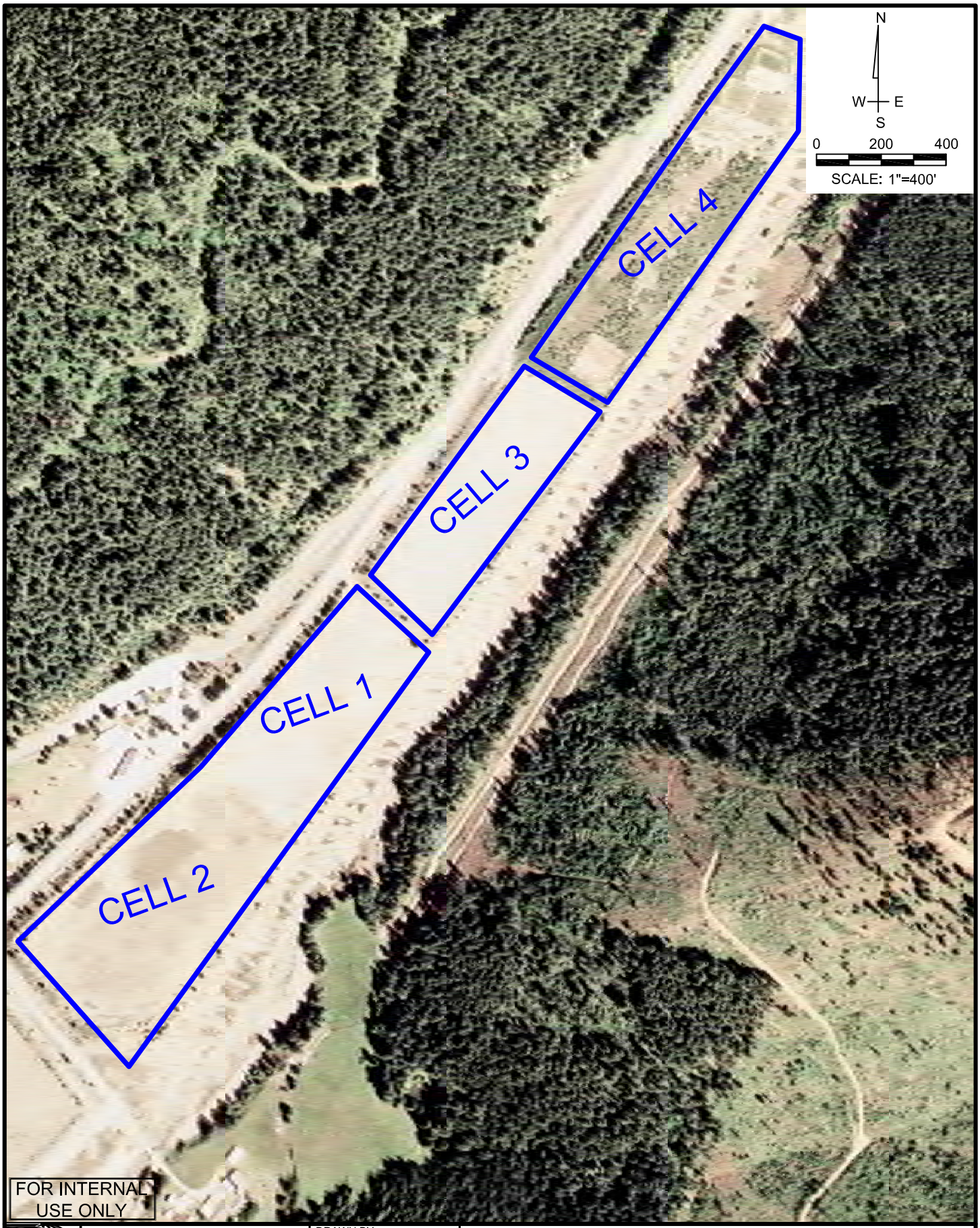
The site layout is shown in Figure 6. The site is comprised of four cells that vary from one another in top elevation. The tops of the cells are all flat, although they may have the slightest doming designed to convey rainwater to the sides.

Cells 1 and 2 have the lowest top surface and are built to the same elevation. The south end of Cell 2 is shown in Figure 7. The top of this combined cell is about 1000 ft long and 300 feet wide. Some sparse vegetation is found on Cell 2, but these two cells, for all practical purposes, are bare tailings. At the north end of this combined cell, Cell 3 starts at an elevation about 25-30 ft higher than Cell 1. The top of Cells 2 and 1 and the transition to Cell 3 are shown in Figure 8.

Cell 3 is about 800 ft by 250 ft on the top and is also void of vegetation. The top of Cell 3 is shown in Figure 9. The transition to Cell 4 is about 25-30 ft tall and steeply sloped (about 1.5:1 H:V). This transition is shown in Figure 10.

Cell 4 is well vegetated with a planted mixed conifer forest that appears to be about 15 years old. There is a power line that intersects this cell diagonally. In the southeast corner is a square of bare ground that must have been a test cell of some sort, which does not appear to be active (Figure 11). At the north end of Cell 4 are three lined ponds. They, too, appear to be inactive (Figure 12).

There are no wetlands anywhere on the HECLA Star site. This appears to be an excellent choice for a repository site from a hydrologic viewpoint, as there is no hill slope run-on potential, and the base of the site is already elevated well above the floodplain. The relationship between the top of Cell 4 and the floodplain of Canyon Creek is shown in Figure 13.



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Environmental Engineering, Inc.

DRAWN BY:	S. FIROR
PROJECT NO:	5030-30
DATE:	10/29/09

FIGURE 6:

HECLA STAR PONDS
POTENTIAL REPOSITORY SITE

Figure 7. The south end of Cell 2 and Grays Bridge Road. Looking west.

Figure 8. Top of Cells 1 and 2 with transition to Cell 3 in the distance.

Figure 9. Top of Cell 3 looking toward Cell 1.

Figure 10. Transition between Cells 3 and 4.

Figure 11. Top of Cell 4, southeast corner looking north.

Figure 12. Lined ponds at north end of Cell 4.

Figure 13. Canyon Creek and floodplain from the top of Cell 4.

Appendix H

Geotechnical Data Reports - TerraGraphics

Budinger & Associates
Proudly serving the Inland Northwest for over 30 years

Geotechnical Engineering
Environmental Engineering
Construction Material Testing
Subsurface Exploration
Special Inspection

Don Vernon
Terra Graphics Environmental Engineering, Inc.
3501 W. Elder Street, Ste. 102
Boise, ID 83705

March 4, 2011

Project Number G10502

PROJECT: Upper Basin Repository, Star Site
Wallace, ID

SUBJECT: Subsurface Exploration Logs
and Laboratory Test Results

Dear Mr. Vernon,

Budinger & Associates, Inc. is pleased to provide the subsurface exploration logs and the laboratory test results for the Star Site of the Upper Basin Repository in Wallace, ID. This report comprises the results of the laboratory tests done on the samples taken from 3 test borings.

We appreciate the opportunity to provide service to you on this project. If we may be of further assistance, please call.

Respectfully Submitted:
BUDINGER & ASSOCIATES, INC.

Megan Rounds

John Finnegan, PE
Geotechnical Engineer, Principal

Megan Rounds, PE
Geotechnical Engineer

JF/rc

Addressee – 1
Attachments:

- Boring Logs – Figure 1-1 to 1-3
- Cone Penetration Test (CPT) Results – Figures 2-1 to 2-7
- Laboratory Summary – Figures 3-1 to 3-2
- Consolidation Results - Figures 4-1 to 4-5
- Triaxial Shear Results – Figures 5-1 to 5-4
- Grain Size Distribution – Figures 6-1 to 6-2
- Unsaturated Hydraulic Conductivity

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Coeur d'Alene, ID 81816
206 E Sherman Avenue
Tel: 208.292.4367
Fax: 208.292.4369

www.budingerinc.com

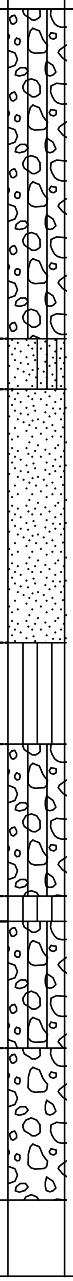
TEST PIT BH-1

Date: 12-8-10
Excavator: Budinger & Assoc., Inc.
Equipment: Mobile B-57 with automatic SPT hammer
Location: SW Boundary
Surface: snow

Elevation: ft
Logged by: E. Hageman
Size of Hole: 6.5" O.D. (3-1/4" I.D.) hollow stem

DEPTH	SAMPLE	MOISTURE, COLOR, CONDITION	DESCRIPTION
0		moist, brown, dense	SILTY Sand with Gravel, subrounded-angular, occasional debris: wood, rubber, (Fill)
5	75 (80%)		
10	10R (80%)		
15	17 (90%)	moist, brown to gray, medium dense	SAND (fine) to SILT, approximate 6-inch bedded, (Fill)
20	13 (90%)	slightly moist, light brown, medium dense	SILT with Fine-Grained Sand, low plasticity (Fill)
25		gray very moist, gray, soft	Clay, low plasticity, (Fill)
30	26 (70%) 15 (60%)	moist, dark gray, medium dense to dense brown	GRAVEL with Silt, Clay and Gravel, angular, (Fill)
35	10 (80%) 6 (80%)	very moist, gray, soft	SILT, low plasticity, (Fill)
40	25 (70%)	moist, black to brown, medium dense to dense	SILTY GRAVEL with Sand and Debris: wood, (Fill)
45	10R (80%)	moist, brown, very dense	GRAVEL with Sand, Silt and Cobbles, subrounded-angular?, (Native?)
50		no free groundwater observed	Refusal @ 47 ft

SOIL LOG



Budinger & Associates
1101 North Fancher Road
Spokane Valley, WA 99212

TEST PIT LOGS **FIGURE 1-1**

Project: Star Tailings Impoundment
Location: Wallace, ID
Number: G10502

TEST PIT BH-2

Date: 12-9-10
Excavator: Budinger & Assoc., Inc.
Equipment: Mobile B-57 with automatic SPT hammer
Location: Middle of SW half
Surface: snow

Elevation: ft
Logged by: E. Hageman
Size of Hole: 6.5" O.D. (3-1/4" I.D.) hollow stem

DEPTH	SAMPLE	MOISTURE, COLOR, CONDITION	DESCRIPTION
0		moist, brown, dense	SAND with Gravel, Silt, Clay and Cobbles, subrounded-angular, occasional debris: wood, (Fill)
5	10R (70%)	very dense	(more difficult advancement)
10	10R (20%)		(very difficult advancement, more coarse, auger refusal in offset hole)
			(easier advancement, fewer coarse parts)
15	19 (40%)		
		moist, brown to gray, medium dense	SAND (fine) to SILT, approximate 6-inch bedded, (Fill)
20	10 (90%)	slightly moist, light brown, medium dense	SILT with Sand and Clay, low plasticity
25		very moist, gray, very soft	SILT with Sand and Clay, low plasticity, (Fill)
30		moist, gray, medium dense	SAND, poorly graded (fine), (Fill)
	14 (100%)		
	8 (100%)	very moist, gray, soft	SILT, low plasticity, (Fill)
		moist, gray, medium dense	SAND, poorly graded (fine), (Fill)
35		very moist, gray, soft	SILT with Clay, low plasticity, (Fill)
40	10R (30%)	moist, brown, very dense	GRAVEL with Sand and Cobbles, subrounded-angular?, (Native?)
		no free groundwater observed	Refusal @ 41 ft
45			
50			

SOIL LOG

Budinger & Associates
1101 North Fancher Road
Spokane Valley, WA 99212

TEST PIT LOGS **FIGURE 1-2**

Project: Star Tailings Impoundment
Location: Wallace, ID
Number: G10502

TEST PIT BH-3

Date: 12-10-10
Excavator: Budinger & Assoc., Inc.
Equipment: Mobile B-57 with automatic SPT hammer
Location: Eastern Boundary, just south of midway
Surface: snow

Elevation: ft
Logged by: E. Hageman
Size of Hole: 6.5" O.D. (3-1/4" I.D.) hollow stem

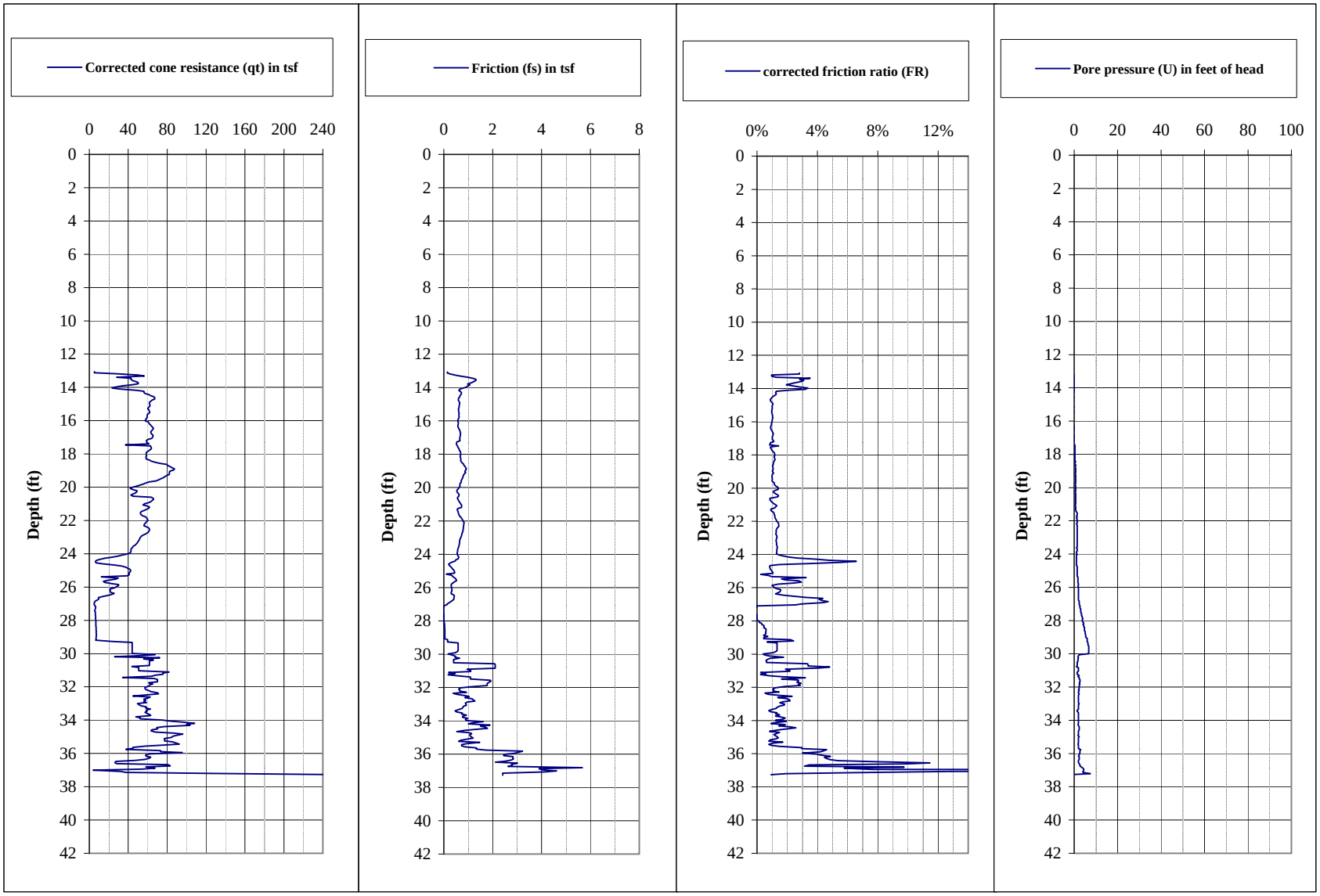
DEPTH	SAMPLE	MOISTURE, COLOR, CONDITION	DESCRIPTION
0		slightly moist, brown, dense	SILTY GRAVEL with Sand, subrounded-angular, (Fill)
		slightly moist, brown/rust, medium dense	SAND, poorly graded (fine), (Fill)
5	36 (80%)	dry, gray, dense	GRAVEL with Sand, angular, (Fill)
10	10R (10%)	slightly moist, brown/gray, dense to very dense	SILTY GRAVEL with Sand and Cobbles, (Fill) (rough, difficult advancement 10.5-11.5 feet)
15	12 (60%)	moist, brown, medium dense	GRAVEL with Sand, Silt and Clay, subrounded-angular, (Fill)
20	10R (20%)	moist, brown/gray, very dense	GRAVEL with Sand and Cobbles, subrounded, (Native?)
		no free groundwater observed	Refusal @ 21 ft
25			
30			
35			
40			
45			
50			

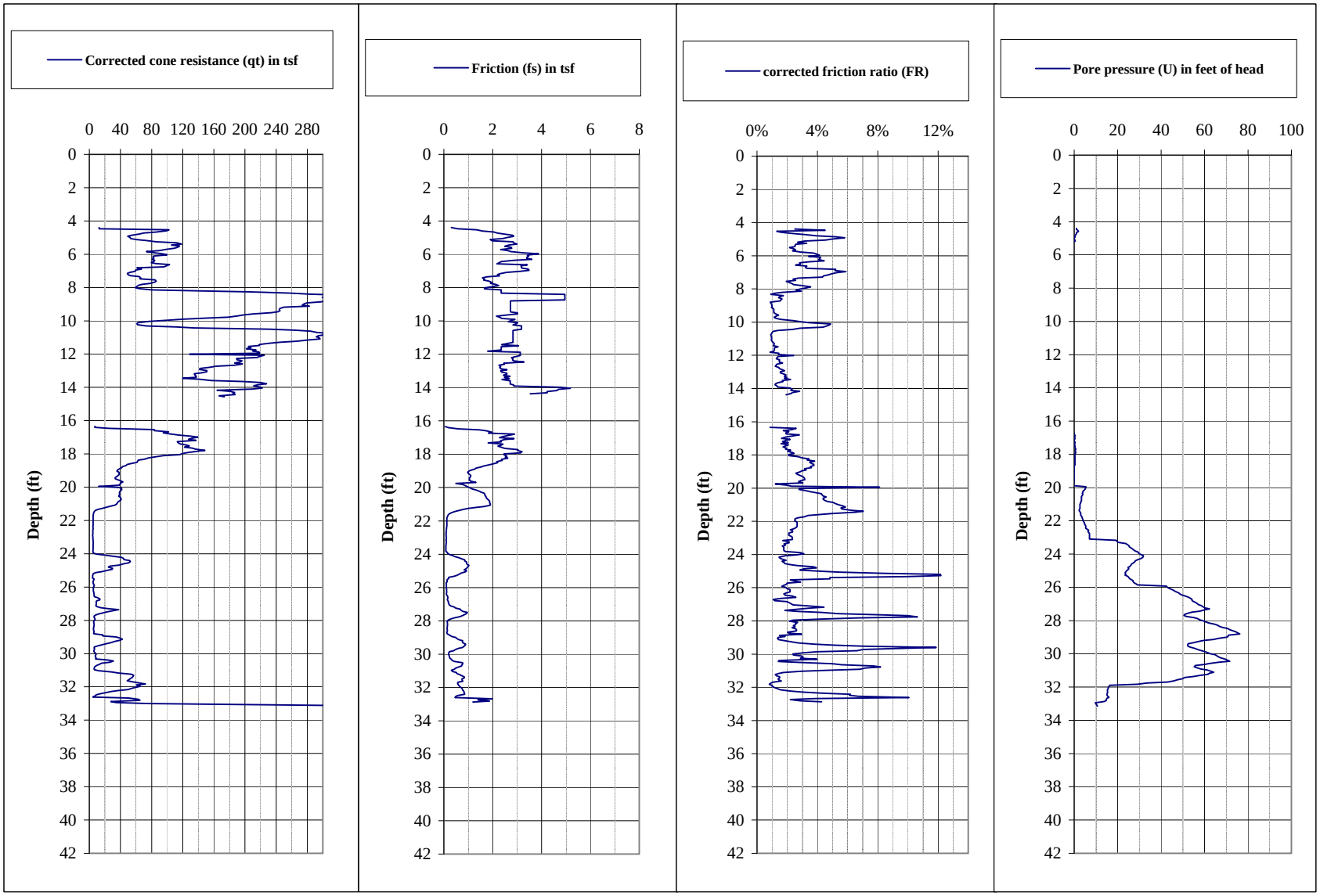
SOIL LOG

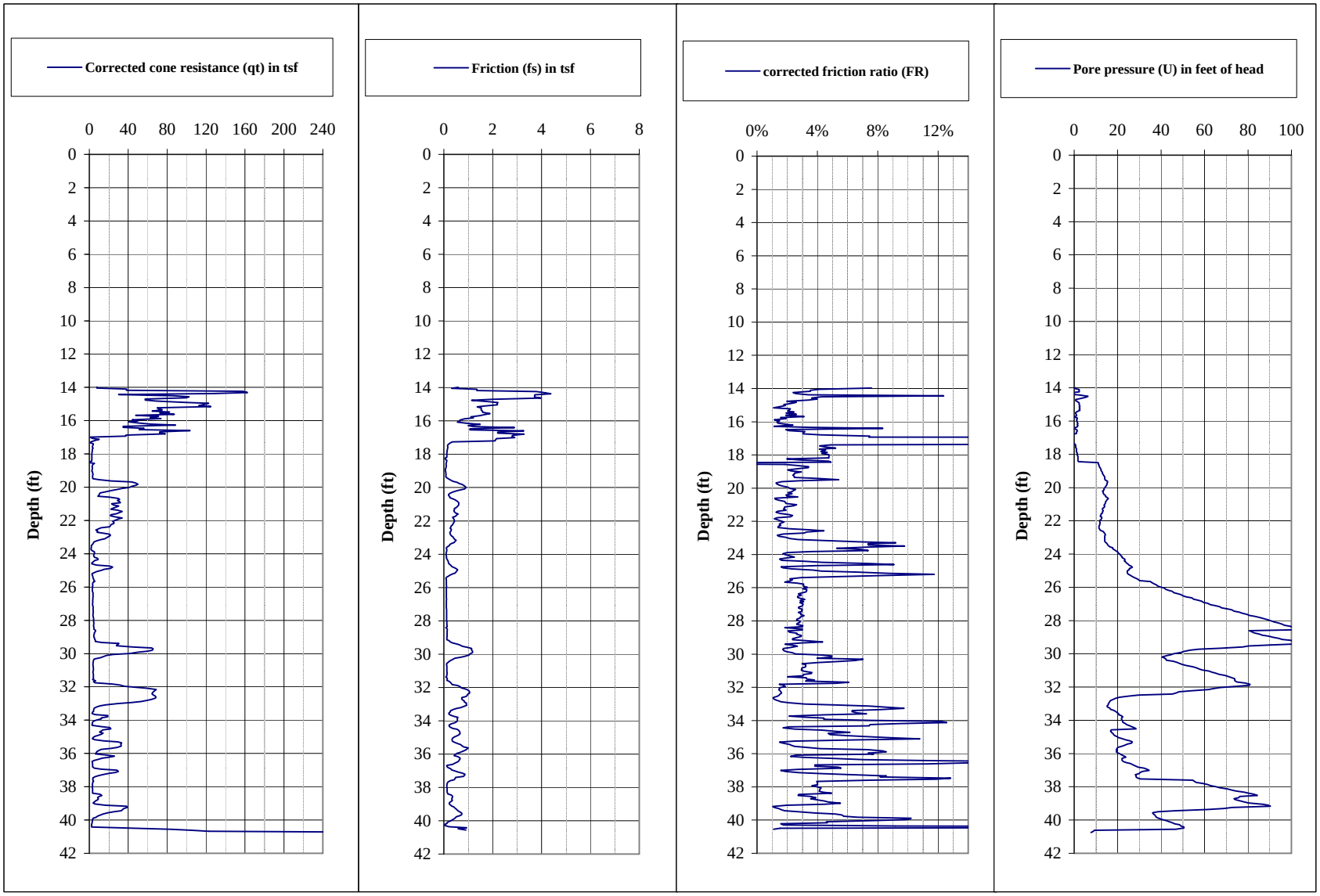
Budinger & Associates
1101 North Fancher Road
Spokane Valley, WA 99212

TEST PIT LOGS **FIGURE 1-3**

Project: Star Tailings Impoundment
Location: Wallace, ID
Number: G10502


Corrected cone resistance (qt) in tsf
0 40 80 120 160 200 240
Depth (ft)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42
Friction (fs) in tsf
0 2 4 6 8
Depth (ft)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42
corrected friction ratio (FR)
0% 4% 8% 12%
Depth (ft)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42
Pore pressure (U) in feet of head
0 20 40 60 80 100
Depth (ft)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42


Corrected cone resistance (qt) in tsf
0 40 80 120 160 200 240 280
Depth (ft)
Friction (fs) in tsf
0 2 4 6 8
Depth (ft)
corrected friction ratio (FR)
0% 4% 8% 12%
Depth (ft)
Pore pressure (U) in feet of head
0 20 40 60 80 100
Depth (ft)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42


Corrected cone resistance (qt) in tsf
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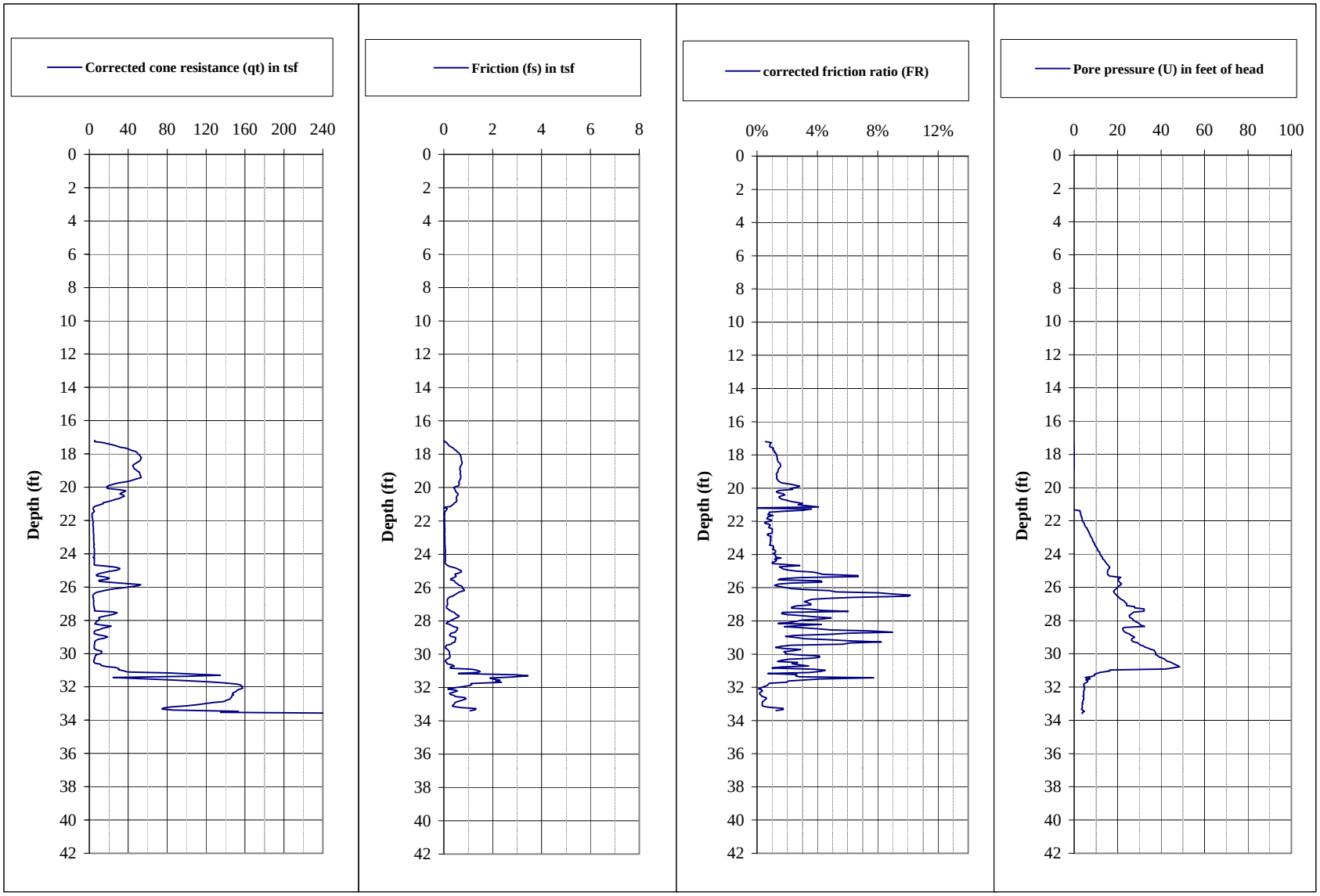
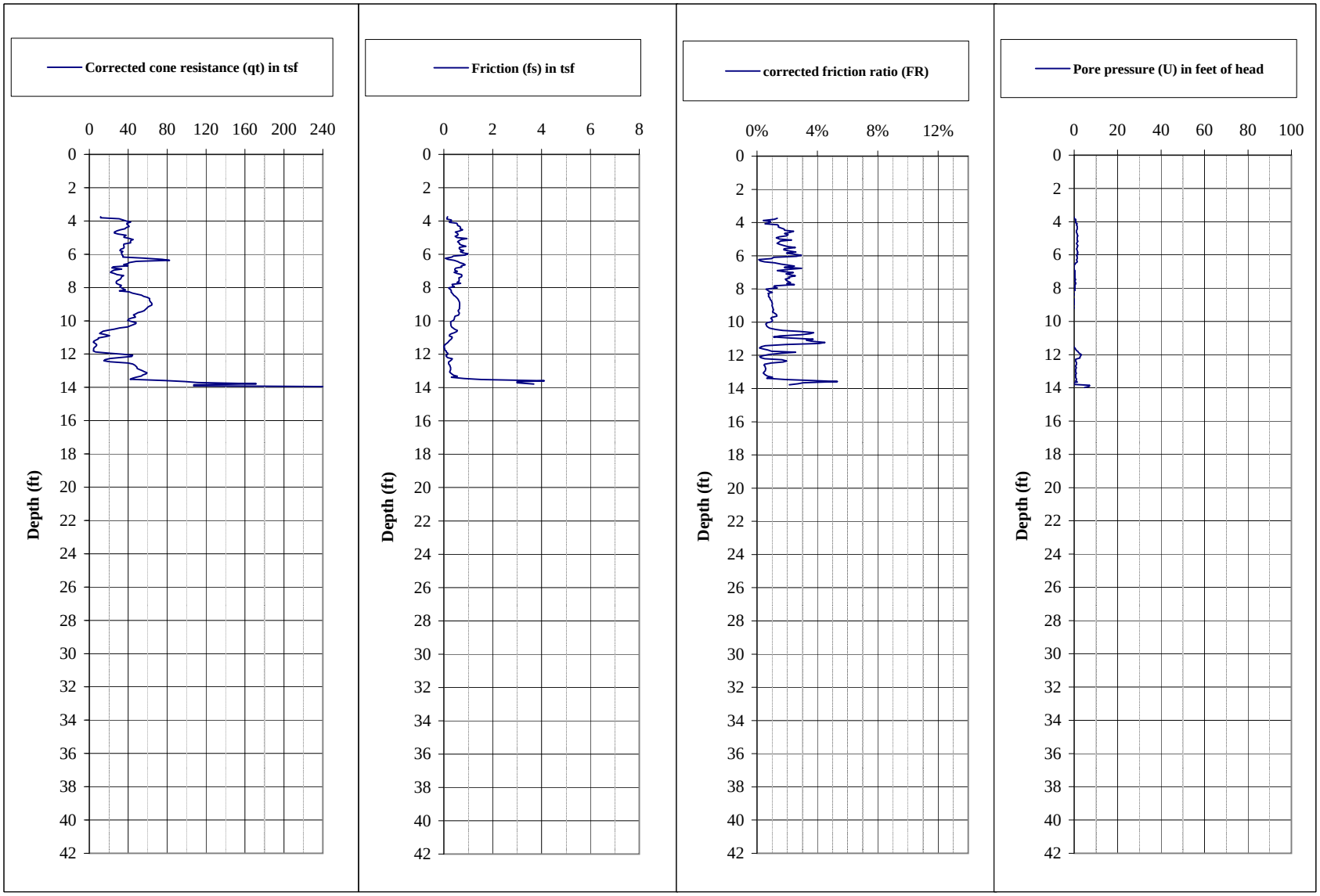
Depth (ft)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42
Friction (fs) in tsf
0 2 4 6 8
Depth (ft)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42
corrected friction ratio (FR)
0% 4% 8% 12%
Depth (ft)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42
Pore pressure (U) in feet of head
0 20 40 60 80 100
Depth (ft)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42


Corrected cone resistance (qt) in tsf
0 40 80 120 160 200 240
Depth (ft)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42
Friction (fs) in tsf
0 2 4 6 8
Depth (ft)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42
corrected friction ratio (FR)
0% 4% 8% 12%
Depth (ft)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42
Pore pressure (U) in feet of head
0 20 40 60 80 100
Depth (ft)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42


Corrected cone resistance (qt) in tsf
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Depth (ft)
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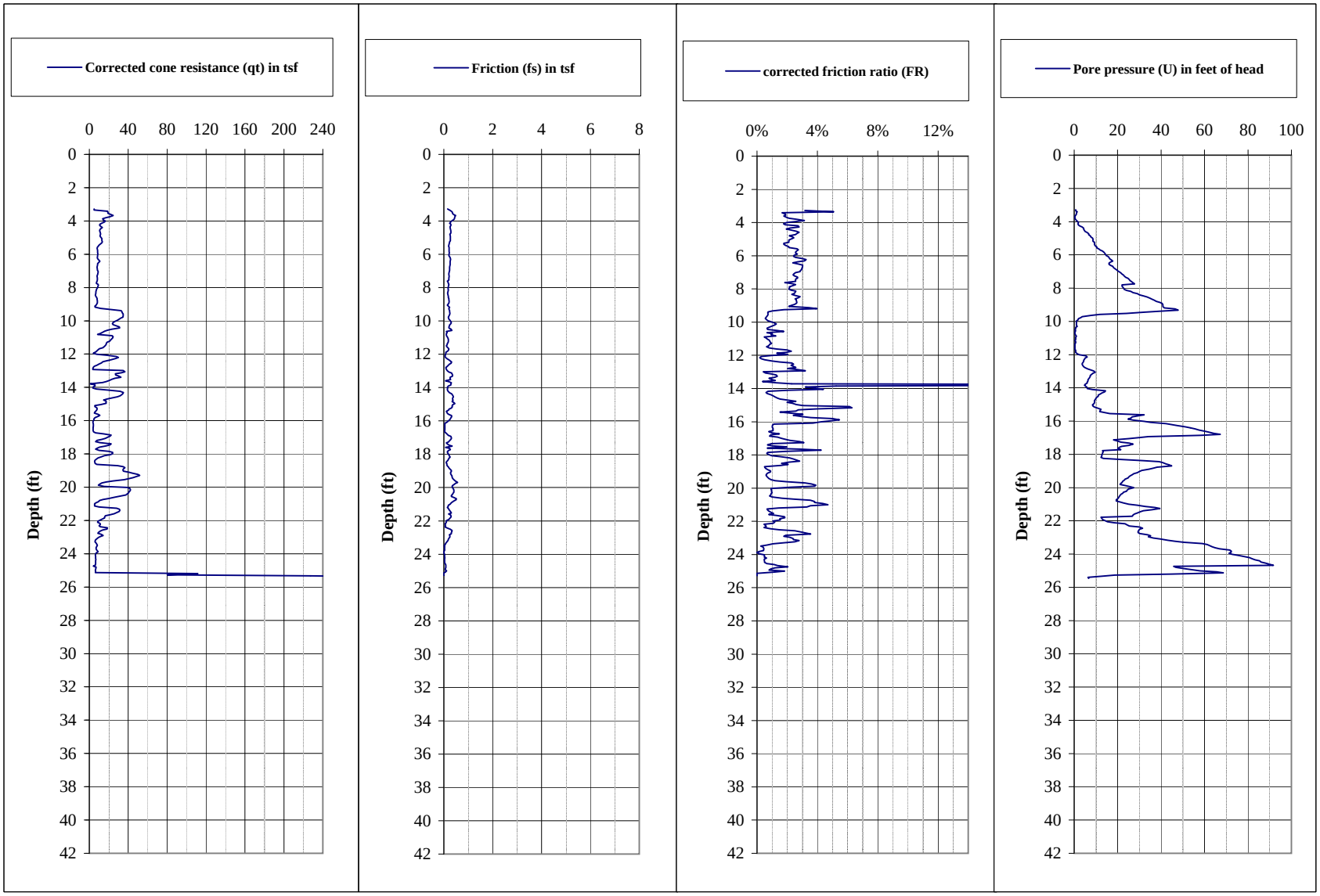
Friction (fs) in tsf
0 2 4 6 8
Depth (ft)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42
corrected friction ratio (FR)
0% 4% 8% 12%
Depth (ft)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42
Pore pressure (U) in feet of head
0 20 40 60 80 100
Depth (ft)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42


Corrected cone resistance (qt) in tsf
0 40 80 120 160 200 240
Depth (ft)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42
Friction (fs) in tsf
0 2 4 6 8
Depth (ft)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42
corrected friction ratio (FR)
0% 4% 8% 12%
Depth (ft)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42
Pore pressure (U) in feet of head
0 20 40 60 80 100
Depth (ft)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42

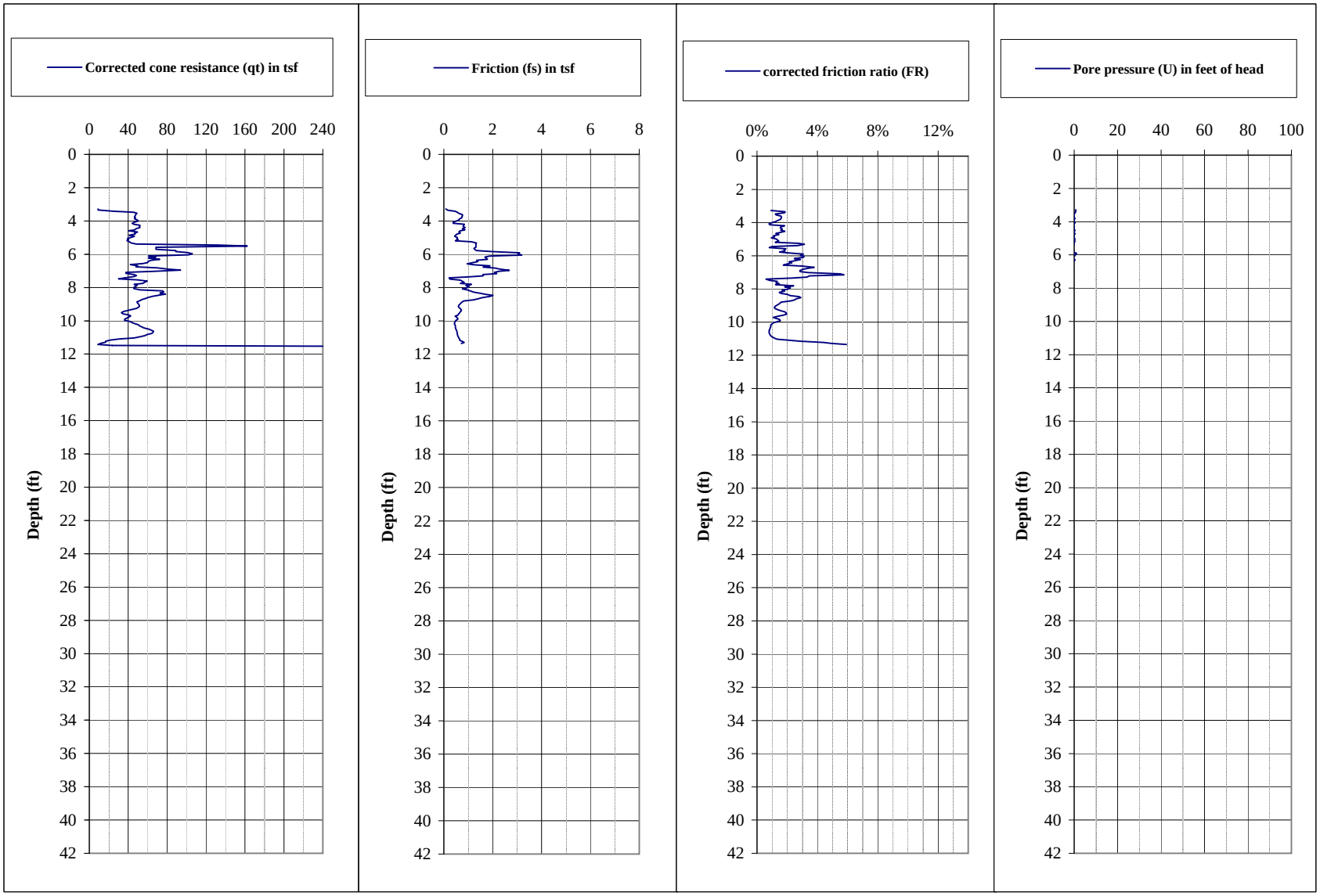

Corrected cone resistance (qt) in tsf
0 40 80 120 160 200 240
Depth (ft)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42
Friction (fs) in tsf
0 2 4 6 8
Depth (ft)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42
corrected friction ratio (FR)
0% 4% 8% 12%
Depth (ft)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42
Pore pressure (U) in feet of head
0 20 40 60 80 100
Depth (ft)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42

Figure 3-1

LABORATORY SUMMARY

		UNITS	Test Methods														
LABORATORY NUMBER				10-2524	10-2525	10-2526	10-2527	10-2528	10-2529	10-2530	10-2531	10-2532	10-2533	10-2534	10-2535	10-2536	10-2537
TEST PIT NUMBER				BH-1	BH-1	BH-1	BH-1	BH-1	BH-1	BH-1	BH-1	BH-1	BH-1	BH-1	BH-1	BH-1	BH-2
DEPTH	TOP	ft		4	9	14	16	19	21	26	26.5	29.5	34	35	39	44	4
	BOTTOM	ft		5.5	9.5	15.5	18	21	22.5		28.5	31	35	35.5	40.5	45	5
RECOVERY		in					24	22			10						
SAMPLE TYPE				SPT	SPT	SPT	SHELBY	SHELBY	SPT		SHELBY	3"SS	SPT	SPT	SPT	SPT	SPT
BLOW/FOOT				75	R	17			13			26	10	6	25	R	R
MOISTURE		%	ASTM D-2216	9.1			9.1	17.5				13.2				8.2	
SPECIFIC GRAVITY (soils -#4)			ASTM D-854					2.857			2.903						
ONE-DIMENSIONAL CONSOLIDATION			ASTM D-2435					see attached			see attached						
TRIAXIAL SHEAR TEST (3-point)			ASTM D-4767				see attached										
UNSATURATED HYDRAULIC CONDUCTIVITY			ASTM D-6836					see attached			see attached						
	3"																
S	1½"	%										100					
I	1"			100								93				100	
E	3/4" GRAVEL	P		95								89				77	
V	1/2"	A		88								81				58	
E	3/8"	S	ASTM D-422	84								74				52	
	#4	S		69								49				36	
S	#10	I		47				100			100	24				24	
I	#16	N		42				100-			100-	21				20	
Z	#30 SAND	G		36				100-			100-	18				16	
E	#40			34				100-			99	17				15	
	#100			28				86			99	15				10	
	#200			24				66			99	13				8	
	.05mm			23				63			98	13				7	
	.01mm		ASTM D-3360	15				26			73	8				4.2	
	.005mm			10				13			52	5				2.4	
	.001mm			4.1				3.5			11	1.0				1.0	

Figure 3-2

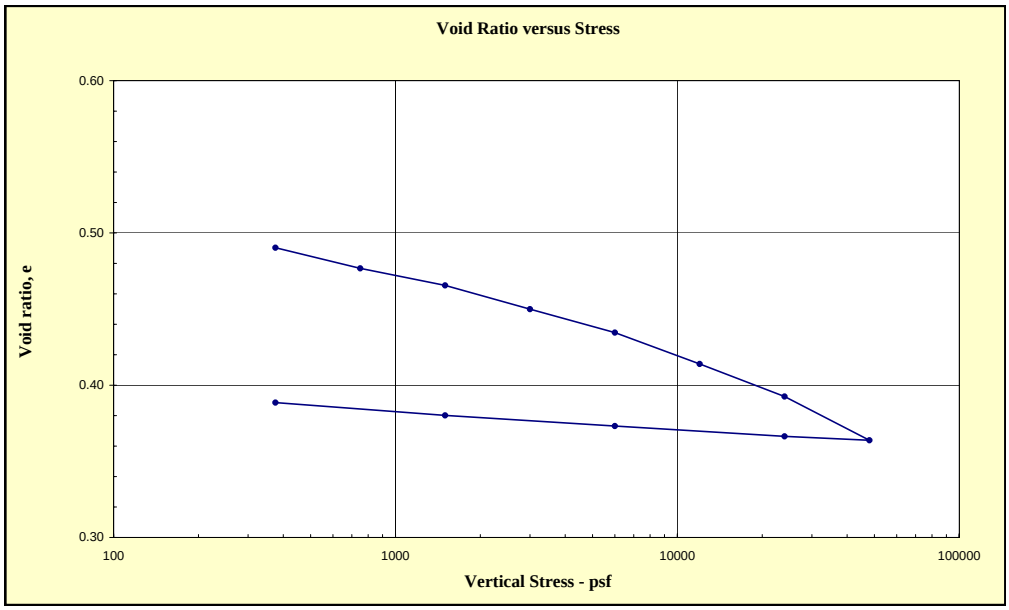
LABORATORY SUMMARY

		UNITS	Test Methods															
LABORATORY NUMBER				10-2538	10-2539	10-2540	10-2551	10-2541	10-2542	10-2543	10-2544	10-2545	10-2546	10-2547	10-2548	10-2549	10-2550
TEST PIT NUMBER				BH2	BH2	BH2	BH2	BH2	BH2	BH2	BH2	BH2	BH2	BH2	BH-3	BH-3	BH-3
DEPTH	TOP	ft		14	18	19	19.5	20.5	22	24.5	27	29.5	32.5	34.5	4.5	5	14.5
	BOTTOM	ft		15.5	20	19.5	20	22.5	24	26.5	29	30.5	34.5	36.5	5	6	16
RECOVERY		in			13			24	18	15	18	12	20	20			
SAMPLE TYPE				SPT	SHELBY	SPT	SPT	SHELBY	SHELBY	SHELBY	SHELBY	SHELBY	SHELBY	SHELBY	SPT	SPT	SPT
BLOW/FOOT				19		8	12								12	36	12
MOISTURE		%	ASTM D-2216	17.6				13.2		28.3	31.7		35.2	30.8			18.9
SPECIFIC GRAVITY (soils -#4)			ASTM D-854							2.883			2.879				
ONE-DIMENSIONAL CONSOLIDATION			ASTM D-2435					see attached		see attached			see attached				
TRIAXIAL SHEAR TEST (3-point)			ASTM D-4767					see attached			see attached			see attached			
UNSATURATED HYDRAULIC CONDUCTIVITY			ASTM D-6836							see attached			see attached				
	3"																
S	1½"	%															
I	1"																100
E	3/4" GRAVEL	P		100													78
V	1/2"	A		87													75
E	3/8"	S	ASTM D-422	83													71
	#4	S		69													58
S	#10	I		53				100		100							42
I	#16	N		46				100-		100-				100			36
Z	#30 SAND	G		37				100-		100-				100-			30
E	#40			33				100-		100-				100-			27
	#100			24				97		99				99			20
	#200			19				67		82				96			17
	.05mm			19				57		70				96			17
	.01mm		ASTM D-3360	11				13		27				65			9
	.005mm			8				7		14				37			6
	.001mm			3.0				2.1		1.3				10			2.5

Consolidation Test Results

Project Name	**Upper Basin Repository**
Project	**G10502**
Boring	BH1
Depth (ft)	19-21
Sampled by	B&A
Sample diameter (in)	2.5
Initial wet unit weight (pcf)	129.6
Initial Moisture (%)	17.5
Initial dry unit weight (pcf)	110.3
Final Moisture (%)	18.5
Final dry unit weight (pcf)	118.2
Specific gravity (assumed)	2.65
Initial height, H (in)	0.750
Initial unit volume of solids (Vs)	0.67
Initial unit volume of voids (Vv)	0.33
Initial void ratio (e_0)	0.50
Max. consolidation (%)	9.0%
Max. unit volume of solids (Vs)	0.73
Minimum void ratio (e_f)	0.36
Saturate sample at (psf)	0

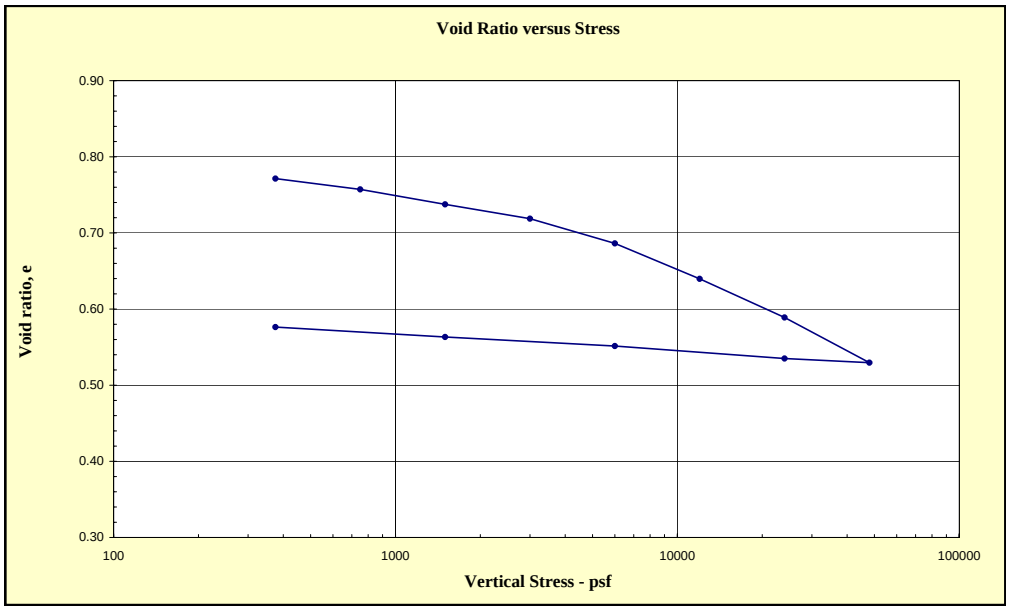
Load (psf)	H (in)	Consol (%)	V_s	e
375	0.7457	0.6%	0.67	0.49
750	0.7389	1.5%	0.68	0.48
1500	0.7333	2.2%	0.68	0.47
3000	0.7255	3.3%	0.69	0.45
6000	0.7178	4.3%	0.70	0.43
12000	0.7075	5.7%	0.71	0.41
24000	0.6968	7.1%	0.72	0.39
48000	0.6824	9.0%	0.73	0.36
24000	0.6837	8.8%	0.73	0.37
6000	0.6871	8.4%	0.73	0.37
1500	0.6906	7.9%	0.72	0.38
375	0.6948	7.4%	0.72	0.39



Consolidation Test Results

Project Name	**Upper Basin Repository**
Project	**G10502**
Boring	BH1
Depth (ft)	20.5-22.5
Sampled by	B&A
Sample diameter (in)	2.5
Initial wet unit weight (pcf)	115.5
Initial Moisture (%)	24.4
Initial dry unit weight (pcf)	92.9
Final Moisture (%)	27.4
Final dry unit weight (pcf)	104.9
Specific gravity (assumed)	2.65
Initial height, H (in)	0.750
Initial unit volume of solids (Vs)	0.56
Initial unit volume of voids (Vv)	0.44
Initial void ratio (e_0)	0.78
Max. consolidation (%)	14.1%
Max. unit volume of solids (Vs)	0.65
Minimum void ratio (e_f)	0.53
Saturate sample at (psf)	0

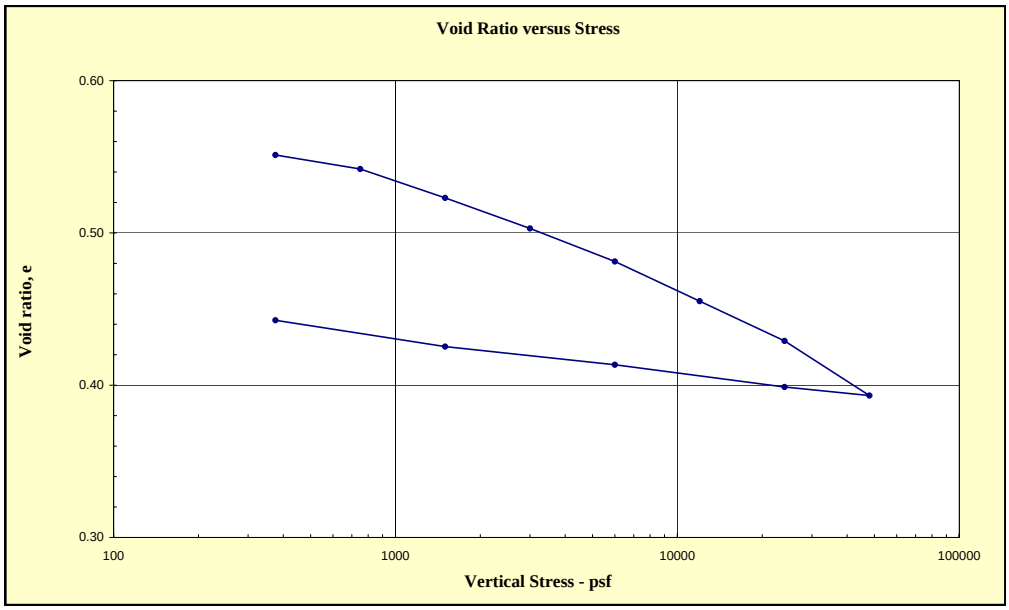
Load (psf)	H (in)	Consol (%)	V_s	e
375	0.7464	0.5%	0.56	0.77
750	0.7404	1.3%	0.57	0.76
1500	0.7321	2.4%	0.58	0.74
3000	0.7242	3.4%	0.58	0.72
6000	0.7105	5.3%	0.59	0.69
12000	0.6909	7.9%	0.61	0.64
24000	0.6695	10.7%	0.63	0.59
48000	0.6445	14.1%	0.65	0.53
24000	0.6468	13.8%	0.65	0.54
6000	0.6537	12.8%	0.64	0.55
1500	0.6587	12.2%	0.64	0.56
375	0.6642	11.4%	0.63	0.58



Consolidation Test Results

Project Name	**Upper Basin Repository**
Project	**G10502**
Boring	BH1
Depth (ft)	26.5-28.5
Sampled by	B&A
Sample diameter (in)	2.5
Initial wet unit weight (pcf)	139.0
Initial Moisture (%)	31.6
Initial dry unit weight (pcf)	105.7
Final Moisture (%)	22.7
Final dry unit weight (pcf)	114.6
Specific gravity (assumed)	2.65
Initial height, H (in)	0.750
Initial unit volume of solids (Vs)	0.64
Initial unit volume of voids (Vv)	0.36
Initial void ratio (e_0)	0.57
Max. consolidation (%)	11.0%
Max. unit volume of solids (Vs)	0.72
Minimum void ratio (e_f)	0.39
Saturate sample at (psf)	0

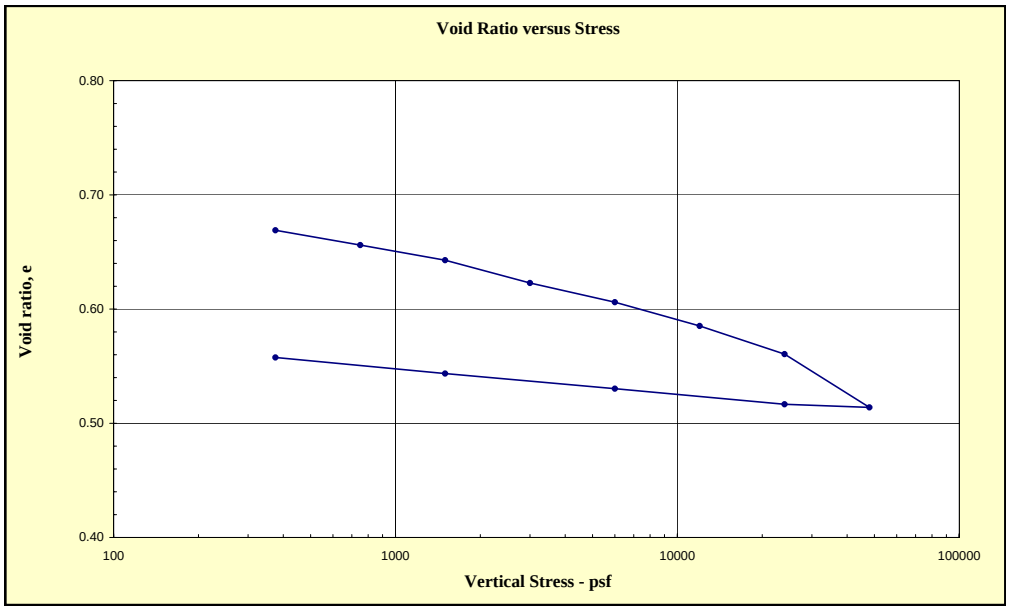
Load (psf)	H (in)	Consol (%)	V_s	e
375	0.7433	0.9%	0.64	0.55
750	0.7389	1.5%	0.65	0.54
1500	0.7298	2.7%	0.66	0.52
3000	0.7202	4.0%	0.67	0.50
6000	0.7098	5.4%	0.68	0.48
12000	0.6973	7.0%	0.69	0.46
24000	0.6848	8.7%	0.70	0.43
48000	0.6676	11.0%	0.72	0.39
24000	0.6703	10.6%	0.71	0.40
6000	0.6773	9.7%	0.71	0.41
1500	0.6830	8.9%	0.70	0.43
375	0.6913	7.8%	0.69	0.44



Consolidation Test Results

Project Name	**Upper Basin Repository**
Project	**G10502**
Boring	BH2
Depth (ft)	24.5-26.5
Sampled by	B&A
Sample diameter (in)	2.5
Initial wet unit weight (pcf)	126.2
Initial Moisture (%)	28.3
Initial dry unit weight (pcf)	98.4
Final Moisture (%)	23.5
Final dry unit weight (pcf)	106.1
Specific gravity (assumed)	2.65
Initial height, H (in)	0.750
Initial unit volume of solids (Vs)	0.60
Initial unit volume of voids (Vv)	0.40
Initial void ratio (e_0)	0.68
Max. consolidation (%)	9.9%
Max. unit volume of solids (Vs)	0.66
Minimum void ratio (e_f)	0.51
Saturate sample at (psf)	0

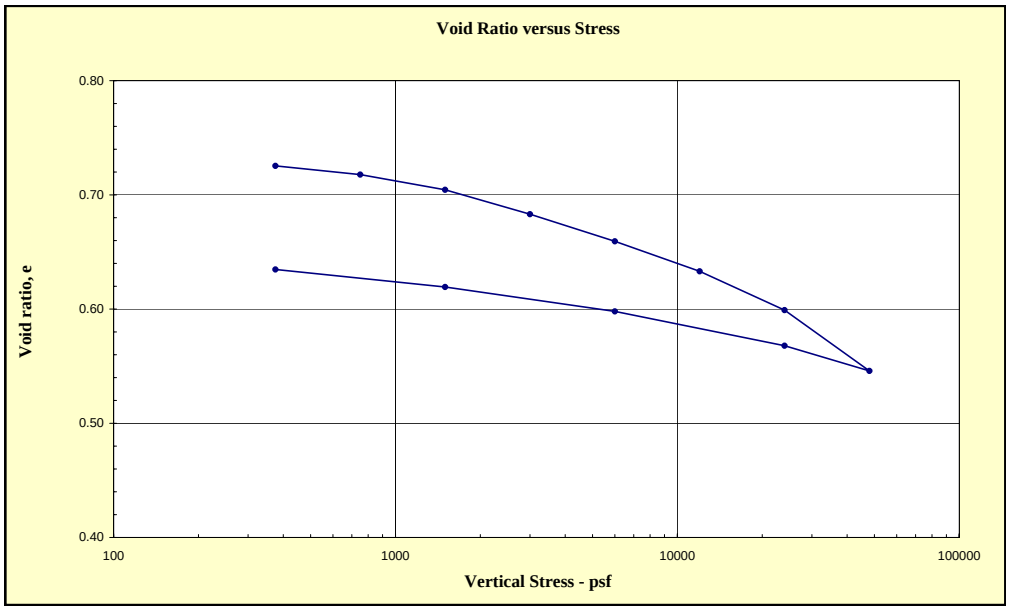
Load (psf)	H (in)	Consol (%)	V_s	e
375	0.7448	0.7%	0.60	0.67
750	0.7390	1.5%	0.60	0.66
1500	0.7331	2.3%	0.61	0.64
3000	0.7242	3.4%	0.62	0.62
6000	0.7167	4.4%	0.62	0.61
12000	0.7074	5.7%	0.63	0.59
24000	0.6964	7.1%	0.64	0.56
48000	0.6756	9.9%	0.66	0.51
24000	0.6768	9.8%	0.66	0.52
6000	0.6829	8.9%	0.65	0.53
1500	0.6888	8.2%	0.65	0.54
375	0.6951	7.3%	0.64	0.56



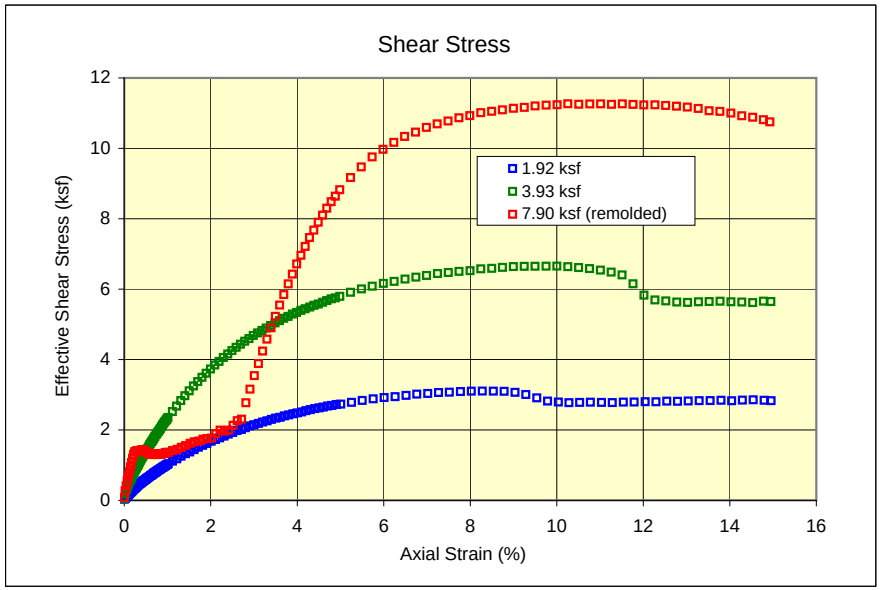
Consolidation Test Results

Project Name	**Upper Basin Repository**
Project	**G10502**
Boring	BH2
Depth (ft)	32.5-34.5
Sampled by	B&A
Sample diameter (in)	2.5
Initial wet unit weight (pcf)	128.2
Initial Moisture (%)	35.2
Initial dry unit weight (pcf)	94.8
Final Moisture (%)	24.0
Final dry unit weight (pcf)	101.1
Specific gravity (assumed)	2.65
Initial height, H (in)	0.750
Initial unit volume of solids (Vs)	0.57
Initial unit volume of voids (Vv)	0.43
Initial void ratio (e_0)	0.74
Max. consolidation (%)	11.4%
Max. unit volume of solids (Vs)	0.65
Minimum void ratio (e_f)	0.55
Saturate sample at (psf)	0

Load (psf)	H (in)	Consol (%)	V_s	e
375	0.7418	1.1%	0.58	0.73
750	0.7385	1.5%	0.58	0.72
1500	0.7328	2.3%	0.59	0.70
3000	0.7236	3.5%	0.59	0.68
6000	0.7134	4.9%	0.60	0.66
12000	0.7021	6.4%	0.61	0.63
24000	0.6875	8.3%	0.63	0.60
48000	0.6646	11.4%	0.65	0.55
24000	0.6741	10.1%	0.64	0.57
6000	0.6870	8.4%	0.63	0.60
1500	0.6962	7.2%	0.62	0.62
375	0.7028	6.3%	0.61	0.63



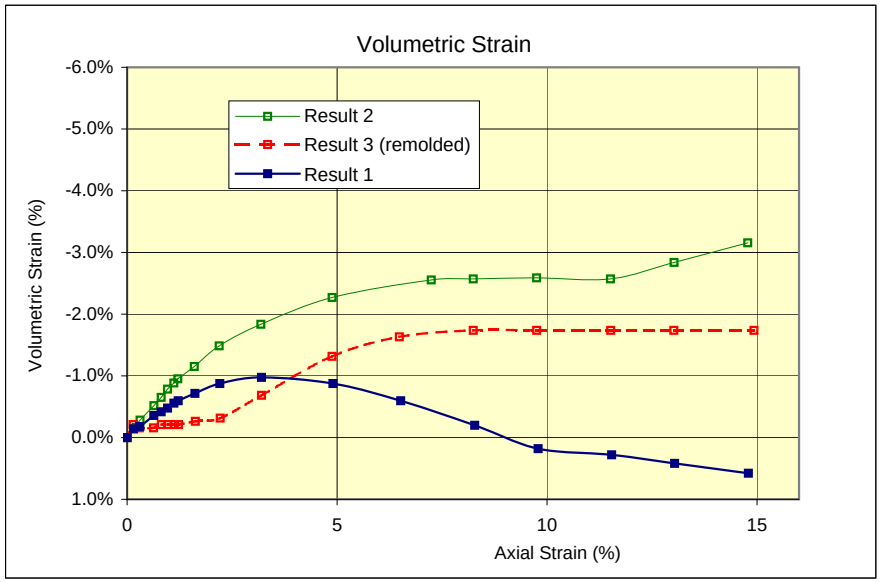
Report of CD Triaxial Shear Test

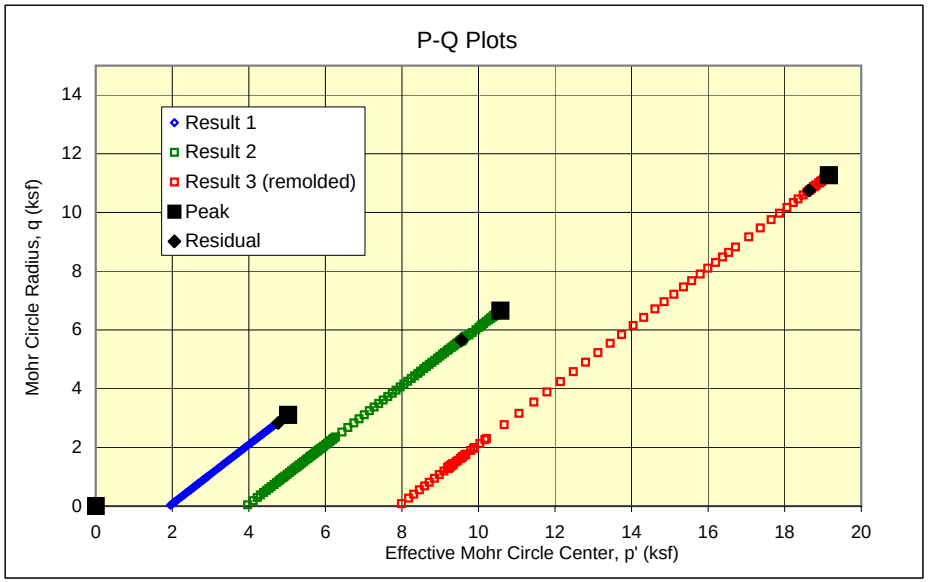


Undisturbed/shear rate 20%/hour	1.92 ksf	3.93 ksf	7.90 ksf (remolded)
Initial dry unit weight (pcf)	99.3	92.7	94.4
Initial Wc (%)	9.1%	15.6%	8.2%
Final dry unit weight (pcf)	101.1	97.4	98.3
Final Wc (%)	24.8%	26.5%	24.8%

	Consolidation Stress (ksf)	Peak Failure Stress p (ksf)	Peak Failure Stress q (ksf)	Residual Failure Stress p (ksf)	Residual Failure Stress q (ksf)
	1.92	5.03	3.11	4.77	2.83
	3.93	10.57	6.66	9.56	5.65
(remolded)	7.90	19.16	11.27	18.64	10.75

Above values are effective stresses





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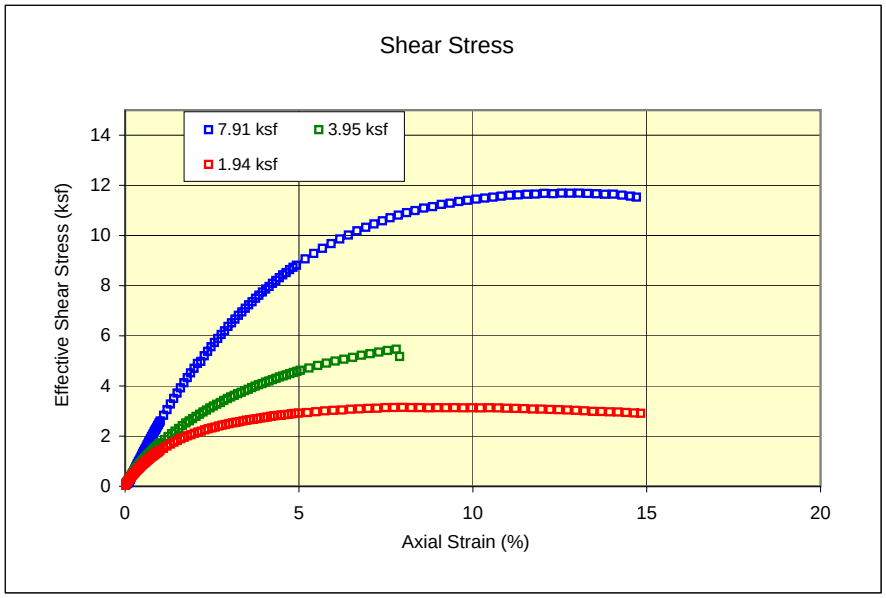
Spokane Valley, WA 99212

TRIAXIAL SHEAR TEST RESULTS
Project: Star Tailings Impoundment
Location: Wallace, Idaho
Number: G10502

Figure 5-1

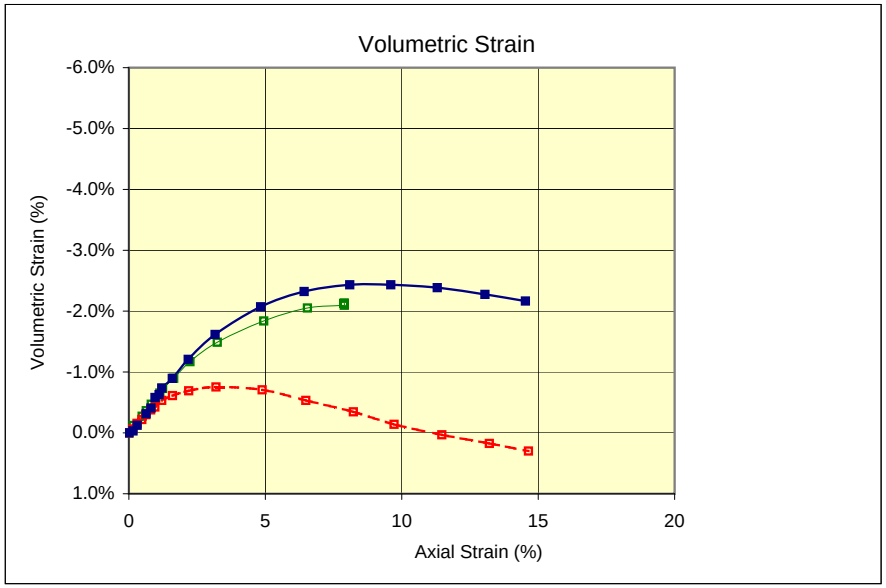
Report of CD Triaxial Shear Test

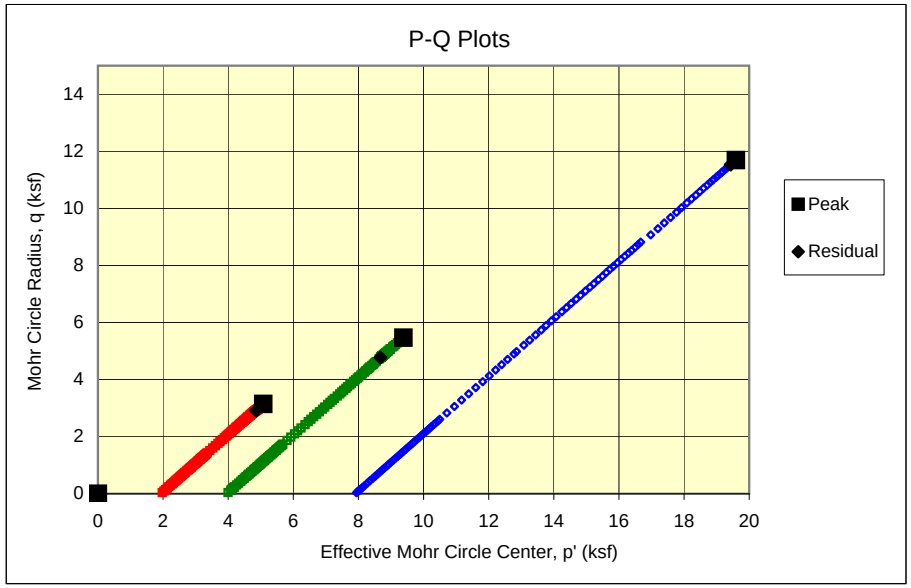


Undisturbed/shear rate 20%/hour	7.91 ksf	3.95 ksf	1.94 ksf
Initial dry unit weight (pcf)	96.4	95.0	87.3
Initial Wc (%)	13.2%	10.6%	22.0%
Final dry unit weight (pcf)	95.8	98.6	87.9
Final Wc (%)	28.3%	29.1%	30.0%

Consolidation Stress (ksf)	Peak Failure Stress p (ksf)	Peak Failure Stress q (ksf)	Residual Failure Stress p (ksf)	Residual Failure Stress q (ksf)
7.91	19.59	11.69	19.43	11.53
3.95	9.38	5.47	8.68	4.77
1.94	5.08	3.15	4.86	2.91

Above values are effective stresses





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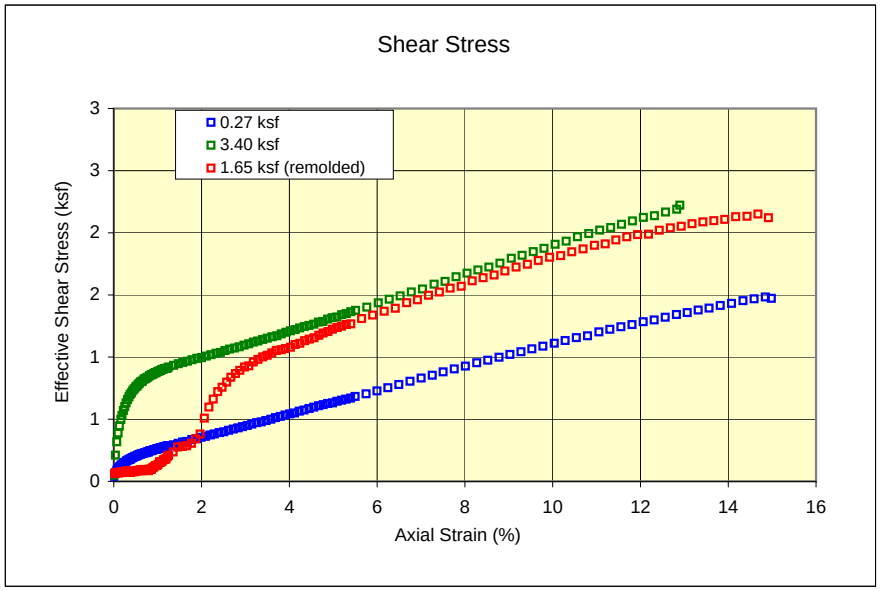
TRIAXIAL SHEAR TEST RESULTS
Project: Star Tailings Impoundment
Location: Wallace, ID
Number: G10502

Figure 5-2

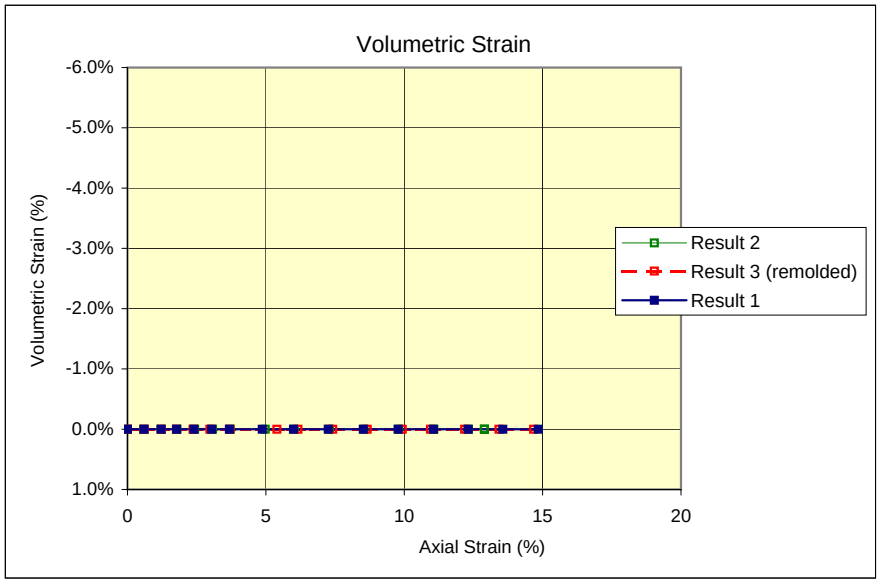
Report of CU Triaxial Shear Test

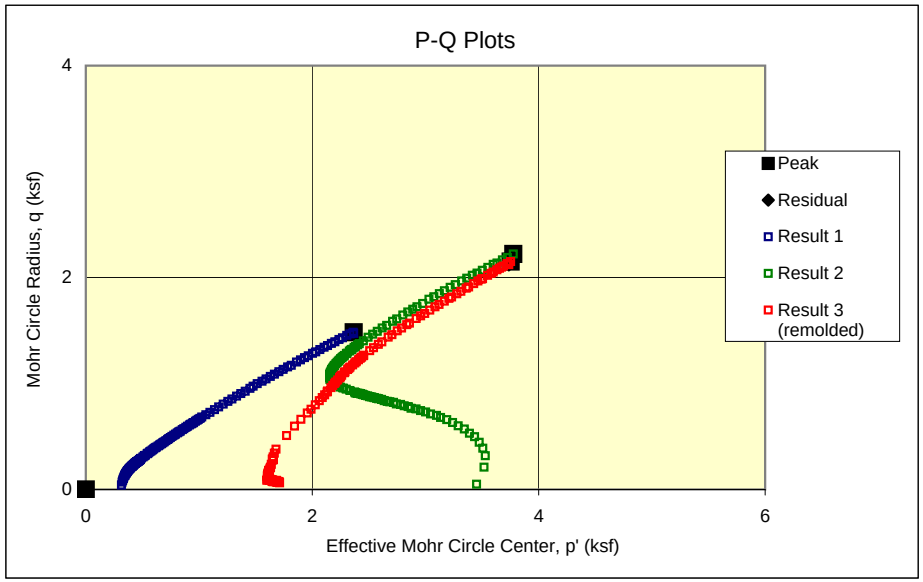


Undisturbed/shear rate 75%/hour	0.27 ksf	3.40 ksf	1.65 ksf (remolded)
Initial dry unit weight (pcf)	89.3	83.5	83.5
Initial Wc (%)	31.7%	39.9%	21.1%
Final dry unit weight (pcf)	91.9	87.3	110.4
Final Wc (%)	35.0%	32.4%	30.8%

Consolidation Stress (ksf)	Peak Failure Stress p (ksf)	Peak Failure Stress q (ksf)	Residual Failure Stress p (ksf)	Residual Failure Stress q (ksf)
0.27	2.37	1.48	2.37	1.47
3.40	3.78	2.22	3.78	2.22
1.65	3.75	2.15	3.74	2.12

Above values are effective stresses





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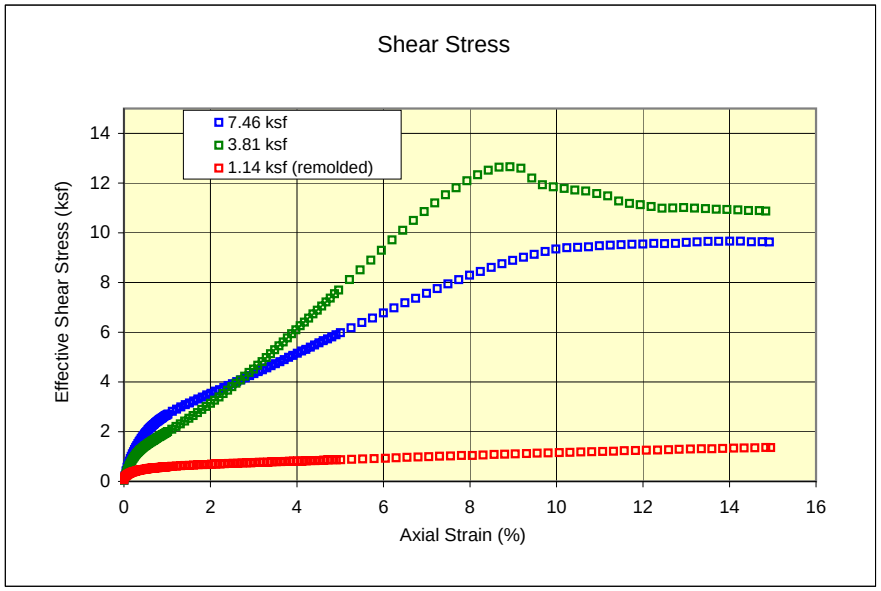
TRIAXIAL SHEAR TEST RESULTS
Project: Star Tailings Impoundment
Location: Wallace, ID
Number: G10502

Figure 5-3

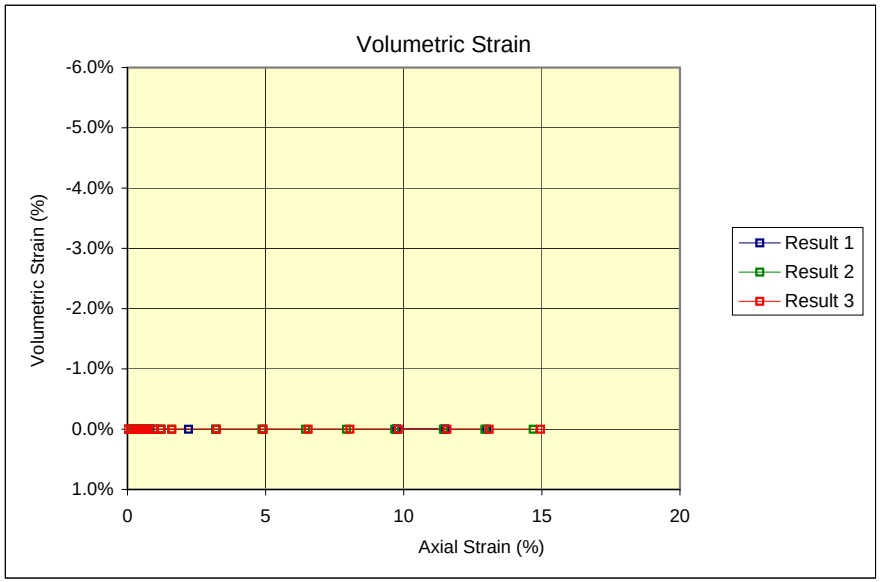
Report of CU Triaxial Shear Test

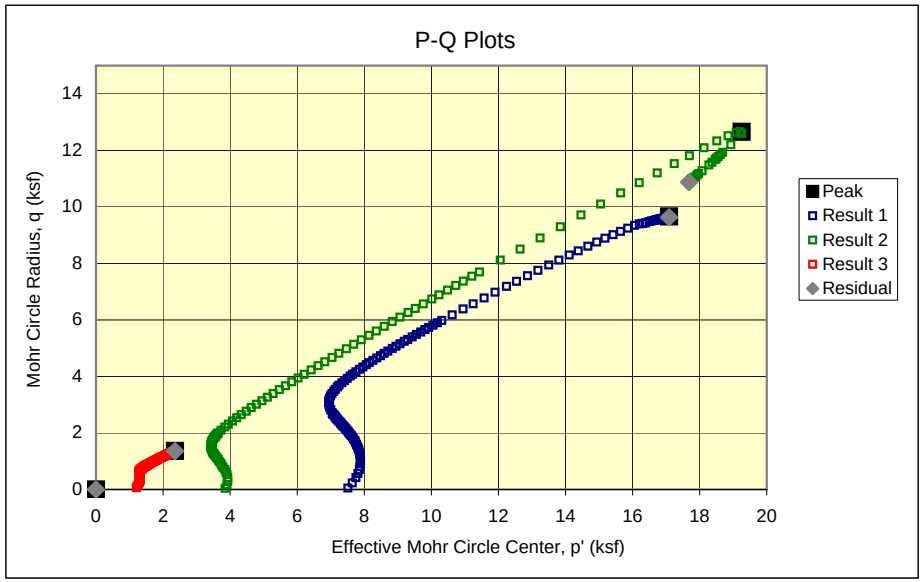


Undisturbed/shear rate 20%/hour	7.46 ksf	3.81 ksf	1.14 ksf (remolded)
Initial dry unit weight (pcf)	91.7	96.5	92.8
Initial Wc (%)	30.8%	26.0%	19.9%
Final dry unit weight (pcf)	95.6	99.0	96.0
Final Wc (%)	25.8%	26.2%	29.8%

Consolidation Stress (ksf)	Peak Failure Stress p (ksf)	Peak Failure Stress q (ksf)	Residual Failure Stress p (ksf)	Residual Failure Stress q (ksf)
7.46	17.09	9.66	17.09	9.63
3.81	19.25	12.66	17.68	10.87
1.14	2.36	1.37	2.36	1.36

Above values are effective stresses





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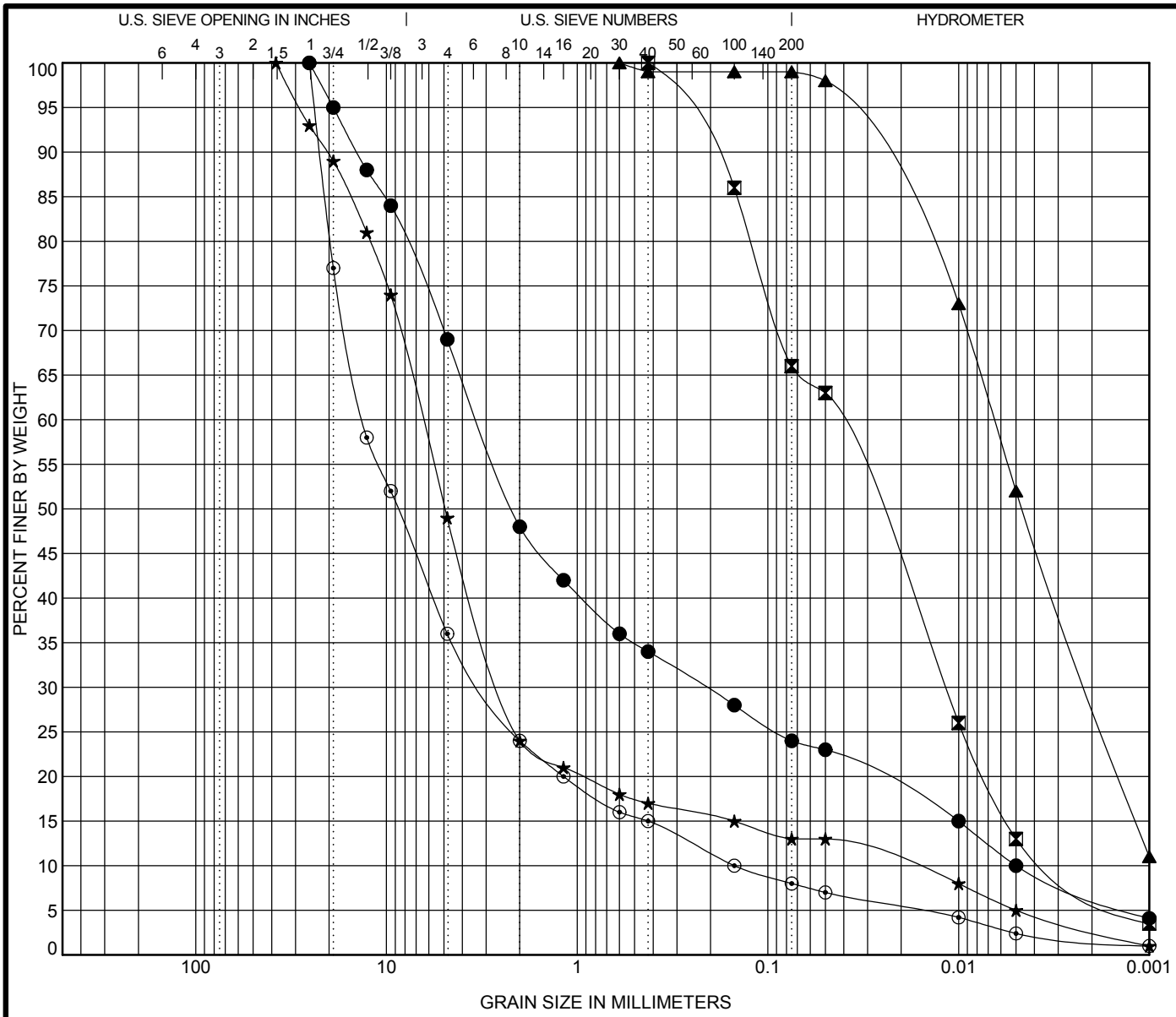
TRIAXIAL SHEAR TEST RESULTS
Project: Star Tailings Impoundment
Location: Wallace, ID
Number: G10502

Figure 5-4



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	# / Depth	Lab #	Classification	LL	PL	PI	Cc	Cu
●	BH-1 4	10-2524					2.73	659.67
⊠	BH-1 19	10-2528					1.07	14.59
▲	BH-1 26.5	10-2531						
★	BH-1 29.5	10-2532					49.35	340.49
⊙	BH-1 44	10-2536					4.83	88.33

	# / Depth	Lab #	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	BH-1	10-2524	25.4	3.298	0.212	0.005	31.3	44.7	14.0	10.0
⊠	BH-1	10-2528	0.425	0.044	0.012	0.003	0.0	34.0	53.0	13.0
▲	BH-1	10-2531	0.6	0.007	0.002		0.0	1.0	47.0	52.0
★	BH-1	10-2532	38	6.482	2.468	0.019	51.3	35.7	8.0	5.0
⊙	BH-1	10-2536	25.4	13.25	3.098	0.15	64.1	27.9	5.6	2.4

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GRAIN SIZE DISTRIBUTION RESULTS

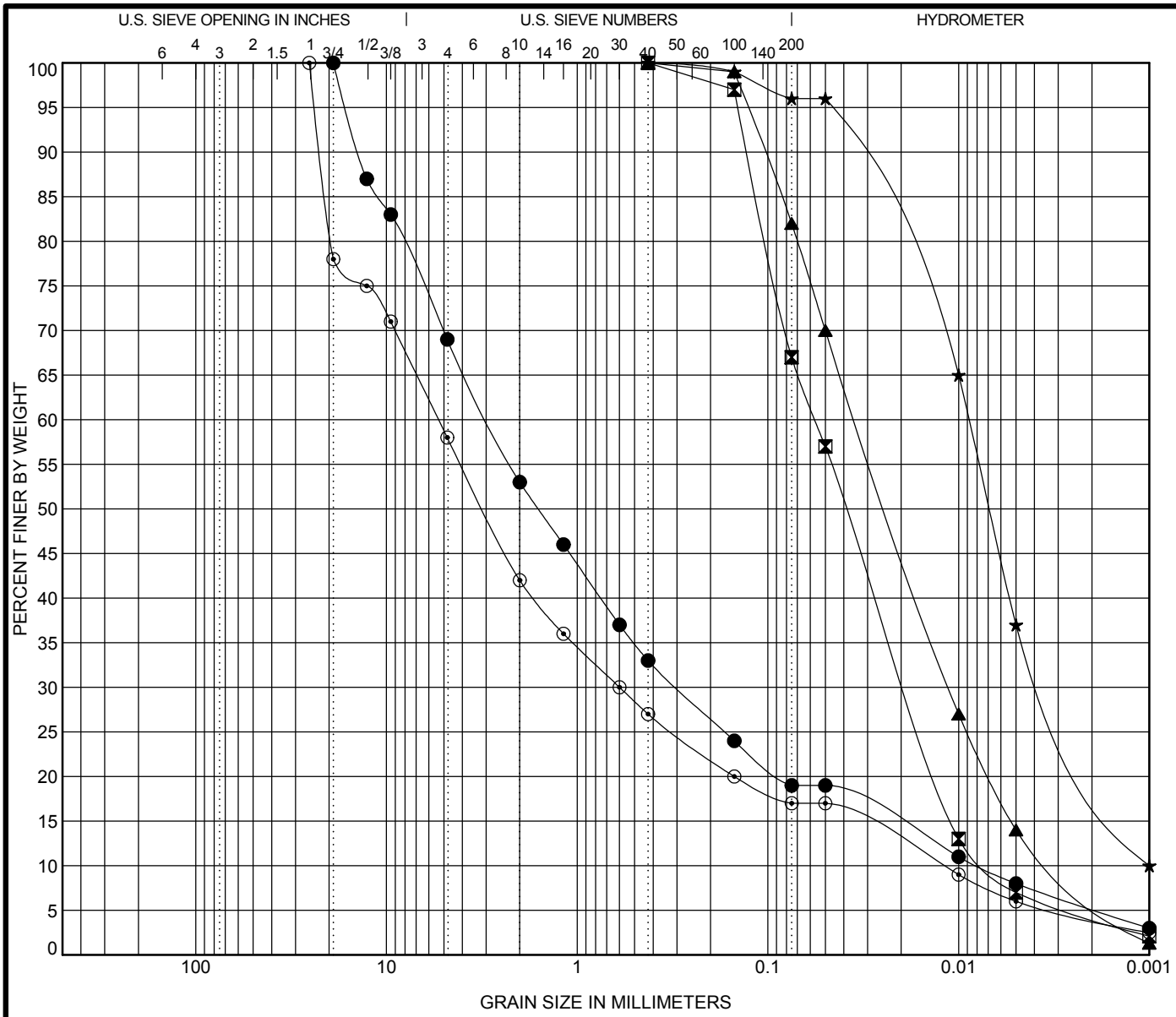
Project: Star Tailings Impoundment

Location: Wallace, ID

Number: G10502

FIGURE 6-1

US_GRAIN_SIZE G10502 STAR TAILINGS - BORING LOGS.GPJ BUDINGER.GDT 2/28/11



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	# / Depth	Lab #	Classification	LL	PL	PI	Cc	Cu
●	BH-2 14	10-2538					3.87	369.59
⊠	BH-2 20.5	10-2541					0.87	7.99
▲	BH-2 24.5	10-2543					1.21	11.42
★	BH-2 34.5	10-2547					1.23	8.84
⊙	BH-3 14.5	10-2550					5.52	436.00

	# / Depth	Lab #	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	BH-2	10-2538	19	2.933	0.3	0.008	31.2	49.8	11.0	8.0
⊠	BH-2	10-2541	0.425	0.056	0.019	0.007	0.0	33.0	60.0	7.0
▲	BH-2	10-2543	0.425	0.034	0.011	0.003	0.0	18.0	68.0	14.0
★	BH-2	10-2547	0.425	0.009	0.003	0.001	0.0	4.0	59.0	37.0
⊙	BH-3	10-2550	25.4	5.332	0.6	0.012	42.2	40.8	11.0	6.0

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GRAIN SIZE DISTRIBUTION RESULTS

Project: Star Tailings Impoundment

Location: Wallace, ID

Number: G10502

FIGURE 6-2

US_GRAIN_SIZE G10502 STAR TAILINGS - BORING LOGS.GPJ BUDINGER.GDT 2/28/11

Laboratory Report for

Budinger & Associates, Inc.

Project G10502, BH1 & BH2 Samples

February 9, 2011

Daniel B. Stephens & Associates, Inc.

5840 Osuna Road NE • Albuquerque, New Mexico 87109

February 9, 2011

Megan Rounds
Budinger & Associates, Inc.
1101 N. Fancher
Spokane Valley, WA 99212
(509) 535-8841

Re: DBS&A Laboratory Report for Budinger & Associates, Inc. Project G10502, BH1 & BH2 Samples

Dear Mrs. Rounds:

Enclosed is the final report for Budinger & Associates, Inc. Project G10502, BH1 & BH2 samples. Please review this report and provide any comments as samples will be held for a maximum of 30 days. After 30 days samples will be returned or disposed of in an appropriate manner.

All testing results were evaluated subjectively for consistency and reasonableness, and the results appear to be reasonably representative of the material tested. However, DBS&A does not assume any responsibility for interpretations or analyses based on the data enclosed, nor can we guarantee that these data are fully representative of the undisturbed materials at the field site. We recommend that careful evaluation of these laboratory results be made for your particular application.

The testing utilized to generate the enclosed final report employs methods that are standard for the industry. The results do not constitute a professional opinion by DBS&A, nor can the results affect any professional or expert opinions rendered with respect thereto by DBS&A. You have acknowledged that all the testing undertaken by us, and the final report provided, constitutes mere test results using standardized methods, and cannot be used to disqualify DBS&A from rendering any professional or expert opinion, having waived any claim of conflict of interest by DBS&A.

We are pleased to provide this service to Budinger & Associates, Inc. and look forward to future laboratory testing on other projects. If you have any questions about the enclosed data, please do not hesitate to call.

Sincerely,

DANIEL B. STEPHENS & ASSOCIATES, INC.
SOIL TESTING & RESEARCH LABORATORY

Joleen Hines

Joleen Hines
Laboratory Supervising Manager

Enclosure

Daniel B. Stephens & Associates, Inc.
Soil Testing & Research Laboratory
5840 Osuna Rd. NE
Albuquerque, NM 87109
505-889-7752
FAX 505-889-0258

Summaries

Summary of Tests Performed

Laboratory Sample Number	Initial Soil Properties[1]			Saturated Hydraulic Conductivity[2]			Moisture Characteristics[3]								Particle Size[4]			Specific Gravity[5]		Air Perm-eability	Atterberg Limits	Proctor Compaction
	G	VM	VD	CH	FH	FW	HC	PP	FP	DPP	RH	EP	WHC	K_{unsat}	DS	WS	H	F	C			
BH1 19'-21'	X	X		X			X	X		X	X			X								
BH1 26.5'-28.5'	X	X		X			X	X		X	X			X								
BH2 24.5'-26.5'	X	X		X			X	X		X	X			X								
BH2 32.5'-34.5'	X	X			X		X	X		X	X			X								

[1] G = Gravimetric Moisture Content, VM = Volume Measurement Method, VD = Volume Displacement Method

[2] CH = Constant Head Rigid Wall, FH = Falling Head Rigid Wall, FW = Falling Head Rising Tail Flexible Wall

[3] HC = Hanging Column, PP = Pressure Plate, FP = Filter Paper, DPP = Dew Point Potentiometer, RH = Relative Humidity Box, EP = Effective Porosity, WHC = Water Holding Capacity, Kunsat = Calculated Unsaturated Hydraulic Conductivity

[4] DS = Dry Sieve, WS = Wet Sieve, H = Hydrometer

[5] F = Fine (<4.75mm), C = Coarse (>4.75mm)

Summary of Sample Preparation/Volume Changes

	Initial Sample Data[1]		Volume Change Post Saturation[2]			Volume Change Post Drying Curve[3]		
Sample Number	Moisture Content (%, g/g)	Dry Bulk Density (g/cm^3)	Dry Bulk Density (g/cm^3)	% Volume Change (%)	% of Initial Density (%)	Dry Bulk Density (g/cm^3)	% Volume Change (%)	% of Initial Density (%)
BH1 19'-21'	14.5	1.45	1.53	-5.0%	105.3%	1.56	-6.9%	107.4%
BH1 26.5'-28.5'	38.7	1.34	1.42	-5.2%	105.5%	1.48	-9.4%	110.4%
BH2 24.5'-26.5'	28.6	1.62	---	---	100%	1.71	-5.3%	105.6%
BH2 32.5'-34.5'	29.5	1.51	1.55	-2.5%	102.5%	1.58	-4.4%	104.6%

[1]Initial Sample Data: The 'as received' dry bulk density and moisture content.

[2]Volume Change Post Saturation: Volume change measurements were obtained after saturated hydraulic conductivity testing.

[3]Volume Change Post Drying Curve: Volume change measurements were obtained throughout hanging column and pressure plate testing. The 'Volume Change Post Drying Curve' values represent the final sample dimensions after the last pressure plate point.

Notes:

"+" indicates sample swelling, "-" indicates sample settling, and "---" indicates no volume change occurred.

Summary of Initial Moisture Content, Dry Bulk Density Wet Bulk Density and Calculated Porosity

Sample Number	Moisture Content: As Received Gravimetric (%, g/g)	Moisture Content: As Received Volumetric (%, cm^3/cm^3)	Moisture Content: Remolded Gravimetric (%, g/g)	Moisture Content: Remolded Volumetric (%, cm^3/cm^3)	Dry Bulk Density (g/cm^3)	Wet Bulk Density (g/cm^3)	Calculated Porosity (%)
BH1 19'-21'	14.5	21.1	---	---	1.45	1.66	49.2
BH1 26.5'-28.5'	38.7	52.0	---	---	1.34	1.86	53.7
BH2 24.5'-26.5'	28.6	46.3	---	---	1.62	2.08	43.9
BH2 32.5'-34.5'	29.5	44.4	---	---	1.51	1.95	47.7

NA = Not analyzed

--- = This sample was not remolded

Summary of Saturated Hydraulic Conductivity Tests

Sample Number	K_{sat} (cm/sec)	Oversize Corrected K_{sat} (cm/sec)	Method of Analysis	
			Constant Head	Falling Head
BH1 19'-21'	1.4E-04	NA	X	
BH1 26.5'-28.5'	9.2E-05	NA	X	
BH2 24.5'-26.5'	2.1E-04	NA	X	
BH2 32.5'-34.5'	1.3E-05	NA		X

--- = Oversize correction is unnecessary since coarse fraction < 5% of composite mass
NR = Not requested
NA = Not applicable

Summary of Moisture Characteristics of the Initial Drainage Curve

Sample Number	Pressure Head (-cm water)	Moisture Content (%, cm^3/cm^3)
BH1 19'-21'	0	49.1 ‡‡
	11	47.2 ‡‡
	32	46.2 ‡‡
	99	30.9 ‡‡
	337	16.6 ‡‡
	20396	1.0 ‡‡
	90252	0.6 ‡‡
	859892	0.3 ‡‡
BH1 26.5'-28.5'	0	52.3 ‡‡
	17	49.9 ‡‡
	48	49.1 ‡‡
	125	48.1 ‡‡
	337	46.5 ‡‡
	11014	8.9 ‡‡
	19070	5.1 ‡‡
	27229	4.2 ‡‡
	112688	2.1 ‡‡
	859892	0.7 ‡‡
BH2 24.5'-26.5'	0	43.1
	11	40.8
	32	41.0 ‡‡
	99	39.6 ‡‡
	337	38.2 ‡‡
	7343	10.6 ‡‡
	12951	5.5 ‡‡
	32430	2.8 ‡‡
	859892	0.5 ‡‡
BH2 32.5'-34.5'	0	45.7 ‡‡
	17	43.2 ‡‡
	48	42.7 ‡‡
	125	35.9 ‡‡
	337	26.0 ‡‡
	11320	7.4 ‡‡
	29778	4.1 ‡‡
	75159	2.1 ‡‡
	859892	0.7 ‡‡

‡‡ Volume adjustments are applicable at this matric potential (see data sheet for this sample).

Summary of Calculated Unsaturated Hydraulic Properties

Sample Number	α (cm^{-1})	N (dimensionless)	θ_r (% vol)	θ_s (% vol)	Oversize Corrected θ_r (% vol)	Oversize Corrected θ_s (% vol)
BH1 19'-21'	0.0145	1.6954	0.21	49.08	NA	NA
BH1 26.5'-28.5'	0.0012	1.6981	0.22	50.17	NA	NA
BH2 24.5'-26.5'	0.0011	1.6933	0.00	41.22	NA	NA
BH2 32.5'-34.5'	0.0092	1.4228	0.00	45.29	NA	NA

--- = Oversize correction is unnecessary since coarse fraction < 5% of composite mass

NR = Not requested

NA = Not applicable

Laboratory Data and Graphical Plots

Initial Properties

Summary of Initial Moisture Content, Dry Bulk Density Wet Bulk Density and Calculated Porosity

Sample Number	Moisture Content: As Received, Gravimetric (%, g/g)	Moisture Content: As Received, Volumetric (%, cm^3/cm^3)	Moisture Content: Remolded, Gravimetric (%, g/g)	Moisture Content: Remolded, Volumetric (%, cm^3/cm^3)	Dry Bulk Density (g/cm^3)	Wet Bulk Density (g/cm^3)	Calculated Porosity (%)
BH1 19'-21'	14.5	21.1	---	---	1.45	1.66	49.2
BH1 26.5'-28.5'	38.7	52.0	---	---	1.34	1.86	53.7
BH2 24.5'-26.5'	28.6	46.3	---	---	1.62	2.08	43.9
BH2 32.5'-34.5'	29.5	44.4	---	---	1.51	1.95	47.7

NA = Not analyzed

--- = This sample was not remolded

Data for Initial Moisture Content, Bulk Density, Porosity, and Percent Saturation

Job Name: Budinger & Associates, Inc.
Job Number: LB11.0005.00
Sample Number: BH1 19'-21'
Project Number: G10502
Depth: 19'-21'

	As Received	Remolded
Test Date:	6-Jan-11	---
Field weight of sample* (g):	573.40	
Tare weight, ring (g):	161.51	
Tare weight, pan/plate (g):	0.00	
Tare weight, other (g):	0.00	
Dry weight of sample (g):	359.67	
Sample volume (cm^3):	247.77	
Client Provided particle density (g/cm^3):	2.86	
Gravimetric Moisture Content (% g/g):	14.5	
Volumetric Moisture Content (% vol):	21.1	
Dry bulk density (g/cm^3):	1.45	
Wet bulk density (g/cm^3):	1.66	
Calculated Porosity (% vol):	49.2	
Percent Saturation:	42.8	

Laboratory analysis by: K. Wright
Data entered by: J. Hines
Checked by: C. Krous

Comments:

* Weight including tares
NA = Not analyzed
--- = This sample was not remolded

Data for Initial Moisture Content, Bulk Density, Porosity, and Percent Saturation

Job Name: Budinger & Associates, Inc.
Job Number: LB11.0005.00
Sample Number: BH1 26.5'-28.5'
Project Number: G10502
Depth: 26.5'-28.5'

	As Received	Remolded
Test Date:	6-Jan-11	---
Field weight of sample* (g)*:*	814.80	
Tare weight, ring (g)*:*	211.20	
Tare weight, pan/plate (g)*:*	0.00	
Tare weight, other (g)*:*	0.00	
Dry weight of sample (g)*:*	435.17	
Sample volume (cm^3)*:*	323.96	
Client Provided particle density (g/cm^3)*:*	2.90	
Gravimetric Moisture Content (% g/g)*:*	38.7	
Volumetric Moisture Content (% vol)*:*	52.0	
Dry bulk density (g/cm^3)*:*	1.34	
Wet bulk density (g/cm^3)*:*	1.86	
Calculated Porosity (% vol)*:*	53.7	
Percent Saturation:	96.8	

Laboratory analysis by: K. Wright
Data entered by: J. Hines
Checked by: C. Krous

Comments:

* Weight including tares
NA = Not analyzed
--- = This sample was not remolded

Data for Initial Moisture Content, Bulk Density, Porosity, and Percent Saturation

Job Name: Budinger & Associates, Inc.
Job Number: LB11.0005.00
Sample Number: BH2 24.5'-26.5'
Project Number: G10502
Depth: 24.5'-26.5'

	As Received	Remolded
Test Date:	6-Jan-11	---
Field weight of sample* (g)*:*	568.56	
Tare weight, ring (g)*:*	135.63	
Tare weight, pan/plate (g)*:*	0.00	
Tare weight, other (g)*:*	0.00	
Dry weight of sample (g)*:*	336.52	
Sample volume (cm^3)*:*	208.12	
Client Provided particle density (g/cm^3)*:*	2.88	
Gravimetric Moisture Content (% g/g)*:*	28.6	
Volumetric Moisture Content (% vol)*:*	46.3	
Dry bulk density (g/cm^3)*:*	1.62	
Wet bulk density (g/cm^3)*:*	2.08	
Calculated Porosity (% vol)*:*	43.9	
Percent Saturation:	105.5	

Laboratory analysis by: K. Wright
Data entered by: J. Hines
Checked by: C. Krous

Comments:

* Weight including tares
NA = Not analyzed
--- = This sample was not remolded

Data for Initial Moisture Content, Bulk Density, Porosity, and Percent Saturation

Job Name: Budinger & Associates, Inc.
Job Number: LB11.0005.00
Sample Number: BH2 32.5'-34.5'
Project Number: G10502
Depth: 32.5'-34.5'

	As Received	Remolded
Test Date:	6-Jan-11	---
Field weight of sample* (g)*:*	700.33	
Tare weight, ring (g)*:*	175.90	
Tare weight, pan/plate (g)*:*	0.00	
Tare weight, other (g)*:*	0.00	
Dry weight of sample (g)*:*	405.01	
Sample volume (cm^3)*:*	268.79	
Client Provided particle density (g/cm^3)*:*	2.88	
Gravimetric Moisture Content (% g/g)*:*	29.5	
Volumetric Moisture Content (% vol)*:*	44.4	
Dry bulk density (g/cm^3)*:*	1.51	
Wet bulk density (g/cm^3)*:*	1.95	
Calculated Porosity (% vol)*:*	47.7	
Percent Saturation:	93.2	

Laboratory analysis by: K. Wright
Data entered by: J. Hines
Checked by: C. Krous

Comments:

* Weight including tares
NA = Not analyzed
--- = This sample was not remolded

Saturated Hydraulic Conductivity

Summary of Saturated Hydraulic Conductivity Tests

Sample Number	K_{sat} (cm/sec)	Oversize Corrected K_{sat} (cm/sec)	Method of Analysis	
			Constant Head	Falling Head
BH1 19'-21'	1.4E-04	NA	X	
BH1 26.5'-28.5'	9.2E-05	NA	X	
BH2 24.5'-26.5'	2.1E-04	NA	X	
BH2 32.5'-34.5'	1.3E-05	NA		X

--- = Oversize correction is unnecessary since coarse fraction < 5% of composite mass
NR = Not requested
NA = Not applicable

Saturated Hydraulic Conductivity
Constant Head Method

Job name:	Budinger & Associates, Inc.	*Type of water used:*	TAP
Job number:	LB11.0005.00	*Collection vessel tare* (g):	10.96
Sample number:	BH1 19'-21'	*Sample length* (cm):	5.85
Project Number:	G10502	*Sample diameter* (cm):	7.35
Depth:	19'-21'	*Sample x-sectional area* (cm^2):	42.38

Date	Time	Temp (°C)	Head (cm)	Q + Tare (g)	Q (cm^3)	Elapsed time (sec)	Ksat (cm/sec)	Ksat @ 20°C (cm/sec)
Test # 1:								
9-Jan-11	9:39:16	19.0	5.3	14.10	3.1	594	1.4E-04	1.4E-04
9-Jan-11	9:49:10							
Test # 2:								
9-Jan-11	10:21:36	19.0	5	13.64	2.7	555	1.3E-04	1.4E-04
9-Jan-11	10:30:51							
Test # 3:								
9-Jan-11	10:51:22	19.0	4.8	13.66	2.7	590	1.3E-04	1.3E-04
9-Jan-11	11:01:12							

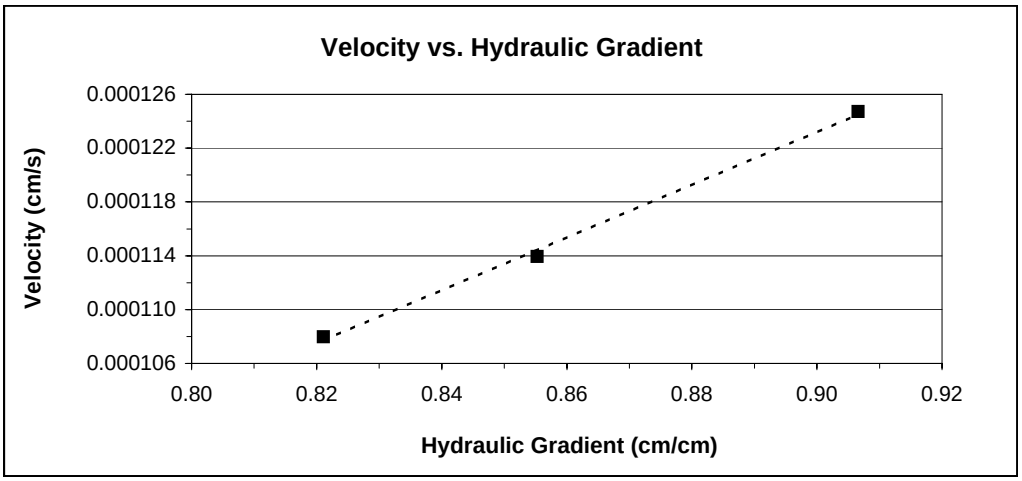
***Average Ksat* (cm/sec):** **1.4E-04**

***Oversize Corrected Ksat* (cm/sec):** **NA**

Comments:

--- = Oversize correction is unnecessary since coarse fraction < 5% of composite mass

NA = Not applicable



Laboratory analysis by: K. Wright

Data entered by: K. Wright

Checked by: J. Hines

Saturated Hydraulic Conductivity
Constant Head Method

Job name:	Budinger & Associates, Inc.	*Type of water used:*	TAP
Job number:	LB11.0005.00	*Collection vessel tare* (g):	10.93
Sample number:	BH1 26.5'-28.5'	*Sample length* (cm):	7.63
Project Number:	G10502	*Sample diameter* (cm):	7.36
Depth:	26.5'-28.5'	*Sample x-sectional area* (cm^2):	42.49

Date	Time	Temp (°C)	Head (cm)	Q + Tare (g)	Q (cm^3)	Elapsed time (sec)	Ksat (cm/sec)	Ksat @ 20°C (cm/sec)
Test # 1:								
9-Jan-11	9:38:59	19.0	6.5	12.72	1.8	541	9.1E-05	9.4E-05
9-Jan-11	9:48:00							
Test # 2:								
9-Jan-11	10:21:04	19.0	6.3	12.60	1.7	543	8.8E-05	9.0E-05
9-Jan-11	10:30:07							
Test # 3:								
9-Jan-11	10:51:05	19.0	6.1	12.66	1.7	561	9.1E-05	9.3E-05
9-Jan-11	11:00:26							

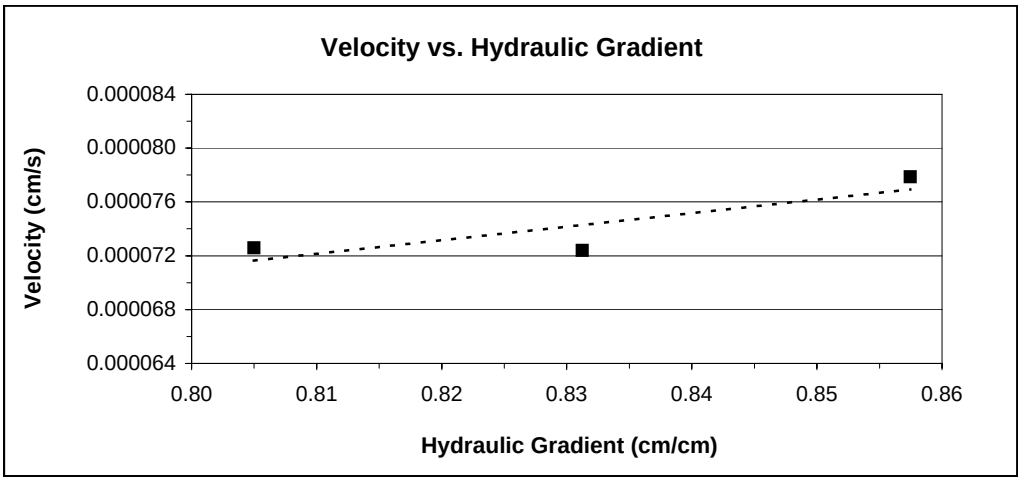
***Average Ksat* (cm/sec):** **9.2E-05**

***Oversize Corrected Ksat* (cm/sec):** **NA**

Comments:

--- = Oversize correction is unnecessary since coarse fraction < 5% of composite mass

NA = Not applicable



Laboratory analysis by: K. Wright

Data entered by: K. Wright

Checked by: J. Hines

Saturated Hydraulic Conductivity
Constant Head Method

Job name:	Budinger & Associates, Inc.	*Type of water used:*	TAP
Job number:	LB11.0005.00	*Collection vessel tare* (g):	11.00
Sample number:	BH2 24.5'-26.5'	*Sample length* (cm):	4.90
Project Number:	G10502	*Sample diameter* (cm):	7.35
Depth:	24.5'-26.5'	*Sample x-sectional area* (cm^2):	42.46

Date	Time	Temp (°C)	Head (cm)	Q + Tare (g)	Q (cm^3)	Elapsed time (sec)	Ksat (cm/sec)	Ksat @ 20°C (cm/sec)
Test # 1:								
9-Jan-11	9:39:33	19.0	3.4	14.34	3.3	541	2.1E-04	2.2E-04
9-Jan-11	9:48:34							
Test # 2:								
9-Jan-11	10:21:56	19.0	3	14.00	3.0	575	2.0E-04	2.1E-04
9-Jan-11	10:31:31							
Test # 3:								
9-Jan-11	10:51:45	19.0	2.8	13.98	3.0	611	2.0E-04	2.1E-04
9-Jan-11	11:01:56							

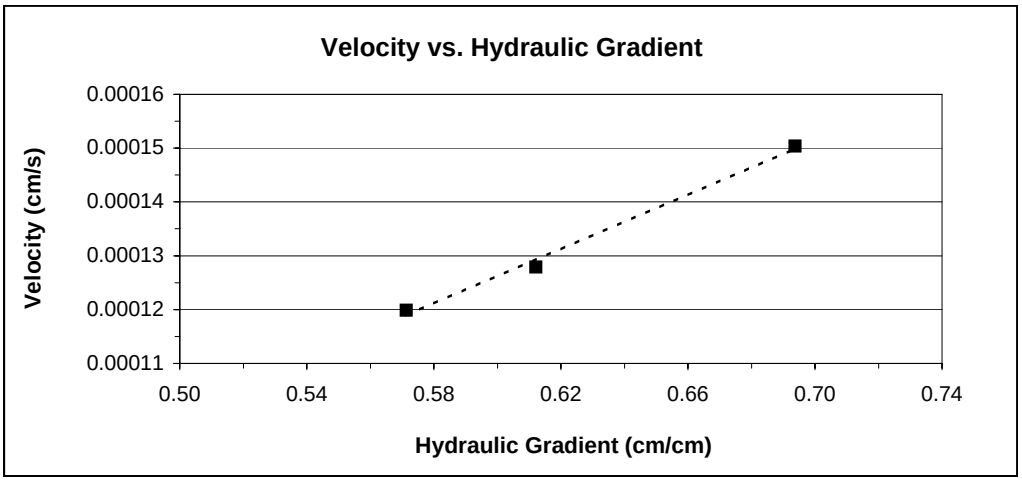
***Average Ksat* (cm/sec):** **2.1E-04**

***Oversize Corrected Ksat* (cm/sec):** **NA**

Comments:

--- = Oversize correction is unnecessary since coarse fraction < 5% of composite mass

NA = Not applicable



Laboratory analysis by: K. Wright

Data entered by: K. Wright

Checked by: J. Hines

Saturated Hydraulic Conductivity
Falling Head Method

Job name:	Budinger & Associates, Inc.	*Type of water used:*	TAP
Job number:	LB11.0005.00	*Backpressure* (psi)*:*	0.0
Sample number:	BH2 32.5'-34.5'	*Offset* (cm)*:*	2.8
Project Number:	G10502	*Sample length* (cm)*:*	6.34
Depth:	32.5'-34.5'	*Sample x-sectional area* (cm^2)*:*	42.43
		Reservoir x-sectional area (cm^2)*:*	0.70

Date	Time	Temp (°C)	Reservoir head (cm)	Corrected head (cm)	Elapsed time (sec)	Ksat (cm/sec)	Ksat @ 20°C (cm/sec)
Test # 1:							
10-Jan-11	8:45:15	19.0	14.15	11.4	3045	1.1E-05	1.1E-05
10-Jan-11	9:36:00	19.0	11.1	8.3			
Test # 2:							
10-Jan-11	9:36:00	19.0	11.1	8.3	1440	1.3E-05	1.3E-05
10-Jan-11	10:00:00	19.0	9.75	7.0			
Test # 3:							
10-Jan-11	10:47:30	19.0	7.75	5.0	2090	1.3E-05	1.4E-05
10-Jan-11	11:22:20	19.0	6.6	3.8			

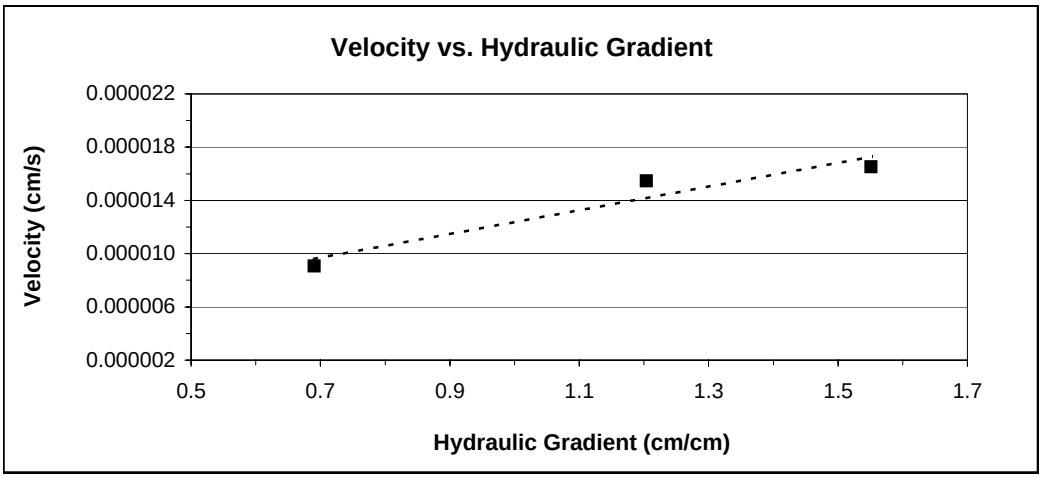
Average Ksat* (cm/sec)*: **1.3E-05**

Oversize Corrected Ksat* (cm/sec)*: **NA**

Comments:

--- = Oversize correction is unnecessary since coarse fraction < 5% of composite mass

NA = Not applicable



Laboratory analysis by: K. Wright

Data entered by: K. Wright

Checked by: J. Hines

Moisture Retention Characteristics

Summary of Moisture Characteristics of the Initial Drainage Curve

Sample Number	Pressure Head (-cm water)	Moisture Content (%, cm^3/cm^3)
BH1 19'-21'	0	49.1 ‡‡
	11	47.2 ‡‡
	32	46.2 ‡‡
	99	30.9 ‡‡
	337	16.6 ‡‡
	20396	1.0 ‡‡
	90252	0.6 ‡‡
	859892	0.3 ‡‡
BH1 26.5'-28.5'	0	52.3 ‡‡
	17	49.9 ‡‡
	48	49.1 ‡‡
	125	48.1 ‡‡
	337	46.5 ‡‡
	11014	8.9 ‡‡
	19070	5.1 ‡‡
	27229	4.2 ‡‡
	112688	2.1 ‡‡
	859892	0.7 ‡‡
BH2 24.5'-26.5'	0	43.1
	11	40.8
	32	41.0 ‡‡
	99	39.6 ‡‡
	337	38.2 ‡‡
	7343	10.6 ‡‡
	12951	5.5 ‡‡
	32430	2.8 ‡‡
	859892	0.5 ‡‡
BH2 32.5'-34.5'	0	45.7 ‡‡
	17	43.2 ‡‡
	48	42.7 ‡‡
	125	35.9 ‡‡
	337	26.0 ‡‡
	11320	7.4 ‡‡
	29778	4.1 ‡‡
	75159	2.1 ‡‡
	859892	0.7 ‡‡

‡‡ Volume adjustments are applicable at this matric potential (see data sheet for this sample).

Summary of Calculated Unsaturated Hydraulic Properties

Sample Number	α (cm^{-1})	N (dimensionless)	θ_r (% vol)	θ_s (% vol)	Oversize Corrected θ_r (% vol)	Oversize Corrected θ_s (% vol)
BH1 19'-21'	0.0145	1.6954	0.21	49.08	NA	NA
BH1 26.5'-28.5'	0.0012	1.6981	0.22	50.17	NA	NA
BH2 24.5'-26.5'	0.0011	1.6933	0.00	41.22	NA	NA
BH2 32.5'-34.5'	0.0092	1.4228	0.00	45.29	NA	NA

--- = Oversize correction is unnecessary since coarse fraction < 5% of composite mass

NR = Not requested

NA = Not applicable

Moisture Retention Data

Hanging Column / Pressure Plate

(Soil-Water Characteristic Curve)

Job Name: Budinger & Associates, Inc.
Job Number: LB11.0005.00
Sample Number: BH1 19'-21'
Project Number: G10502
Depth: 19'-21'

Dry wt. of sample (g): 359.67
Tare wt., ring (g): 161.51
Tare wt., screen & clamp (g): 28.90
Initial sample volume (cm^3): 247.77
Initial dry bulk density (g/cm^3): 1.45
Client Provided particle density (g/cm^3): 2.86
Initial calculated total porosity (%): 49.19

	Date	Time	Weight* (g)	Matric Potential (-cm water)	Moisture Content† (% vol)	
Hanging column:	10-Jan-11	12:55	665.59	0	49.09	‡‡
	16-Jan-11	11:15	660.48	11.0	47.17	‡‡
	22-Jan-11	10:10	656.91	32.0	46.20	‡‡
	28-Jan-11	10:50	621.51	99.0	30.92	‡‡
Pressure plate:	6-Feb-11	10:50	588.39	337	16.61	‡‡

Volume Adjusted Data [1]

	Matric Potential (-cm water)	Adjusted Volume (cm^3)	% Volume Change [2] (%)	Adjusted Density (g/cm^3)	Adjusted Calculated Porosity (%)
Hanging column:	0.0	235.31	-5.03%	1.53	46.50
	11.0	234.04	-5.54%	1.54	46.21
	32.0	231.24	-6.67%	1.56	45.56
	99.0	231.03	-6.76%	1.56	45.51
Pressure plate:	337	230.61	-6.93%	1.56	45.41

Comments:

[1] Applicable if the sample experienced volume changes during testing. 'Volume Adjusted' values represent each of the volume change measurements obtained after saturated hydraulic conductivity testing and throughout hanging column/pressure plate testing. "---" indicates no volume changes occurred.

[2] Represents percent volume change from original sample volume. A '+' denotes measured sample swelling, a '-' denotes measured sample settling, and '---' denotes no volume change occurred.

* Weight including tares

† Assumed density of water is 1.0 g/cm^3

‡‡ Volume adjustments are applicable at this matric potential (see comment #1).

Technician Notes:

Laboratory analysis by: K. Wright
Data entered by: J. Hines
Checked by: C. Krous

Moisture Retention Data

Dew Point Potentiometer / Relative Humidity Box

(Soil-Water Characteristic Curve)

Sample Number: BH1 19'-21'

Initial sample bulk density (g/cm^3)*:* 1.45
Fraction of bulk sample used (<2.00mm fraction) (%): 100.00

Dry weight of dew point potentiometer sample* (g)*:* 163.02
Tare weight, jar (g)*:* 112.36

	Date	Time	Weight* (g)	Water Potential (-cm water)	Moisture Content † (% vol)	
Dew point potentiometer:	7-Feb-11	14:20	163.33	20396	0.95	‡‡
	8-Feb-11	11:30	163.20	90252	0.55	‡‡

Volume Adjusted Data [1]

	Water Potential (-cm water)	Adjusted Volume (cm^3)	% Volume Change [2] (%)	Adjusted Density (g/cm^3)	Adjusted Calc. Porosity (%)
Dew point potentiometer:	20396	230.61	-6.93%	1.56	45.41
	90252	230.61	-6.93%	1.56	45.41

Dry weight of relative humidity box sample* (g)*:* 68.46
Tare weight (g)*:* 38.03

	Date	Time	Weight* (g)	Water Potential (-cm water)	Moisture Content † (% vol)	
Relative humidity box:	14-Jan-11	10:15	68.52	859892	0.29	‡‡

Volume Adjusted Data [1]

	Water Potential (-cm water)	Adjusted Volume (cm^3)	% Volume Change [2] (%)	Adjusted Density (g/cm^3)	Adjusted Calc. Porosity (%)
Relative humidity box:	859892	230.61	-6.93%	1.56	45.41

Comments:

[1] Applicable if the sample experienced volume changes during testing. 'Volume Adjusted' values represent the volume change measurements obtained after the last hanging column or pressure plate point. "---" indicates no volume changes occurred.

[2] Represents percent volume change from original sample volume. A '+' denotes measured sample swelling, a '-' denotes measured sample settling, and '---' denotes no volume change occurred.

* Weight including tares

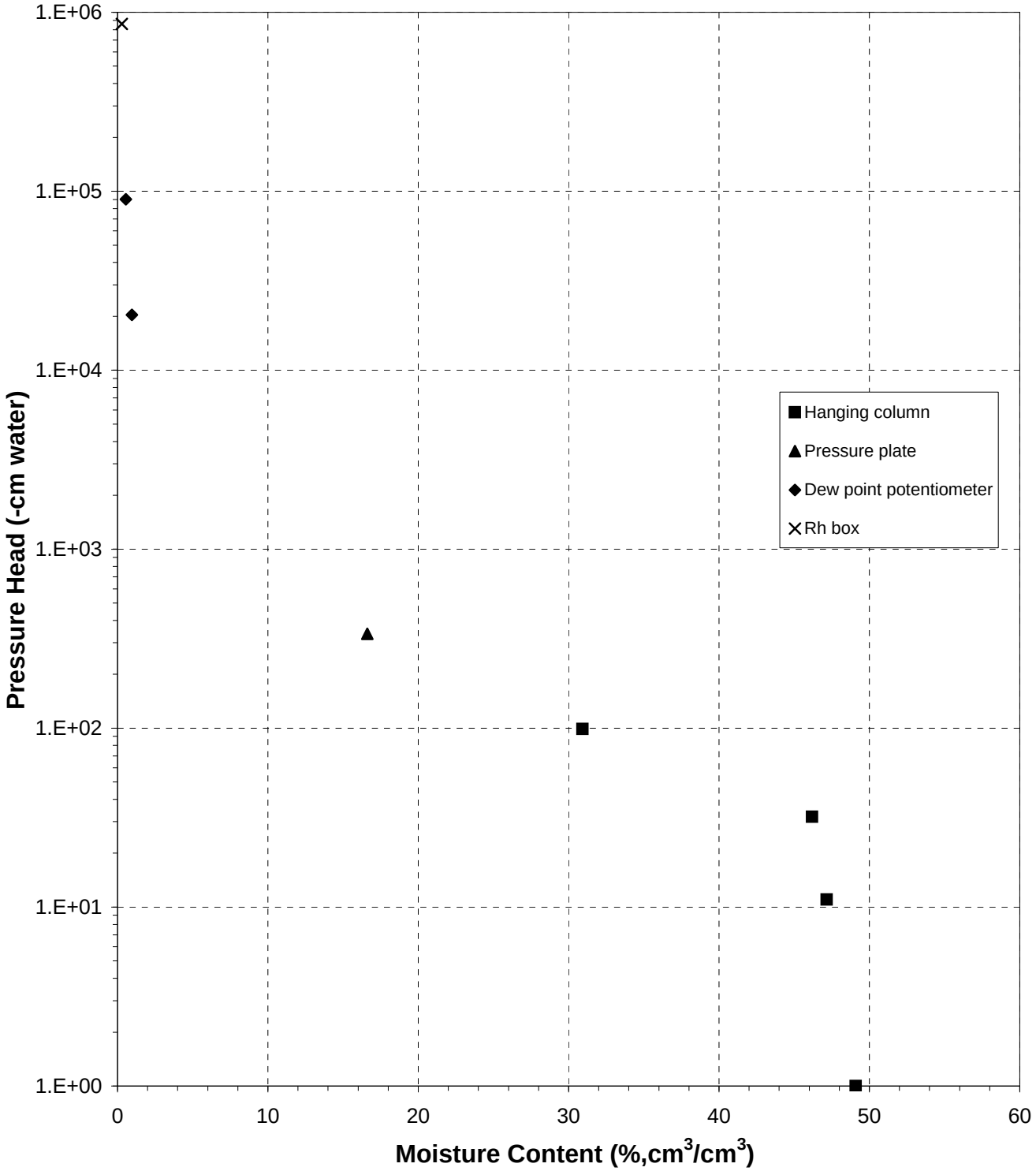
† Adjusted for >2.00mm (#10 sieve) material not used in DPP/RH testing. Assumed moisture content of material >2.00mm is zero, and assumed density of water is 1.0 g/cm^3.

‡‡ Volume adjustments are applicable at this matric potential (see comment #1).

Laboratory analysis by: J. Hines/K. Wright
Data entered by: J. Hines
Checked by: C. Krous

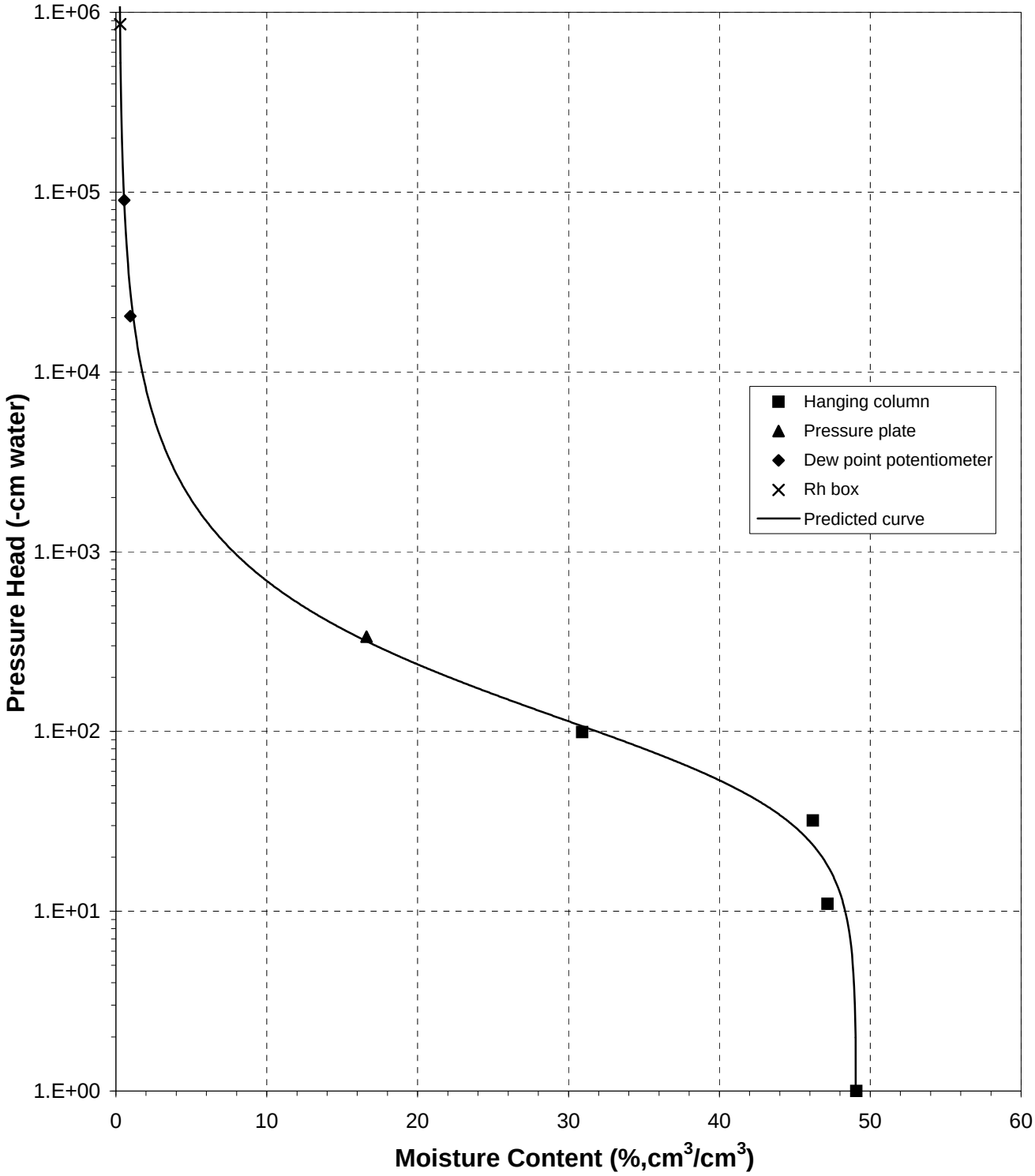
Water Retention Data Points

Sample Number: BH1 19'-21'



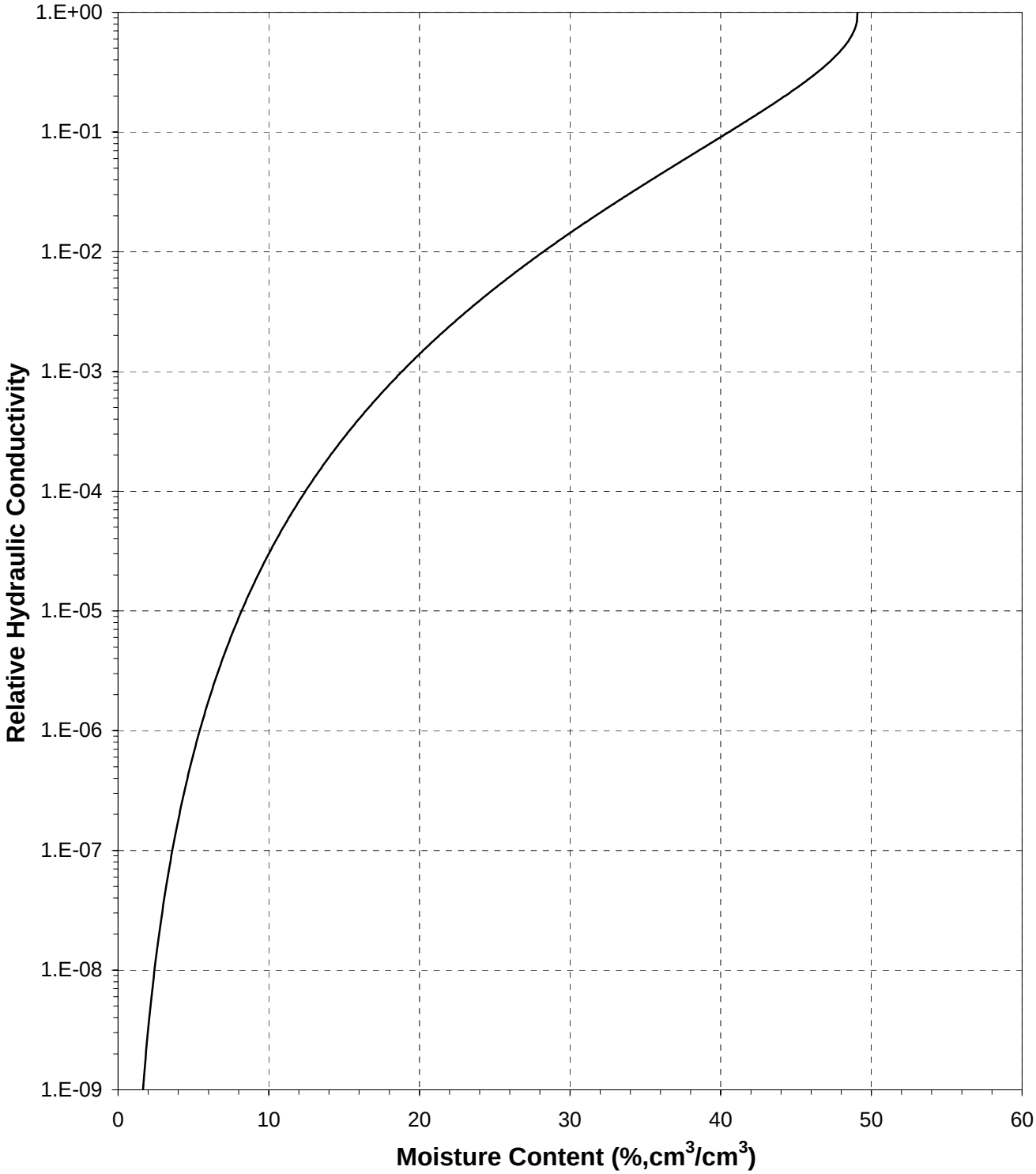
Predicted Water Retention Curve and Data Points

Sample Number: BH1 19'-21'



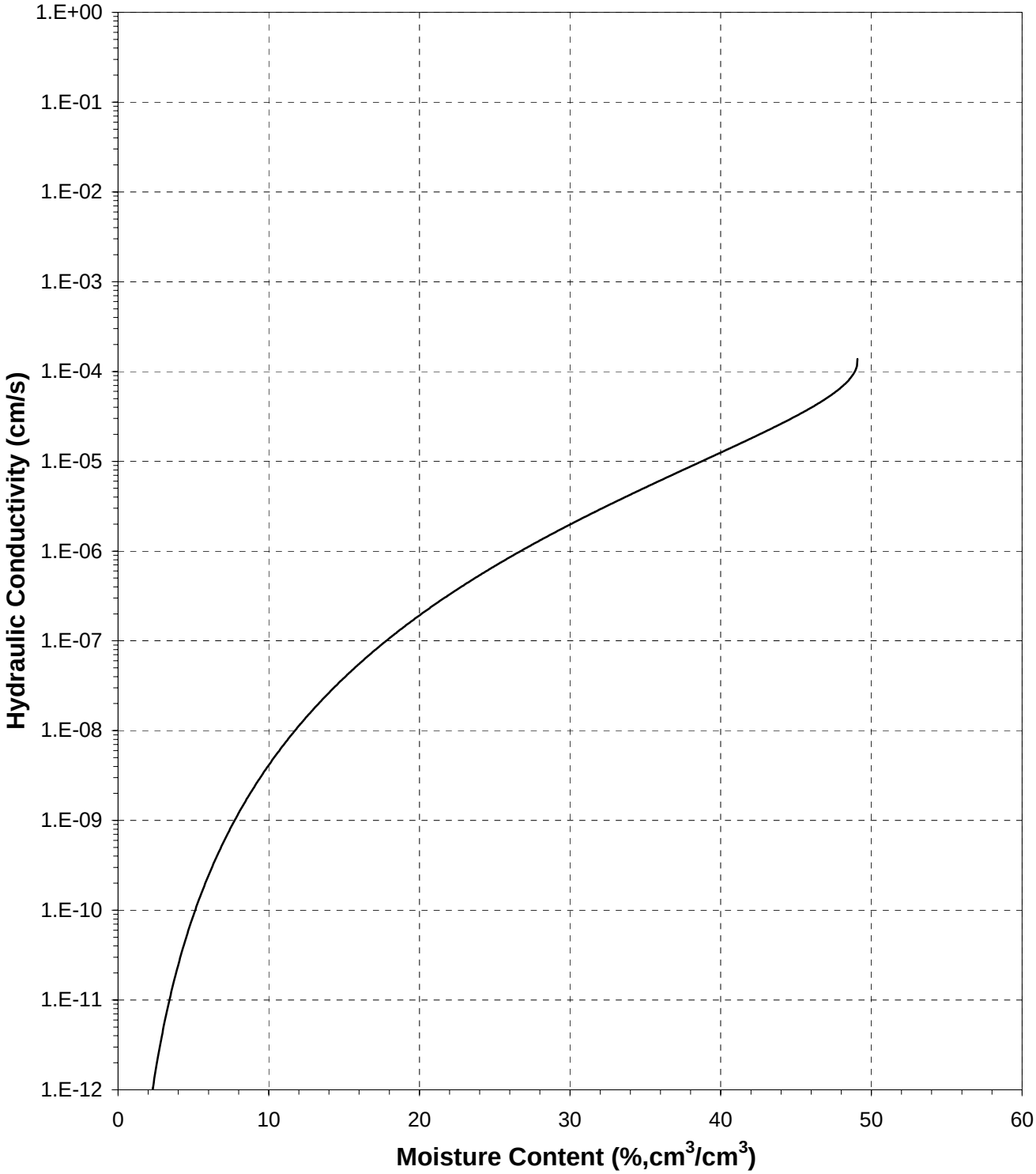
Plot of Relative Hydraulic Conductivity vs Moisture Content

Sample Number: BH1 19'-21'



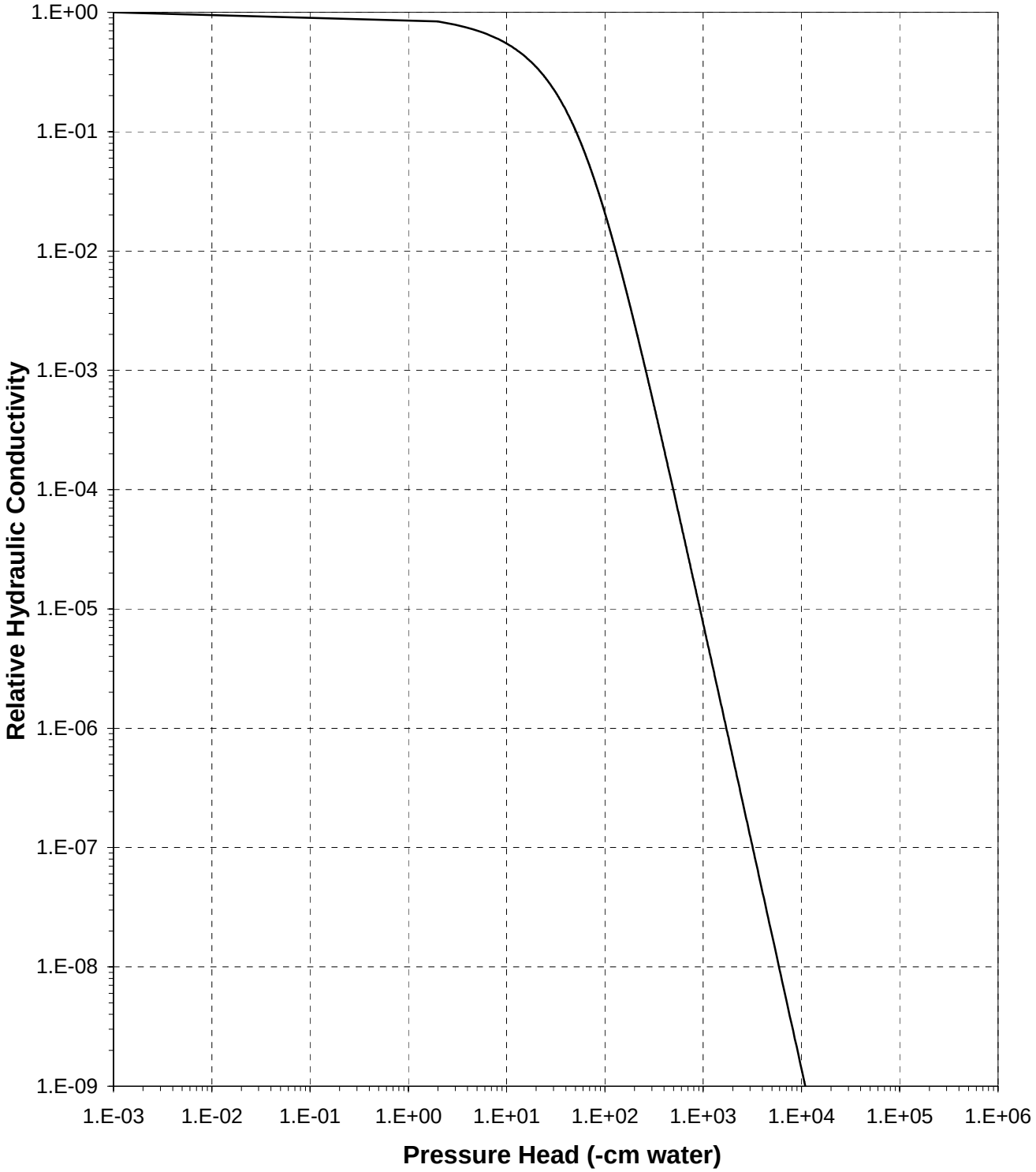
Plot of Hydraulic Conductivity vs Moisture Content

Sample Number: BH1 19'-21'



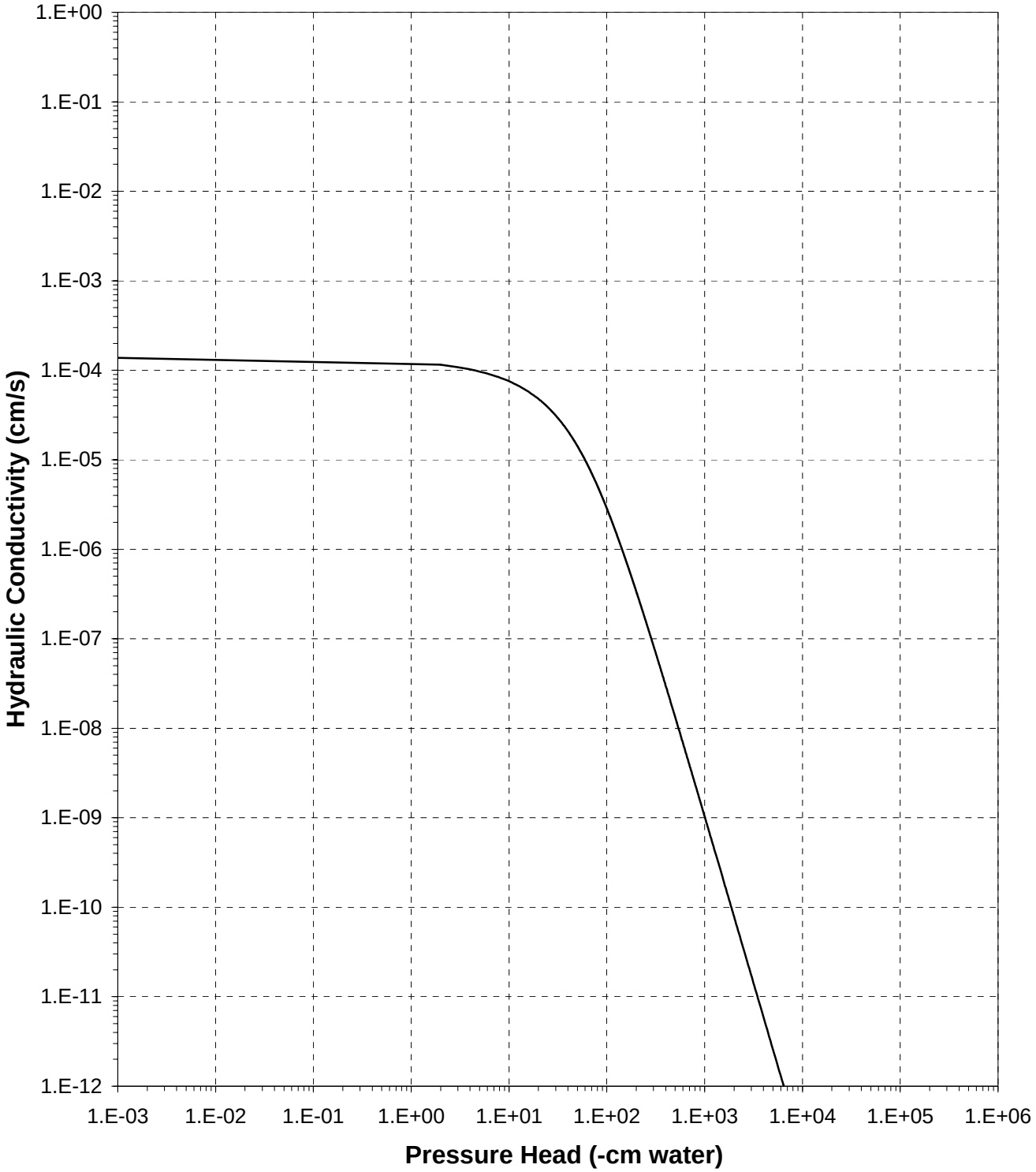
Plot of Relative Hydraulic Conductivity vs Pressure Head

Sample Number: BH1 19'-21'



Plot of Hydraulic Conductivity vs Pressure Head

Sample Number: BH1 19'-21'



Moisture Retention Data

Hanging Column / Pressure Plate

(Soil-Water Characteristic Curve)

Job Name: Budinger & Associates, Inc.
Job Number: LB11.0005.00
Sample Number: BH1 26.5'-28.5'
Project Number: G10502
Depth: 26.5'-28.5'

Dry wt. of sample (g): 435.17
Tare wt., ring (g): 211.20
Tare wt., screen & clamp (g): 28.24
Initial sample volume (cm^3): 323.96
Initial dry bulk density (g/cm^3): 1.34
Client Provided particle density (g/cm^3): 2.90
Initial calculated total porosity (%): 53.73

	Date	Time	Weight* (g)	Matric Potential (-cm water)	Moisture Content† (% vol)	
Hanging column:	10-Jan-11	13:00	835.19	0	52.30	‡‡
	16-Jan-11	11:30	824.47	17.0	49.87	‡‡
	22-Jan-11	10:20	818.95	48.0	49.08	‡‡
	28-Jan-11	11:05	815.84	125.0	48.08	‡‡
Pressure plate:	6-Feb-11	10:40	811.08	337	46.52	‡‡

Volume Adjusted Data [1]

	Matric Potential (-cm water)	Adjusted Volume (cm^3)	% Volume Change [2] (%)	Adjusted Density (g/cm^3)	Adjusted Calculated Porosity (%)
Hanging column:	0.0	307.05	-5.22%	1.42	51.18
	17.0	300.51	-7.24%	1.45	50.12
	48.0	294.09	-9.22%	1.48	49.03
	125.0	293.75	-9.32%	1.48	48.97
Pressure plate:	337	293.37	-9.44%	1.48	48.90

Comments:

[1] Applicable if the sample experienced volume changes during testing. 'Volume Adjusted' values represent each of the volume change measurements obtained after saturated hydraulic conductivity testing and throughout hanging column/pressure plate testing. "---" indicates no volume changes occurred.

[2] Represents percent volume change from original sample volume. A '+' denotes measured sample swelling, a '-' denotes measured sample settling, and '---' denotes no volume change occurred.

* Weight including tares

† Assumed density of water is 1.0 g/cm^3

‡‡ Volume adjustments are applicable at this matric potential (see comment #1).

Technician Notes:

Laboratory analysis by: K. Wright
Data entered by: J. Hines
Checked by: C. Krous

Moisture Retention Data

Dew Point Potentiometer / Relative Humidity Box

(Soil-Water Characteristic Curve)

Sample Number: BH1 26.5'-28.5'

Initial sample bulk density (g/cm^3)*:* 1.34

Fraction of bulk sample used (<2.00mm fraction) (%): 100.00

Dry weight of dew point potentiometer sample* (g)*:* 156.30

Tare weight, jar (g)*:* 110.69

	Date	Time	Weight* (g)	Water Potential (-cm water)	Moisture Content† (% vol)	
Dew point potentiometer:	8-Feb-11	14:54	159.03	11014	8.88	‡‡
	8-Feb-11	13:50	157.87	19070	5.11	‡‡
	7-Feb-11	13:52	157.59	27229	4.20	‡‡
	8-Feb-11	11:01	156.95	112688	2.11	‡‡

Volume Adjusted Data [1]

	Water Potential (-cm water)	Adjusted Volume (cm^3)	% Volume Change [2] (%)	Adjusted Density (g/cm^3)	Adjusted Calc. Porosity (%)
Dew point potentiometer:	11014	293.37	-9.44%	1.48	48.90
	19070	293.37	-9.44%	1.48	48.90
	27229	293.37	-9.44%	1.48	48.90
	112688	293.37	-9.44%	1.48	48.90

Dry weight of relative humidity box sample* (g)*:* 64.96

Tare weight (g)*:* 40.70

	Date	Time	Weight* (g)	Water Potential (-cm water)	Moisture Content† (% vol)	
Relative humidity box:	14-Jan-11	10:15	65.08	859892	0.72	‡‡

Volume Adjusted Data [1]

	Water Potential (-cm water)	Adjusted Volume (cm^3)	% Volume Change [2] (%)	Adjusted Density (g/cm^3)	Adjusted Calc. Porosity (%)
Relative humidity box:	859892	293.37	-9.44%	1.48	48.90

Comments:

[1] Applicable if the sample experienced volume changes during testing. 'Volume Adjusted' values represent the volume change measurements obtained after the last hanging column or pressure plate point. "---" indicates no volume changes occurred.

[2] Represents percent volume change from original sample volume. A '+' denotes measured sample swelling, a '-' denotes measured sample settling, and '---' denotes no volume change occurred.

* Weight including tares

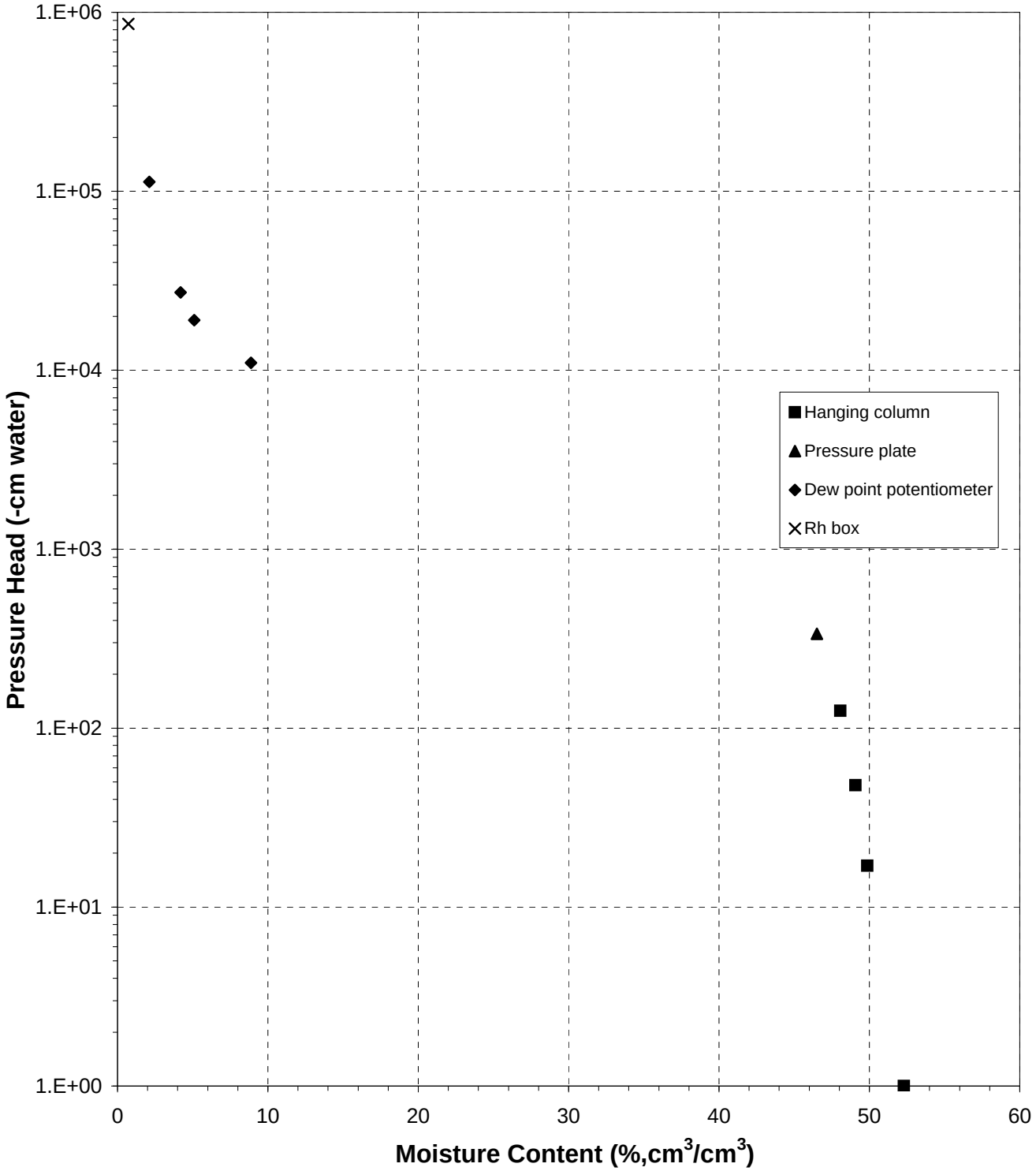
† Adjusted for >2.00mm (#10 sieve) material not used in DPP/RH testing. Assumed moisture content of material >2.00mm is zero, and assumed density of water is 1.0 g/cm^3.

‡‡ Volume adjustments are applicable at this matric potential (see comment #1).

Laboratory analysis by: J. Hines/K. Wright
Data entered by: J. Hines
Checked by: C. Krous

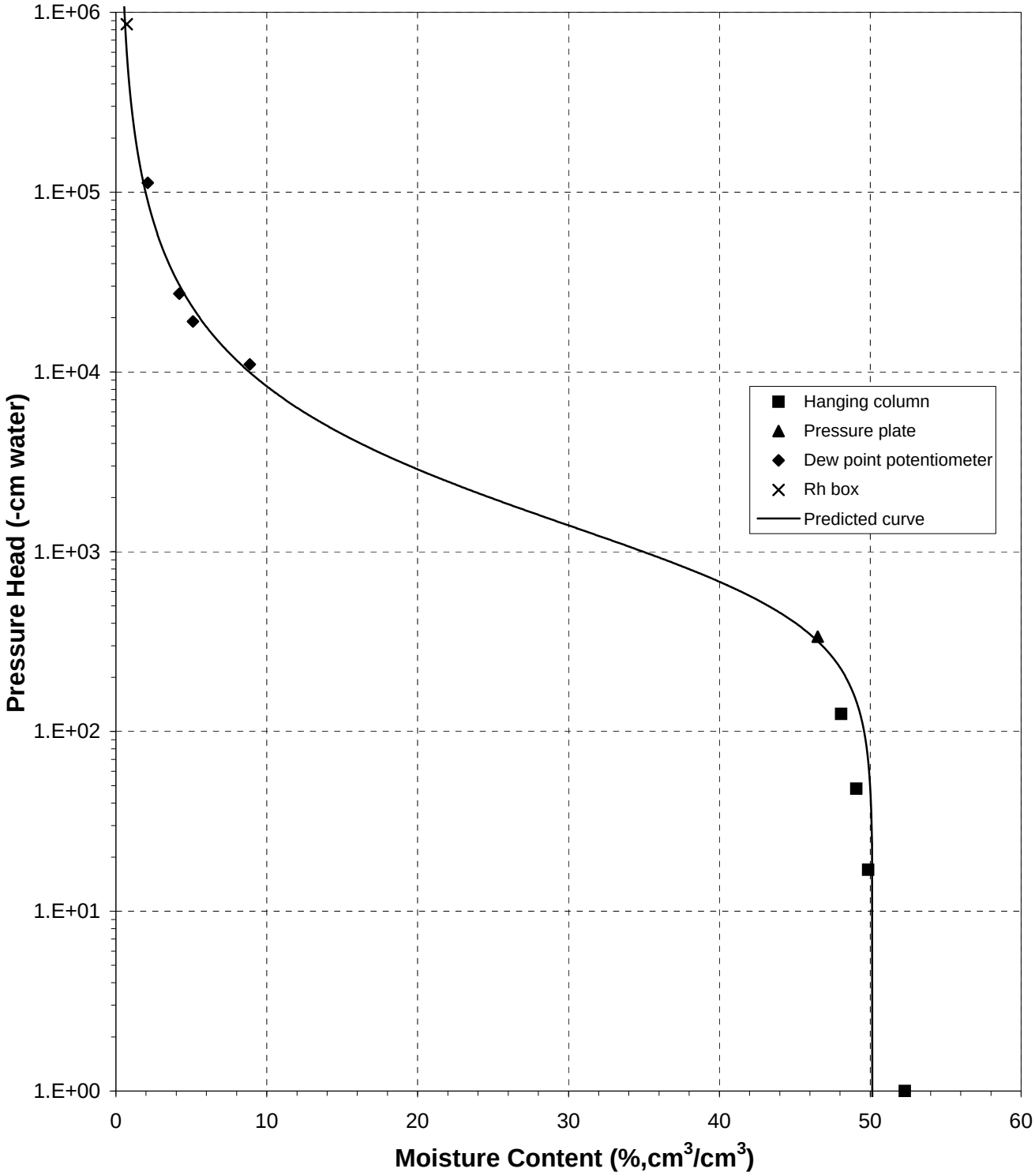
Water Retention Data Points

Sample Number: BH1 26.5'-28.5'



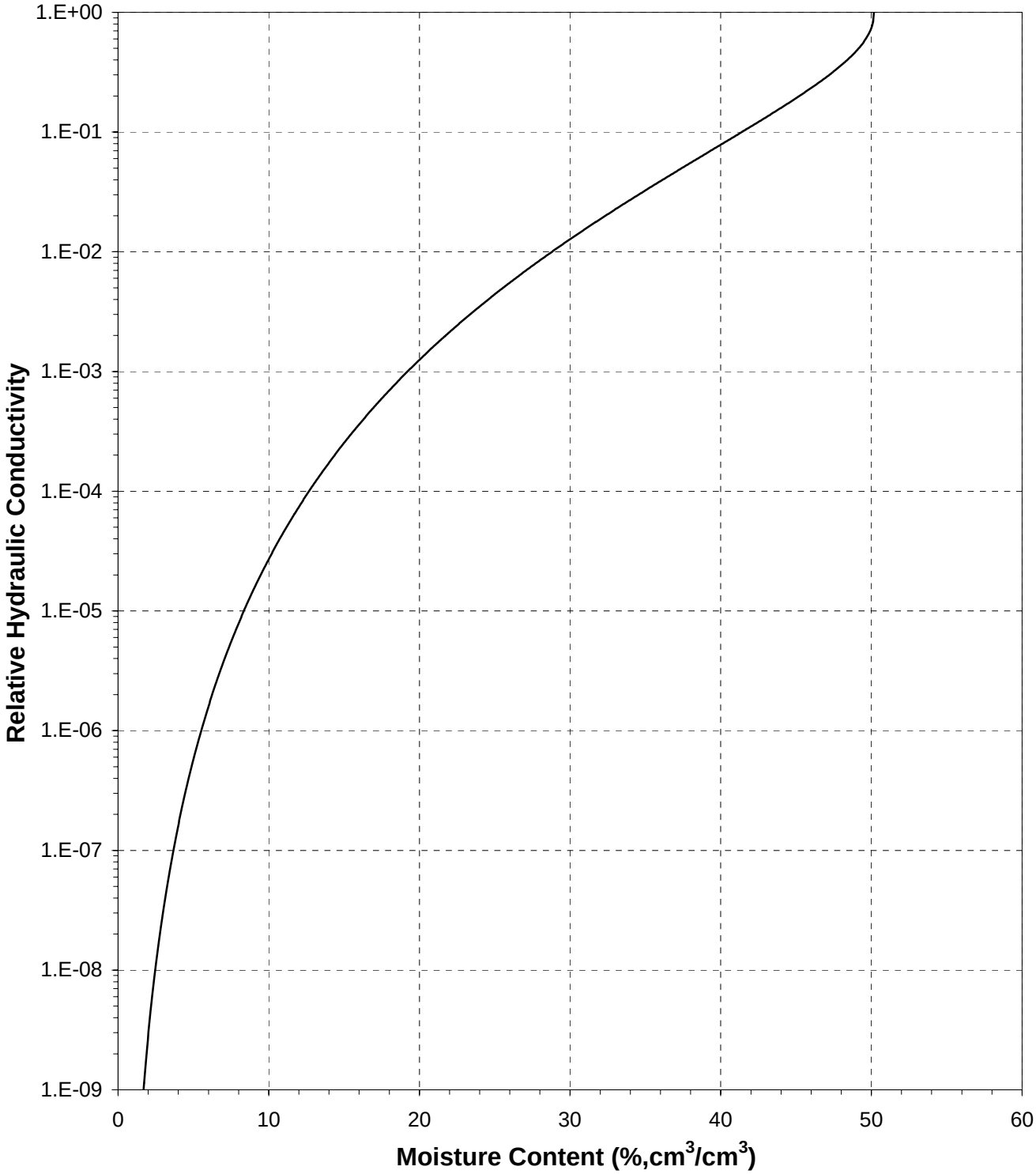
Predicted Water Retention Curve and Data Points

Sample Number: BH1 26.5'-28.5'



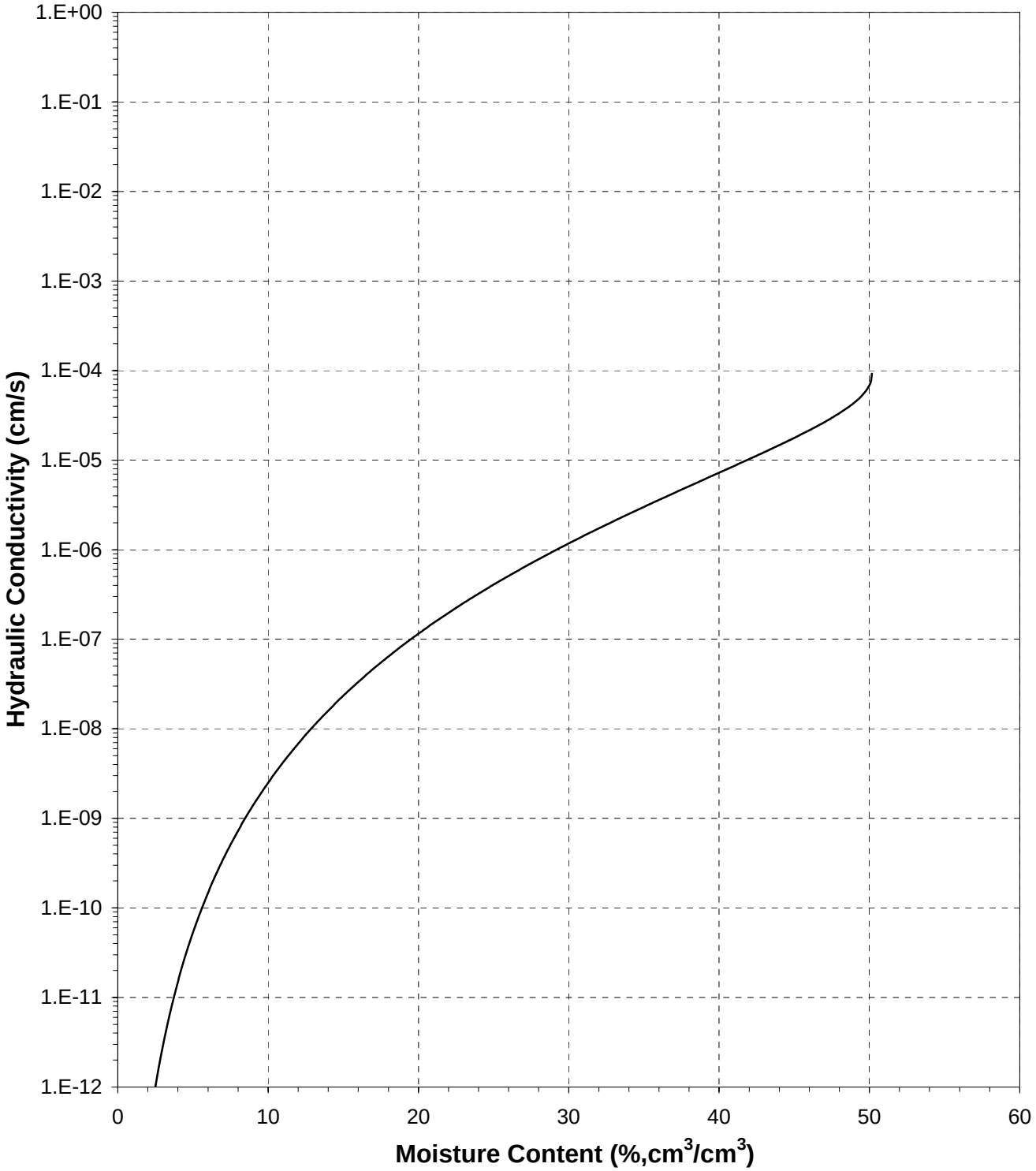
Plot of Relative Hydraulic Conductivity vs Moisture Content

Sample Number: BH1 26.5'-28.5'



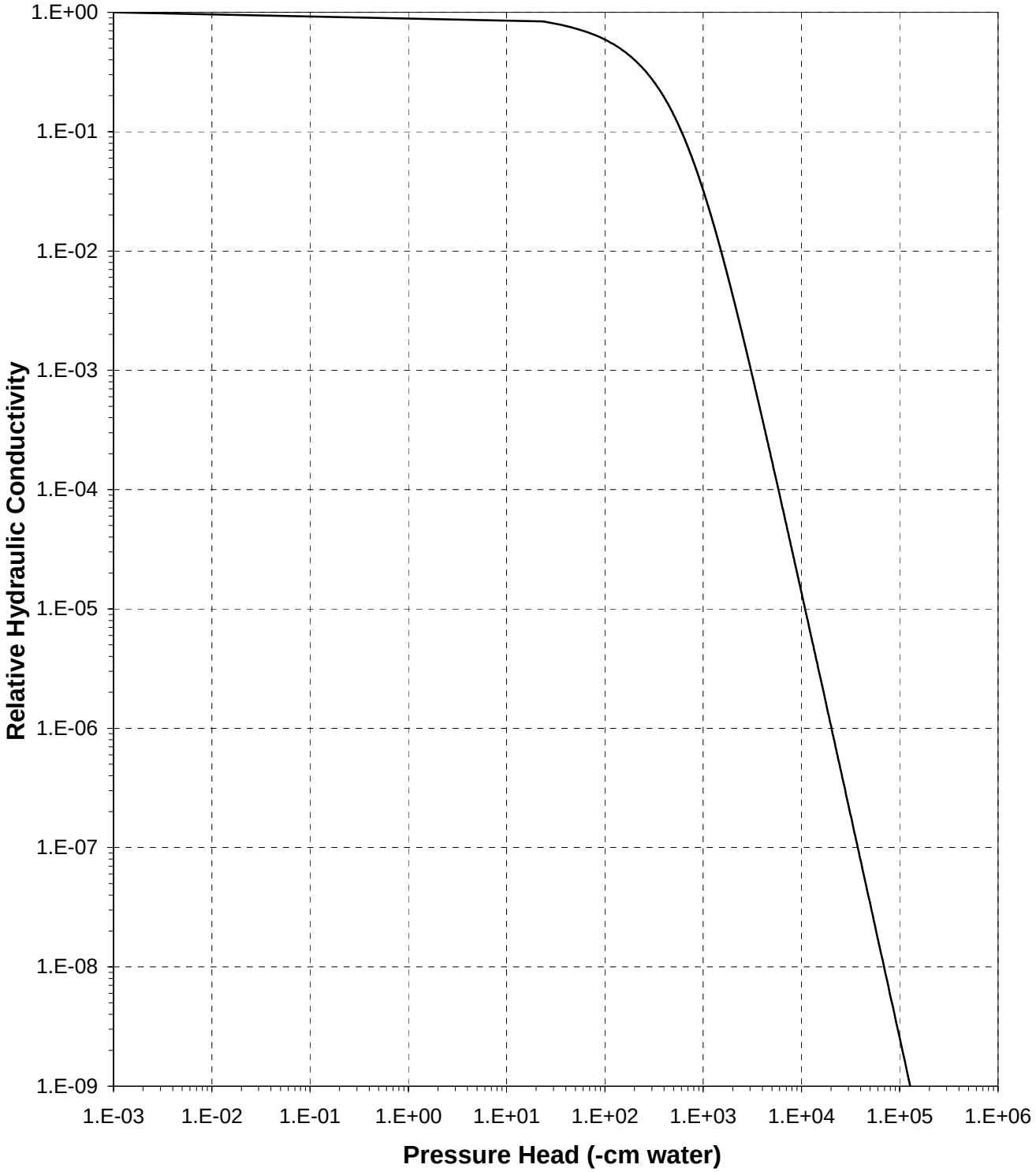
Plot of Hydraulic Conductivity vs Moisture Content

Sample Number: BH1 26.5'-28.5'



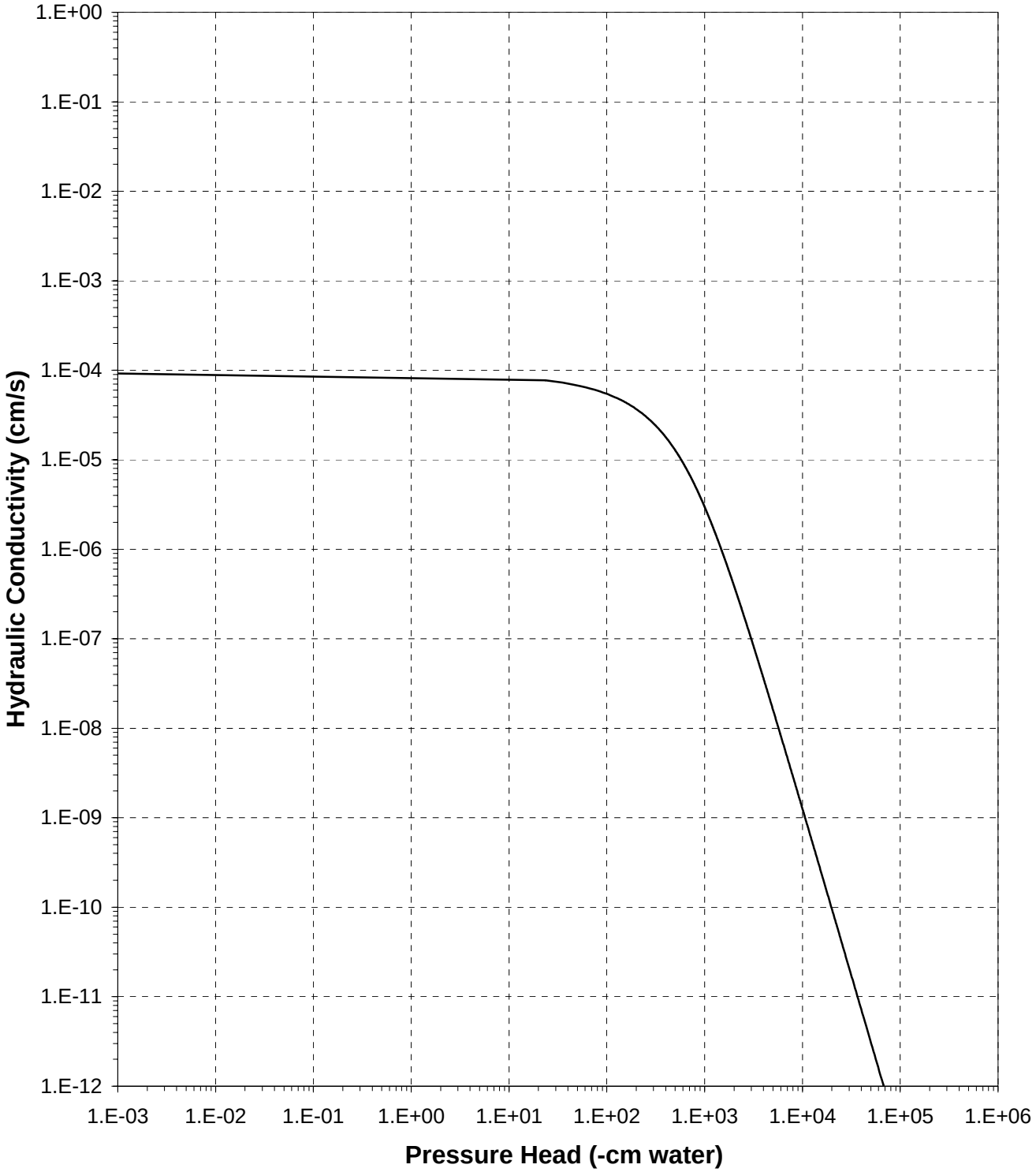
Plot of Relative Hydraulic Conductivity vs Pressure Head

Sample Number: BH1 26.5'-28.5'



Plot of Hydraulic Conductivity vs Pressure Head

Sample Number: BH1 26.5'-28.5'



Moisture Retention Data

Hanging Column / Pressure Plate

(Soil-Water Characteristic Curve)

Job Name: Budinger & Associates, Inc.
Job Number: LB11.0005.00
Sample Number: BH2 24.5'-26.5'
Project Number: G10502
Depth: 24.5'-26.5'

Dry wt. of sample (g): 336.52
Tare wt., ring (g): 135.63
Tare wt., screen & clamp (g): 28.07
Initial sample volume (cm^3): 208.12
Initial dry bulk density (g/cm^3): 1.62
Client Provided particle density (g/cm^3): 2.88
Initial calculated total porosity (%): 43.91

	Date	Time	Weight* (g)	Matric Potential (-cm water)	Moisture Content† (% vol)	
Hanging column:	10-Jan-11	12:45	589.90	0	43.09	
	16-Jan-11	11:10	585.17	11.0	40.82	
	22-Jan-11	10:05	581.39	32.0	40.97	‡‡
	28-Jan-11	10:50	578.54	99.0	39.65	‡‡
Pressure plate:	6-Feb-11	10:45	575.42	337	38.16	‡‡

Volume Adjusted Data [1]

	Matric Potential (-cm water)	Adjusted Volume (cm^3)	% Volume Change [2] (%)	Adjusted Density (g/cm^3)	Adjusted Calculated Porosity (%)
Hanging column:	0.0	---	---	---	---
	11.0	---	---	---	---
	32.0	198.14	-4.79%	1.70	41.09
	99.0	197.54	-5.08%	1.70	40.91
Pressure plate:	337	197.07	-5.31%	1.71	40.77

Comments:

[1] Applicable if the sample experienced volume changes during testing. 'Volume Adjusted' values represent each of the volume change measurements obtained after saturated hydraulic conductivity testing and throughout hanging column/pressure plate testing. "---" indicates no volume changes occurred.

[2] Represents percent volume change from original sample volume. A '+' denotes measured sample swelling, a '-' denotes measured sample settling, and '---' denotes no volume change occurred.

* Weight including tares

† Assumed density of water is 1.0 g/cm^3

‡‡ Volume adjustments are applicable at this matric potential (see comment #1).

Technician Notes:

Laboratory analysis by: K. Wright
Data entered by: J. Hines
Checked by: C. Krous

Moisture Retention Data

Dew Point Potentiometer / Relative Humidity Box

(Soil-Water Characteristic Curve)

Sample Number: BH2 24.5'-26.5'

Initial sample bulk density (g/cm^3)*:* 1.62
Fraction of bulk sample used (<2.00mm fraction) (%): 100.00

Dry weight of dew point potentiometer sample* (g)*:* 151.57
Tare weight, jar (g)*:* 113.15

	Date	Time	Weight* (g)	Water Potential (-cm water)	Moisture Content † (% vol)	
Dew point potentiometer:	8-Feb-11	13:39	153.95	7343	10.58	‡‡
	7-Feb-11	14:26	152.81	12951	5.51	‡‡
	8-Feb-11	11:38	152.20	32430	2.80	‡‡

Volume Adjusted Data [1]

	Water Potential (-cm water)	Adjusted Volume (cm^3)	% Volume Change [2] (%)	Adjusted Density (g/cm^3)	Adjusted Calc. Porosity (%)
Dew point potentiometer:	7343	197.07	-5.31%	1.71	40.77
	12951	197.07	-5.31%	1.71	40.77
	32430	197.07	-5.31%	1.71	40.77

Dry weight of relative humidity box sample* (g)*:* 65.46
Tare weight (g)*:* 40.97

	Date	Time	Weight* (g)	Water Potential (-cm water)	Moisture Content † (% vol)	
Relative humidity box:	14-Jan-11	10:15	65.53	859892	0.51	‡‡

Volume Adjusted Data [1]

	Water Potential (-cm water)	Adjusted Volume (cm^3)	% Volume Change [2] (%)	Adjusted Density (g/cm^3)	Adjusted Calc. Porosity (%)
Relative humidity box:	859892	197.07	-5.31%	1.71	40.77

Comments:

[1] Applicable if the sample experienced volume changes during testing. 'Volume Adjusted' values represent the volume change measurements obtained after the last hanging column or pressure plate point. "---" indicates no volume changes occurred.

[2] Represents percent volume change from original sample volume. A '+' denotes measured sample swelling, a '-' denotes measured sample settling, and '---' denotes no volume change occurred.

* Weight including tares

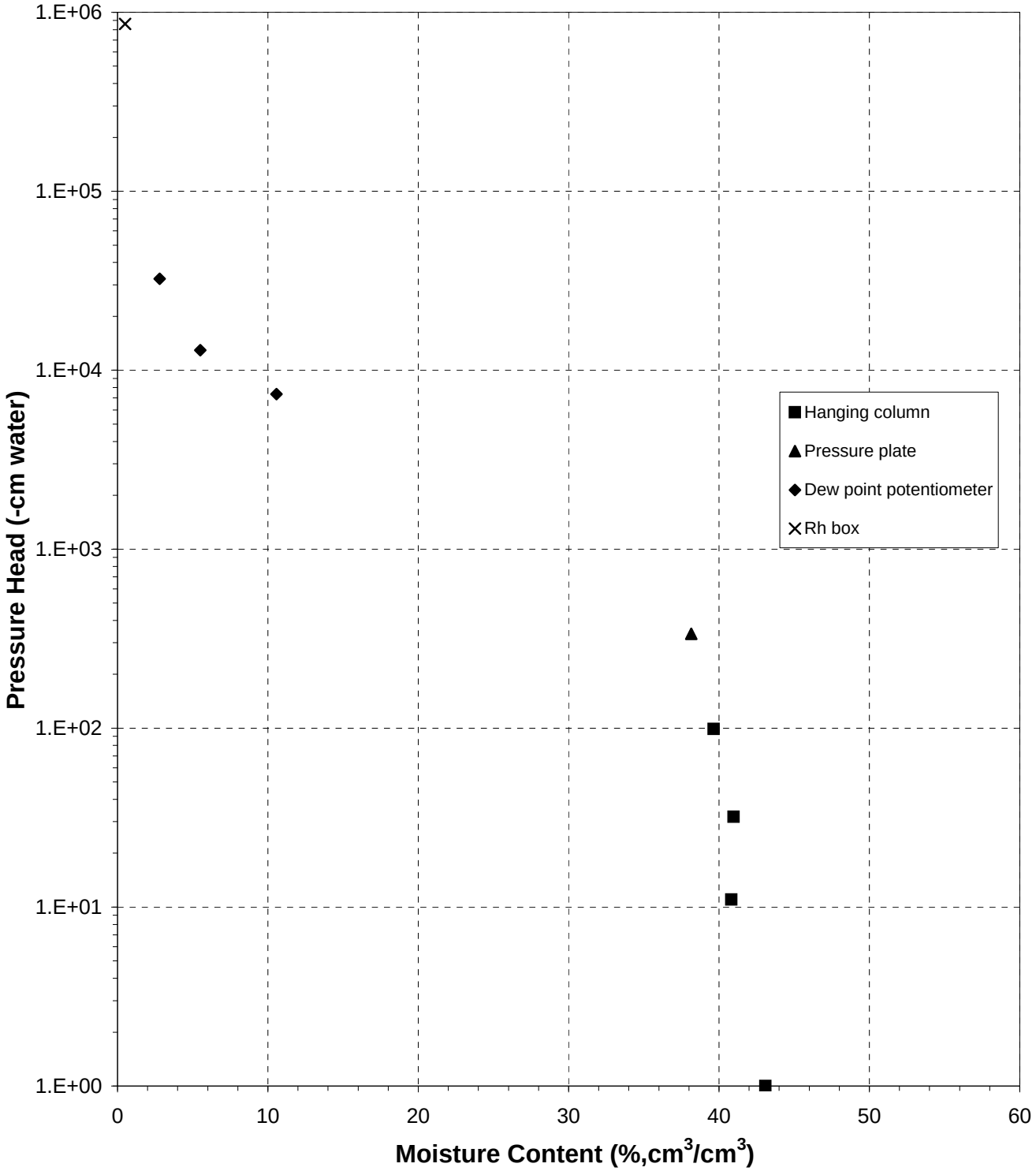
† Adjusted for >2.00mm (#10 sieve) material not used in DPP/RH testing. Assumed moisture content of material >2.00mm is zero, and assumed density of water is 1.0 g/cm^3.

‡‡ Volume adjustments are applicable at this matric potential (see comment #1).

Laboratory analysis by: J. Hines/K. Wright
Data entered by: J. Hines
Checked by: C. Krous

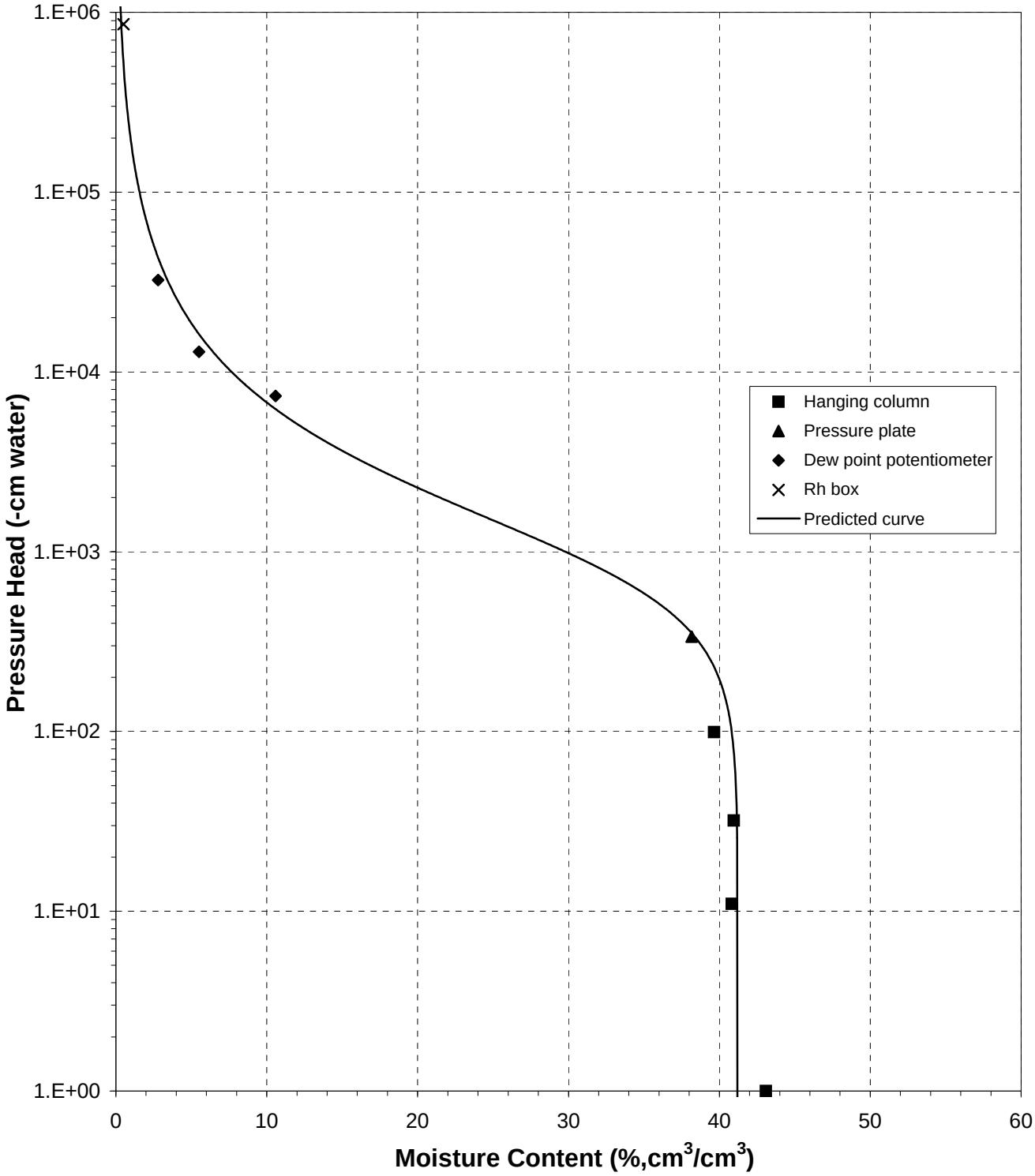
Water Retention Data Points

Sample Number: BH2 24.5'-26.5'



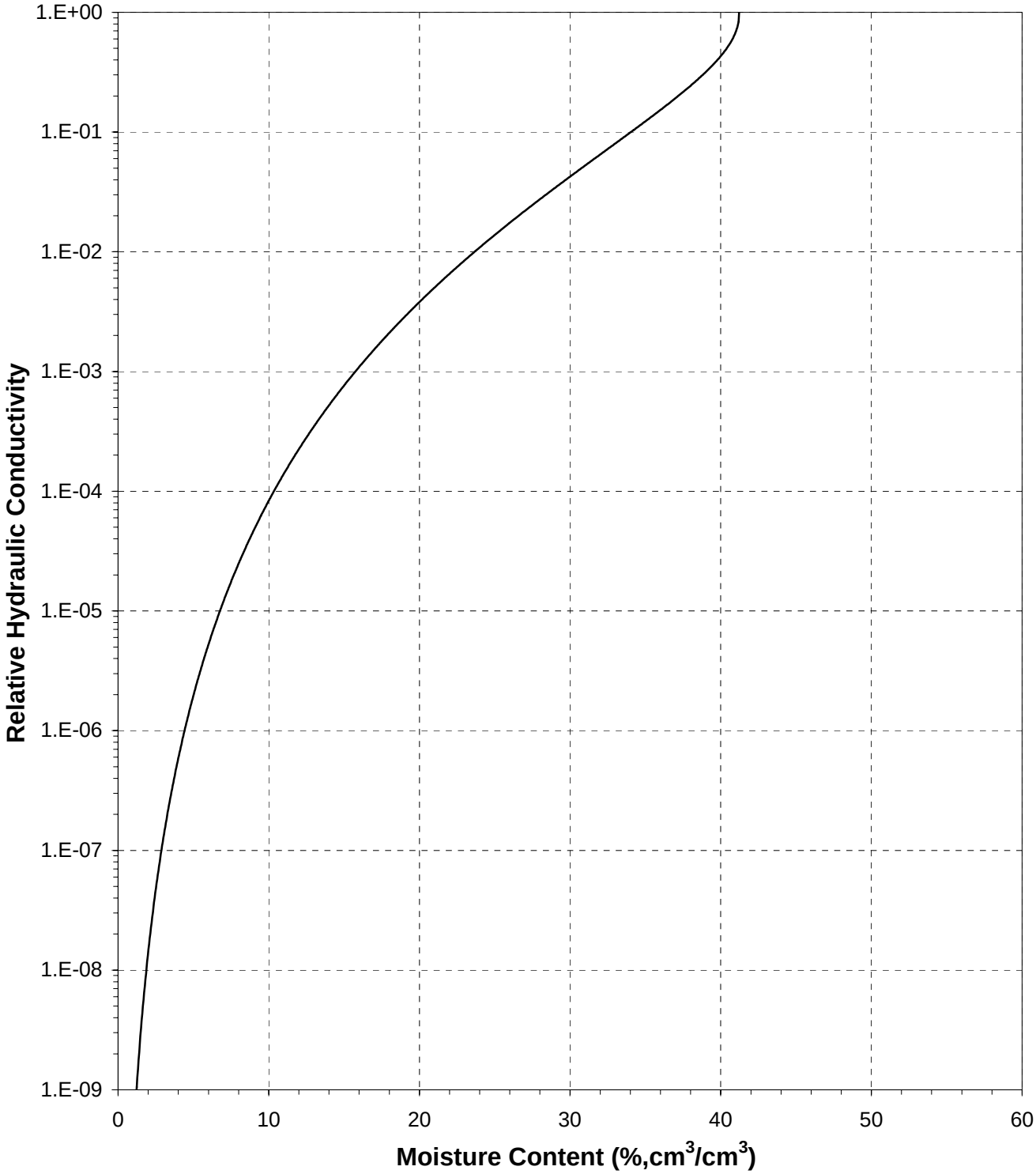
Predicted Water Retention Curve and Data Points

Sample Number: BH2 24.5'-26.5'



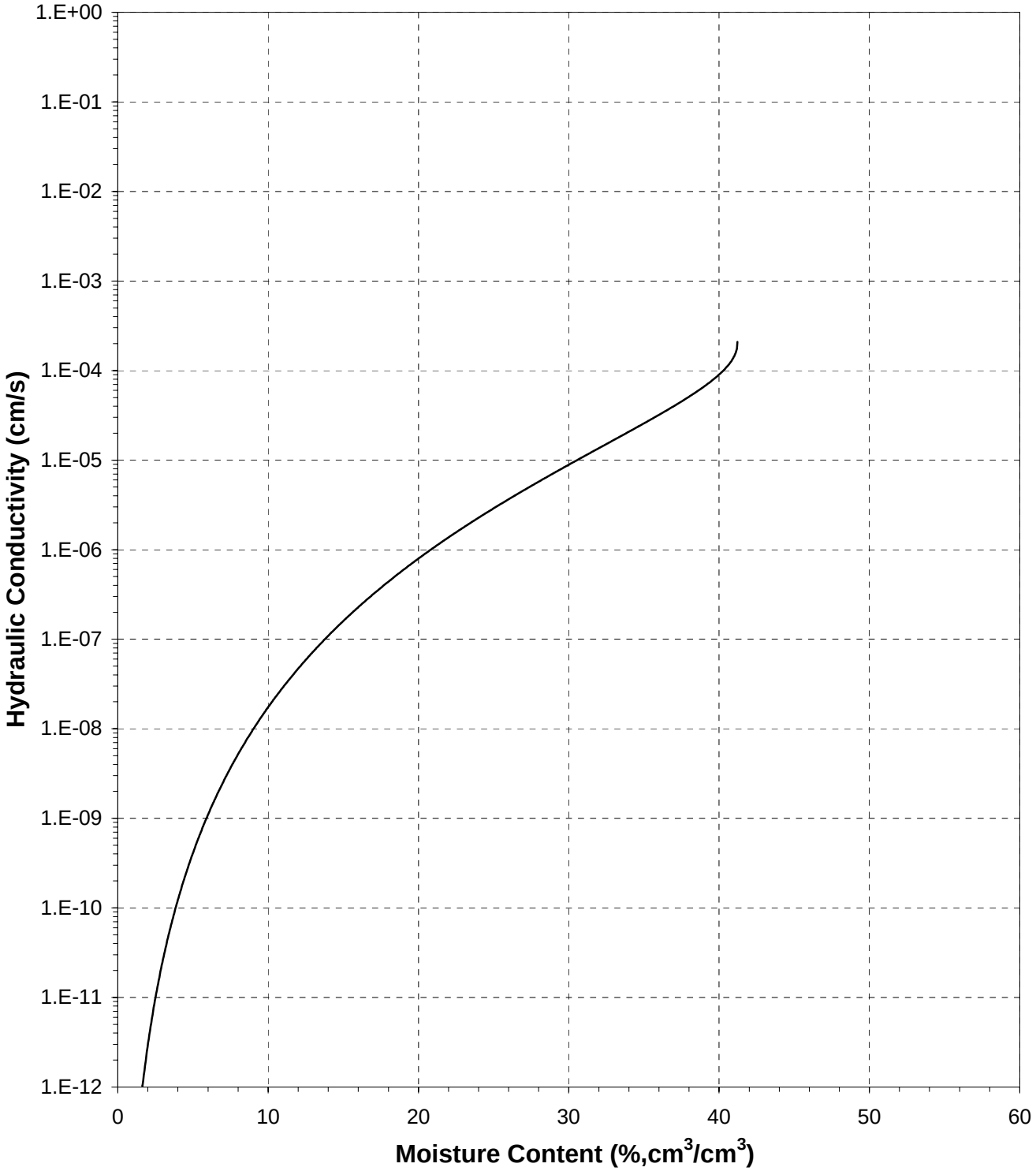
Plot of Relative Hydraulic Conductivity vs Moisture Content

Sample Number: BH2 24.5'-26.5'



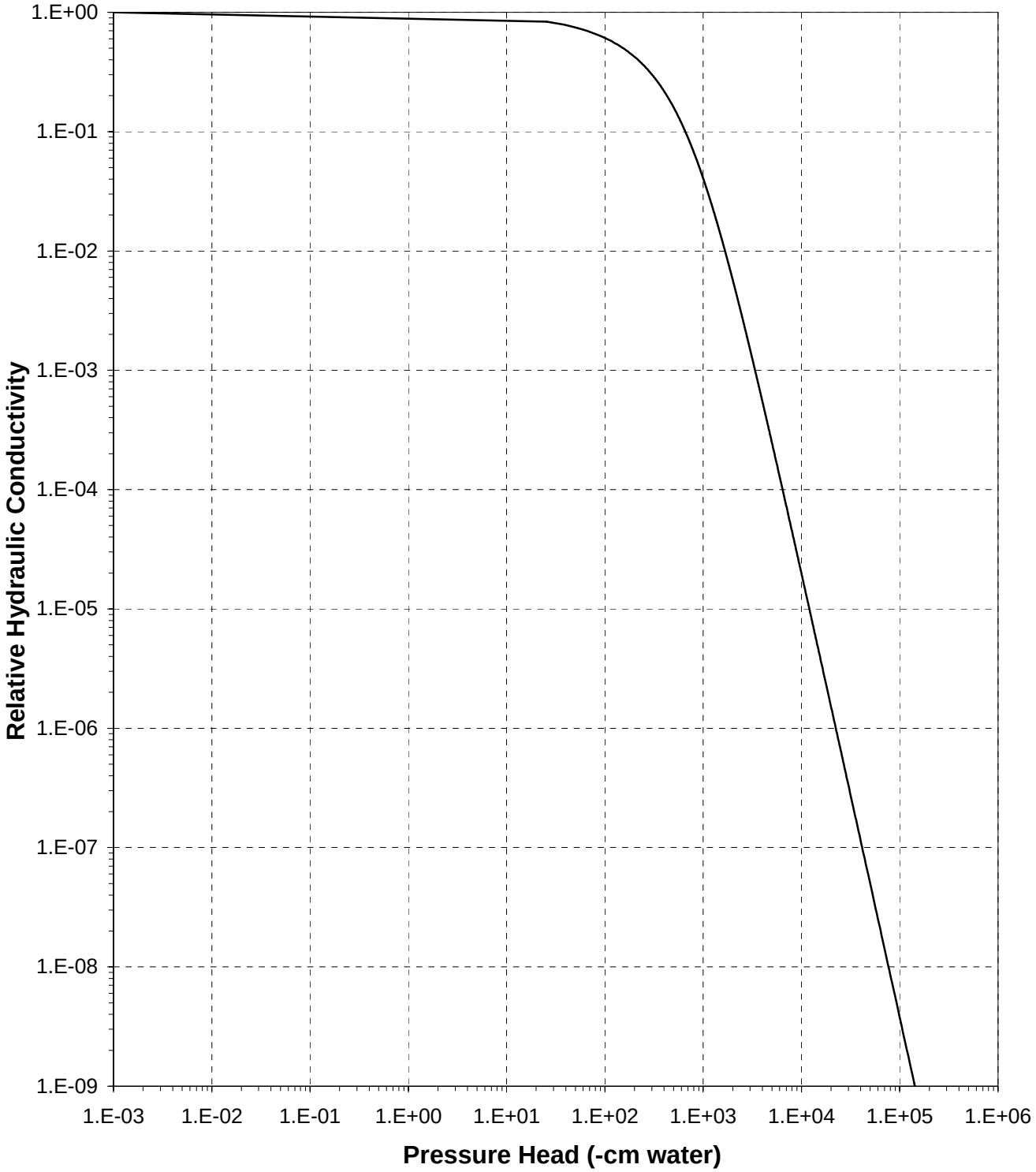
Plot of Hydraulic Conductivity vs Moisture Content

Sample Number: BH2 24.5'-26.5'



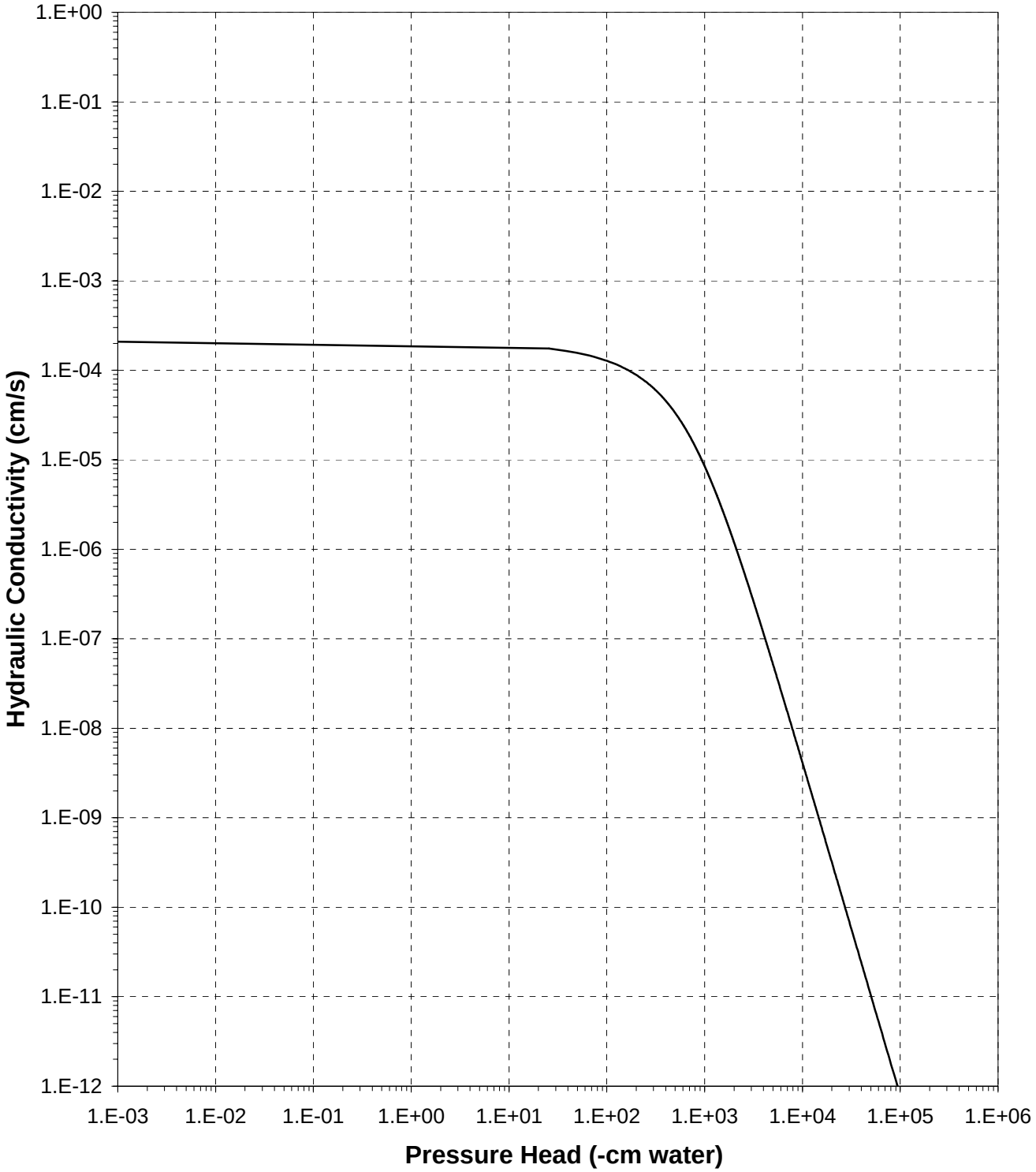
Plot of Relative Hydraulic Conductivity vs Pressure Head

Sample Number: BH2 24.5'-26.5'



Plot of Hydraulic Conductivity vs Pressure Head

Sample Number: BH2 24.5'-26.5'



Moisture Retention Data

Hanging Column / Pressure Plate

(Soil-Water Characteristic Curve)

Job Name: Budinger & Associates, Inc.
Job Number: LB11.0005.00
Sample Number: BH2 32.5'-34.5'
Project Number: G10502
Depth: 32.5'-34.5'

Dry wt. of sample (g): 405.01
Tare wt., ring (g): 175.90
Tare wt., screen & clamp (g): 26.58
Initial sample volume (cm^3): 268.79
Initial dry bulk density (g/cm^3): 1.51
Client Provided particle density (g/cm^3): 2.88
Initial calculated total porosity (%): 47.66

	Date	Time	Weight* (g)	Matric Potential (-cm water)	Moisture Content† (% vol)	
Hanging column:	10-Jan-11	13:25	727.22	0	45.68	‡‡
	16-Jan-11	11:35	720.28	17.0	43.24	‡‡
	22-Jan-11	10:30	716.81	48.0	42.66	‡‡
	28-Jan-11	11:00	699.71	125.0	35.87	‡‡
Pressure plate:	6-Feb-11	10:35	674.22	337	25.98	‡‡

Volume Adjusted Data [1]

	Matric Potential (-cm water)	Adjusted Volume (cm^3)	% Volume Change [2] (%)	Adjusted Density (g/cm^3)	Adjusted Calculated Porosity (%)
Hanging column:	0.0	262.13	-2.48%	1.55	46.33
	17.0	260.85	-2.95%	1.55	46.07
	48.0	256.23	-4.67%	1.58	45.10
	125.0	257.08	-4.36%	1.58	45.28
Pressure plate:	337	256.87	-4.44%	1.58	45.23

Comments:

[1] Applicable if the sample experienced volume changes during testing. 'Volume Adjusted' values represent each of the volume change measurements obtained after saturated hydraulic conductivity testing and throughout hanging column/pressure plate testing. "---" indicates no volume changes occurred.

[2] Represents percent volume change from original sample volume. A '+' denotes measured sample swelling, a '-' denotes measured sample settling, and '---' denotes no volume change occurred.

* Weight including tares

† Assumed density of water is 1.0 g/cm^3

‡‡ Volume adjustments are applicable at this matric potential (see comment #1).

Technician Notes:

Laboratory analysis by: K. Wright
Data entered by: J. Hines
Checked by: C. Krous

Moisture Retention Data

Dew Point Potentiometer / Relative Humidity Box

(Soil-Water Characteristic Curve)

Sample Number: BH2 32.5'-34.5'

Initial sample bulk density (g/cm^3)*:* 1.51
Fraction of bulk sample used (<2.00mm fraction) (%): 100.00

Dry weight of dew point potentiometer sample* (g)*:* 143.60
Tare weight, jar (g)*:* 112.98

	Date	Time	Weight* (g)	Water Potential (-cm water)	Moisture Content† (% vol)	
Dew point potentiometer:	8-Feb-11	14:58	145.04	11320	7.42	‡‡
	7-Feb-11	14:10	144.40	29778	4.12	‡‡
	8-Feb-11	11:21	144.01	75159	2.11	‡‡

Volume Adjusted Data [1]

	Water Potential (-cm water)	Adjusted Volume (cm^3)	% Volume Change [2] (%)	Adjusted Density (g/cm^3)	Adjusted Calc. Porosity (%)
Dew point potentiometer:	11320	256.87	-4.44%	1.58	45.23
	29778	256.87	-4.44%	1.58	45.23
	75159	256.87	-4.44%	1.58	45.23

Dry weight of relative humidity box sample* (g)*:* 72.15
Tare weight (g)*:* 42.10

	Date	Time	Weight* (g)	Water Potential (-cm water)	Moisture Content† (% vol)	
Relative humidity box:	14-Jan-11	10:15	72.28	859892	0.67	‡‡

Volume Adjusted Data [1]

	Water Potential (-cm water)	Adjusted Volume (cm^3)	% Volume Change [2] (%)	Adjusted Density (g/cm^3)	Adjusted Calc. Porosity (%)
Relative humidity box:	859892	256.87	-4.44%	1.58	45.23

Comments:

[1] Applicable if the sample experienced volume changes during testing. 'Volume Adjusted' values represent the volume change measurements obtained after the last hanging column or pressure plate point. "---" indicates no volume changes occurred.

[2] Represents percent volume change from original sample volume. A '+' denotes measured sample swelling, a '-' denotes measured sample settling, and '---' denotes no volume change occurred.

* Weight including tares

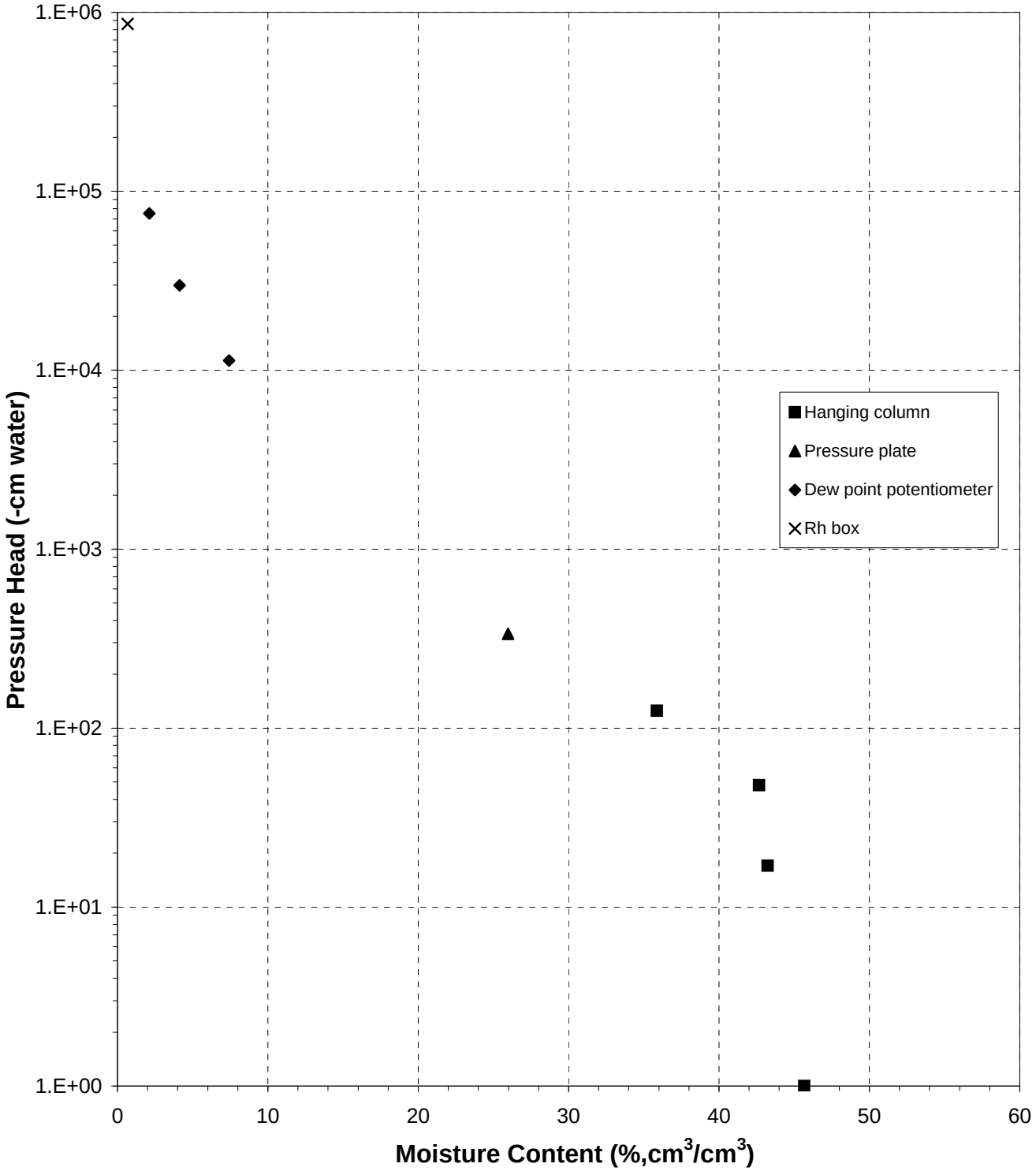
† Adjusted for >2.00mm (#10 sieve) material not used in DPP/RH testing. Assumed moisture content of material >2.00mm is zero, and assumed density of water is 1.0 g/cm^3.

‡‡ Volume adjustments are applicable at this matric potential (see comment #1).

Laboratory analysis by: J. Hines/K. Wright
Data entered by: J. Hines
Checked by: C. Krous

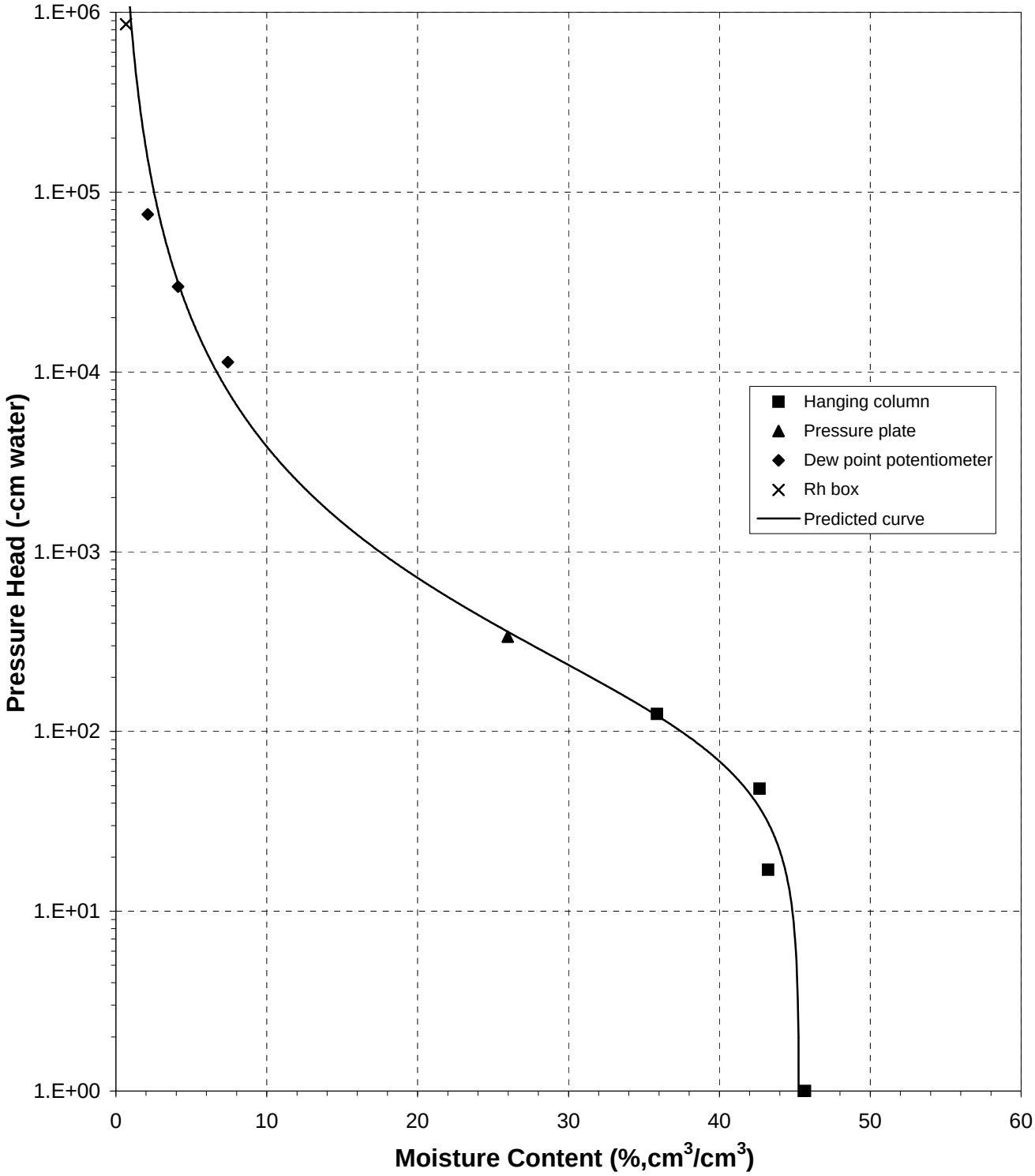
Water Retention Data Points

Sample Number: BH2 32.5'-34.5'



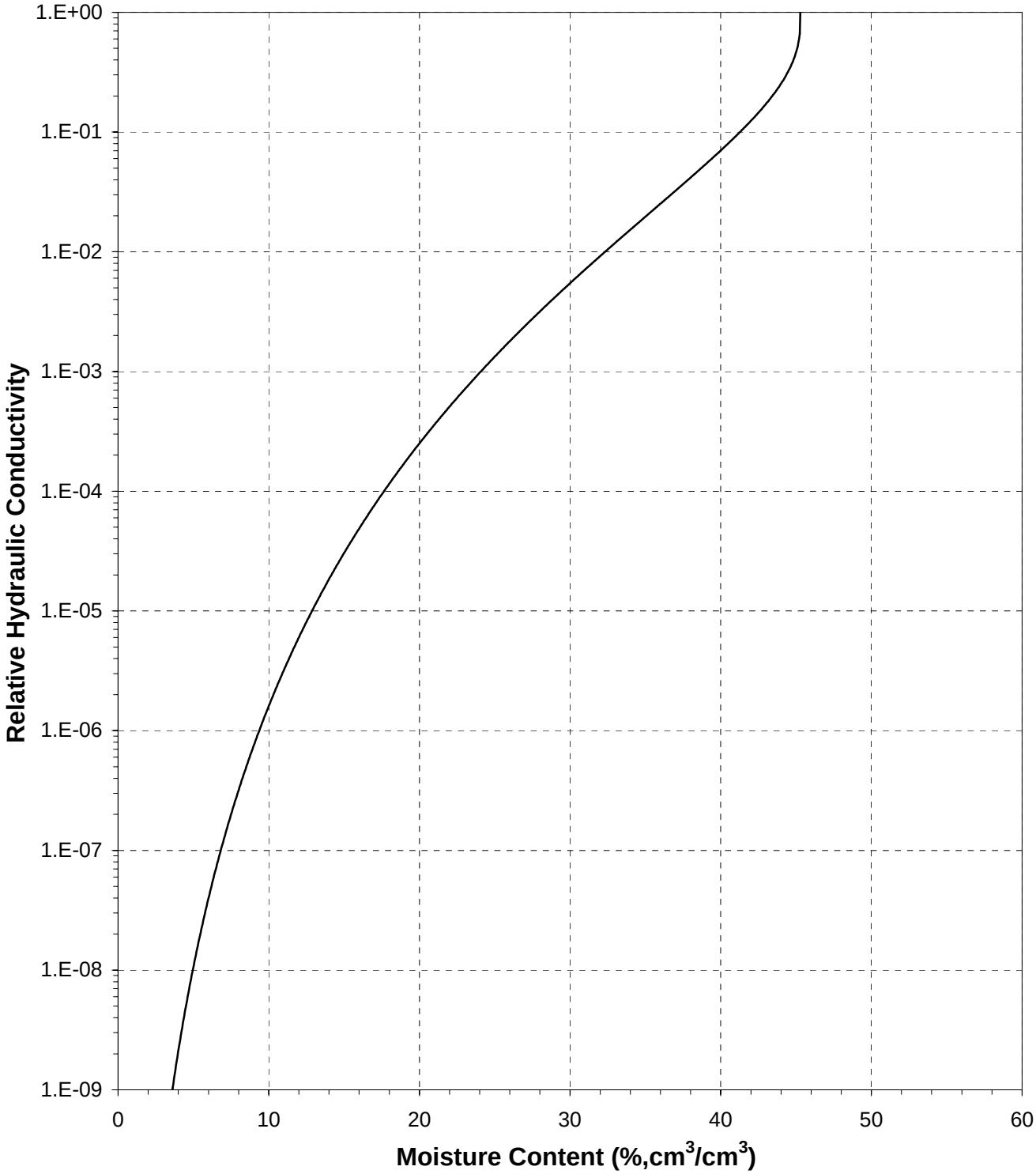
Predicted Water Retention Curve and Data Points

Sample Number: BH2 32.5'-34.5'



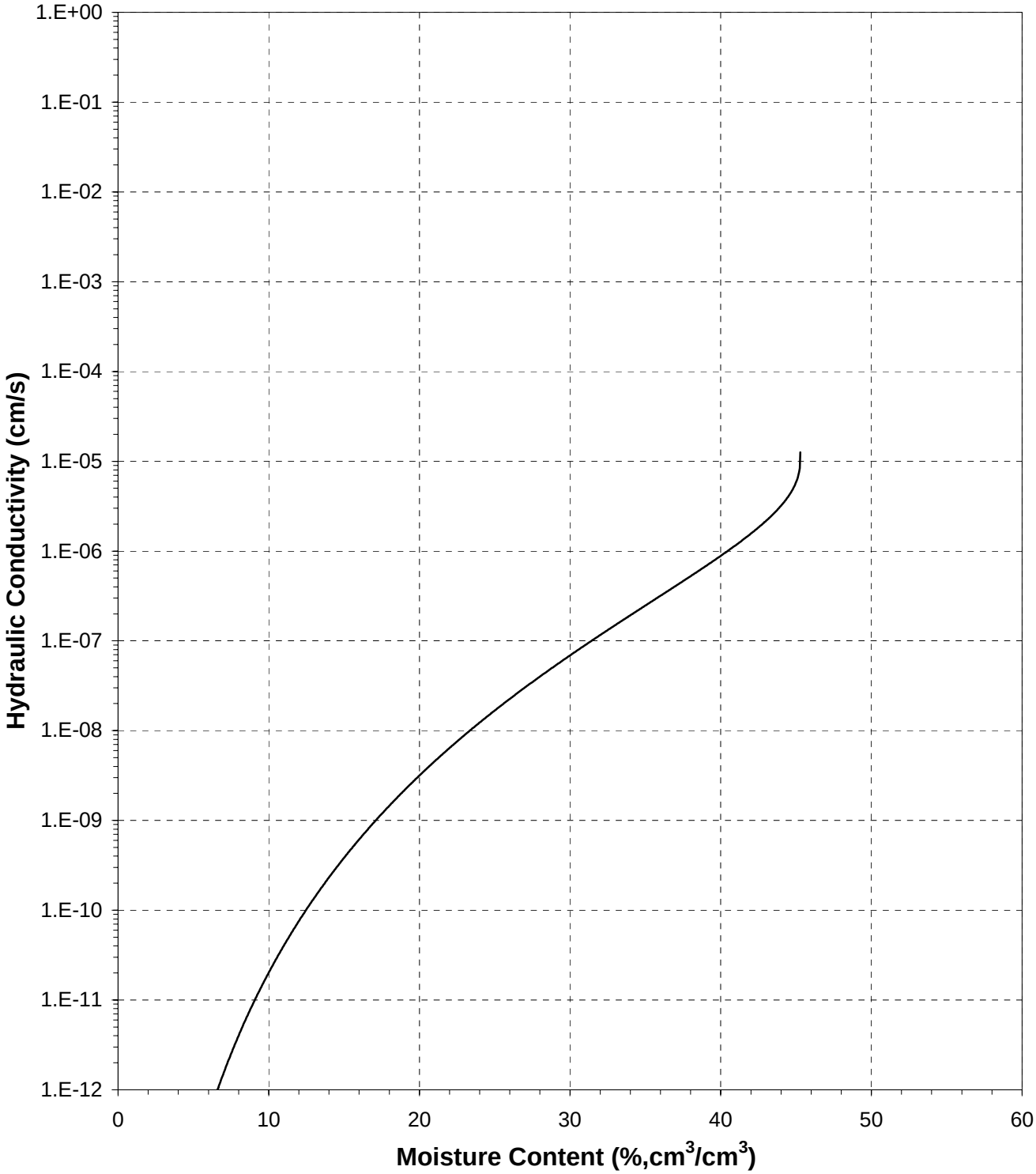
Plot of Relative Hydraulic Conductivity vs Moisture Content

Sample Number: BH2 32.5'-34.5'



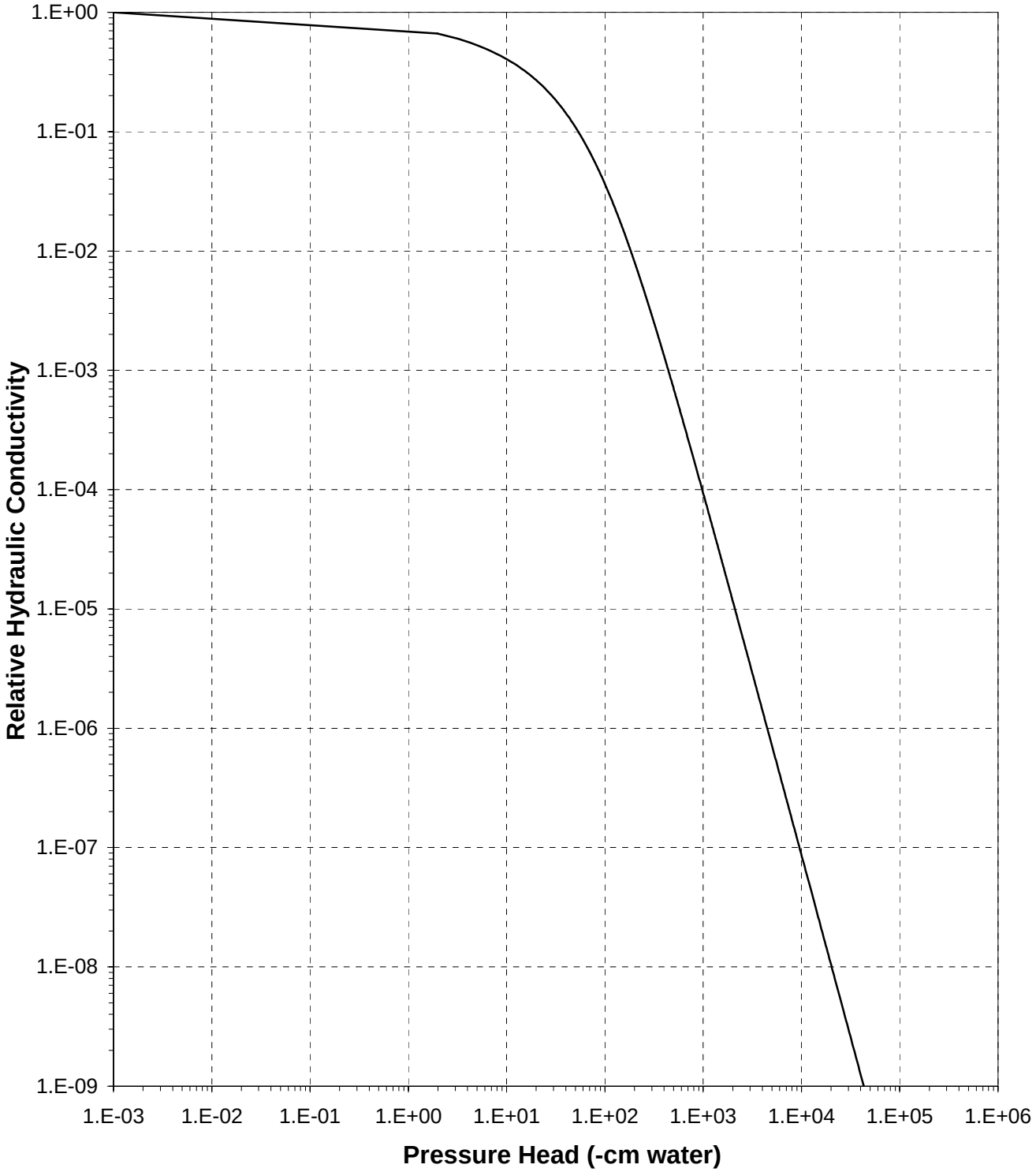
Plot of Hydraulic Conductivity vs Moisture Content

Sample Number: BH2 32.5'-34.5'



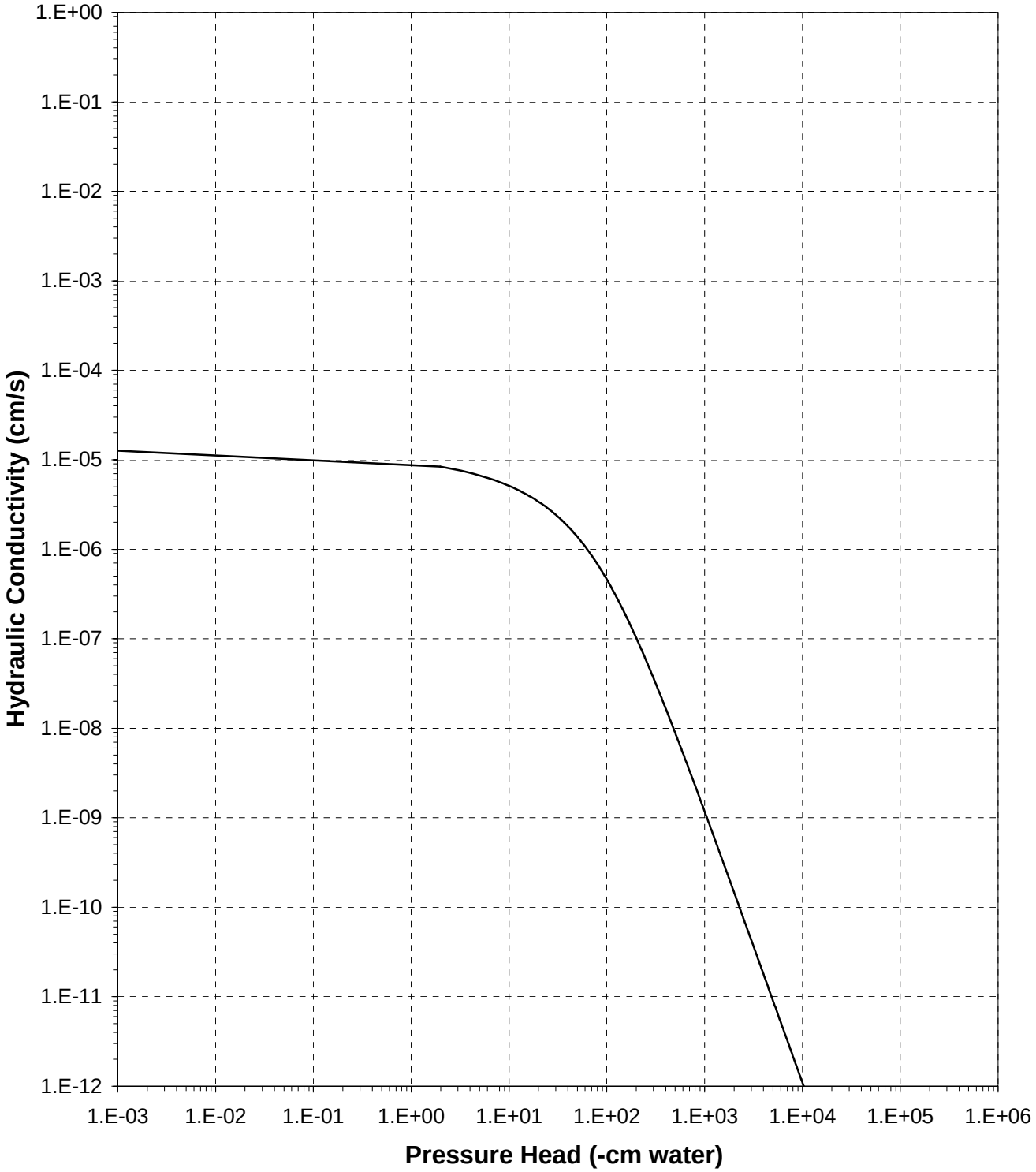
Plot of Relative Hydraulic Conductivity vs Pressure Head

Sample Number: BH2 32.5'-34.5'



Plot of Hydraulic Conductivity vs Pressure Head

Sample Number: BH2 32.5'-34.5'



Laboratory Tests and Methods

Tests and Methods

Dry Bulk Density:	ASTM D7263
Moisture Content:	ASTM D7263
Calculated Porosity:	ASTM D7263
Saturated Hydraulic Conductivity:	
Constant Head: (Rigid Wall)	ASTM D 2434 (modified apparatus)
Falling Head: (Rigid Wall)	Klute, A. and C. Dirkson. 1986. Hydraulic Conductivity and Diffusivity: Laboratory Methods.Chp. 28, pp. 200-203, in A. Klute (ed.), Methods of Soil Analysis, American Society of Agronomy, Madison, WI
Hanging Column Method:	ASTM D6836 (modified apparatus)
Pressure Plate Method:	ASTM D6836 (modified apparatus)
Water Potential (Dewpoint Potentiometer) Method:	ASTM D6836
Relative Humidity (Box) Method:	Karathanasis & Hajek. 1982. Quantitative Evaluation of Water Adsorption on Soil Clays. SSA Journal 46:1321-1325; Campbell, G. and G. Gee. 1986. Water Potential: Miscellaneous Methods. Chp. 25, pp. 631-632, in A. Klute (ed.), Methods of Soil Analysis, American Society of Agronomy, Madison, WI
Moisture Retention Characteristics & Calculated Unsaturated Hydraulic Conductivity:	ASTM D6836; van Genuchten, M.T. 1980. A closed-form equation for predicting the hydraulic conductivity of unsaturated soils. SSSAJ 44:892-898; van Genuchten, M.T., F.J. Leij, and S.R. Yates. 1991. The RETC code for quantifying the hydraulic functions of unsaturated soils. Robert S. Kerr Environmental Research Laboratory, Office of Research and Development, U.S. Environmental Protection Agency, Ada, Oklahoma. EPA/600/2091/065. December 1991

STRATA
A PROFESSIONAL SERVICES CORPORATION
Integrity from the Ground Up

January 24, 2012
File: TERRA1 A11004A

Mr. Scott McGourty, E.I.T.
Project Engineer
TerraGraphics Environmental Engineering, Inc.
3501 W. Elder Street, Suite 102
Boise, Idaho 83705

RE: **SUMMARY LETTER**
Geotechnical Services
Star Tailings Impoundment
Woodland Park, Shoshone County, Idaho

Dear Mr. McGourty:

Strata, A Professional Services Corporation (STRATA) is pleased to provide this letter summarizing our geotechnical sampling and laboratory testing to assist project planning and design for impoundment expansion at the Star Tailings Impoundment (STI) near Woodland Park, Idaho. We performed our services referencing our authorized proposal dated December 19, 2011, and our subsequent discussions. The following paragraphs summarize and describe our project understanding, services performed and present laboratory test results.

PROJECT UNDERSTANDING

The STI site is approximately 1.5 miles northeast of Wallace, east of State Highway 4, and consists of an inactive tailings impoundment complex. TerraGraphics Environmental Engineering, Inc. (TerraGraphics) requested STRATA accomplish a geotechnical investigation consisting of coordinating hollow-stem auger borings, conducting field observation during exploration, providing exploratory boring logs and performing laboratory testing. You also requested STRATA provide this letter summarizing our fieldwork and laboratory test results. We understand TerraGraphics will use the information provided in this report to supplement impoundment expansion design. As presented in our proposal, following sample collection, STRATA worked with TerraGraphics to finalize the laboratory testing program prior to its initiation.

SCOPE OF SERVICE

Based on the above project understanding, our approved scope of service as amended based on conditions encountered during fieldwork and our discussions with you, we accomplished the following:

1. STRATA subcontracted a drill rig and operator to accomplish 5 exploratory borings, in locations determined and surveyed by TerraGraphics. We accomplished borings with a truck-mounted drill rig equipped with hollow-stem augers. STRATA described the subsurface conditions encountered and logged each boring referencing ASTM D 2487 and D 2488, *Unified Soil Classification System* (USCS). STRATA obtained soil samples referencing the proposed subsurface sampling schedule we provided via electronic mail on December 19, 2011. The sampling schedule was modified in cooperation with TerraGraphics during fieldwork based on the coarse soil conditions encountered. STRATA backfilled each boring with drilling spoils and a bentonite seal, finished level with the ground surface.

2. STRATA submitted a proposed laboratory testing program to you via electronic mail on January 3, 2012. Following subsequent discussions and your acceptance of the testing plan, STRATA initiated laboratory testing on samples obtained from exploration per the amended laboratory test program.

3. STRATA provided this letter summarizing fieldwork and providing laboratory test results. We submitted 1 electronic and 3 hard copies of our letter for your use and distribution.

FIELD EVALUATION

Exploration

We evaluated the subsurface conditions at the site by observing 5 exploratory borings to depths ranging from 4.5 to 38.0 feet beneath the ground surface on December 20 and 21, 2011. Borings were advanced by a subcontracted BK-61 drill rig equipped with 8-inch-diameter, hollow-stem augers. Appendix A presents TerraGraphics' Figure 1 which presents exploratory boring locations. We understand borings B-1 through B-3 were previously accomplished by others. A professional geologist described and classified the subsurface conditions encountered referencing the USCS. A brief explanation of the USCS is included with exploratory borings logs in Appendix B. We obtained select disturbed soil samples using 3-inch outside-diameter California Modified and 2-inch outside-diameter split-spoon samplers for laboratory testing.

Standard Penetration Test (SPT) soil samples were obtained by driving the 2 and 3-inch split-spoon samplers using a 140-pound hammer with a drop of 30 inches. The SPT "N-value" was obtained by counting the number of hammer blows required to advance the 18-inch-long

samplers from 6 to 18 inches below the desired sampling interval. SPT N-values are presented on the boring logs in Appendix B and have not been corrected for overburden pressure, rod length, dilation effects or for sampler diameter. Following drilling completion, borings were backfilled with on-site soil and a bentonite seal.

Subsurface Conditions

Borings identified the following 4 soil units.

- Cover Soil – Cover soil consisted of silt with varying amounts of sand and gravel. Silty sand was tan to brown, very loose and moist and was generally encountered in the upper 3 to 8 feet of the soil profile.
- Embankment Fill – Approximately 1.0 to 2.5 feet of surficial embankment fill was encountered at the ground surface in each exploration location, with the exception of B-8. Embankment fill generally comprised gravel with varying amounts of clay, sand and cobbles. Additional embankment fill was encountered beneath cover soil in B-5 and B-7. Embankment fill was also encountered beneath tailings soil and overlying native alluvium in B-5 and B-7.
- Tailings – Silt tailings were encountered in each boring, with the exception of B-8. Tailings were gray, soft and moist. In B-4 and B-6, tailings were underlain by native alluvium. In B-5 and B-7, tailings were overlain and underlain by silty gravel embankment soil.
- Alluvium – Native, well-rounded, poorly-graded gravel with sand, cobbles and boulders was encountered in each boring. Alluvium was very dense and resulted in sample and auger refusal and little to no sample recovery. In B-8, coarse alluvium was encountered at the ground surface and soil sampling was feasible only via drill cuttings.

Neither groundwater nor bedrock was encountered to the depths explored. Depth to groundwater has the potential to change with seasonal variations in precipitation, infiltration, and site development.

LABORATORY TESTING

Based on the above conditions encountered, STRATA worked with TerraGraphics to develop a laboratory testing program commensurate with the samples we were able to recover and your design needs. The following table summarizes laboratory testing we accomplished based on laboratory testing revisions we discussed with TerraGraphics. We accomplished laboratory testing referencing *ASTM International* (ASTM) standards. Appendix C presents laboratory test results graphically along with ASTM test designations.

Table 1. Laboratory Test Summary

Boring	Sample Interval (BGS)[1]	Soil Unit	Tests Accomplished[2]	Remarks
B-4	1.0 – 2.5	Cover Soil	• Moisture content • Hydrometer • Atterberg limits • Direct shear	Direct shear accomplished at normal loads = 1,500, 3,000, 6,000 psf[3]; in-situ sample.
B-4	15.0 – 16.5	Tailings	• Moisture content • Hydrometer • Atterberg limits • Time-rate consolidation	Time-rate consolidation test run with rebound points; saturated at test execution; maximum load = 36,000 psf; in-situ sample.
B-5	5.0 – 6.5	Embankment	• Moisture content • Hydrometer • Paraffin density • Atterberg limits • Direct shear • One-point Standard Proctor	Direct shear accomplished at normal loads = 1,500, 3,000, 6,000 psf; sample remolded to 95% of one-point Standard Proctor near optimum moisture on sample portion passing the No. 10 sieve.
B-7	5.0 – 6.5	Embankment	• Moisture content • Hydrometer • Paraffin density • Atterberg limits • Direct shear • One-point Standard Proctor	Direct shear accomplished at normal loads = 1,500, 3,000, 6,000 psf; sample remolded to 95% of one-point Standard Proctor near optimum moisture on sample portion passing the No. 10 sieve.
B-8	4.0 – 4.5	Alluvium	• Moisture content • Hydrometer • Atterberg limits • Direct shear (2) • One-point Standard Proctor (2)	Direct shear tests accomplished at normal loads = 1,500, 3,000, 6,000 psf; samples remolded to 100% and 95% of one-point Standard Proctor near optimum moisture on sample portion passing the No. 10 sieve.

1. Feet below existing ground surface in the locations explored.
2. ASTM designations provided on results in Appendix C.
3. Pounds per square foot (psf).

LIMITATIONS

STRATA's authorized scope of service did not include geotechnical engineering analysis, recommendations or any other service not specifically outlined in our scope of service or in this report. We performed the laboratory testing program with involvement and agreement from TerraGraphics based on discussions with STRATA's engineering and laboratory testing professionals and as modified by the conditions encountered. Use of the laboratory results

presented for correlation to engineering properties must be done so by applying appropriate engineering judgment and safety factors which are applicable to the design approach. STRATA was not retained to provide recommended engineering design parameters based on the attached results. We performed our services referencing the geotechnical standard-of-care as it exists in the north Idaho area at the time of this report. This acknowledgement is in lieu of any express or implied warranties.

CLOSING

We sincerely appreciate the opportunity to continuing working with TerraGraphics. Please contact us with any questions or comments.

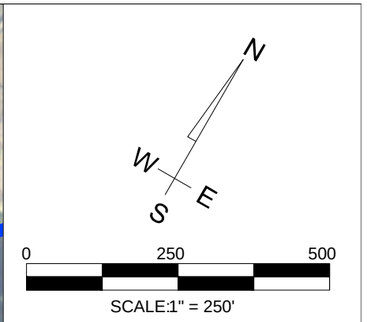
Sincerely,
STRATA, INC.

Angela K. Lemmerman, P.E.
Project Manager and Engineer

Chris M. Comstock, P.E., P.G.
Area Manager

Enclosures: Appendix A: Figure 1 (TerraGraphics)
Appendix B: Exploration Logs and USCS Explanation
Appendix C: Graphical Laboratory Test Results

APPENDIX A



LEGEND

- HWY 4 (BURKE RD)
- GRAYS BRIDGE RD
- CANYON CREEK
- BORE HOLE LOCATION
- CONE PENETRATION TEST LOCATION
- NEW MONITOR WELL LOCATION
- EXISTING MONITOR WELL LOCATION
- PROPOSED 2011 BORE HOLE LOCATION

NOTES:
1. COORDINATE SYSTEM NAD83 AND NAVD88

TerraGraphics Environmental Engineering, Inc.	DRAWN BY: D. SHAVER PROJECT MANAGER: D. VERNON	PROJECT NO: DATE: 12/19/2011	PROJECT NAME: CANYON CREEK REPOSITORY	FIGURE 1 GEOTECHNICAL SAMPLE AND *IN-SITU* TESTING LOCATIONS

APPENDIX B

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GRAPH SYMBOL	LETTER SYMBOL	TYPICAL NAMES
COARSE GRAINED SOILS	GRAVELS	CLEAN GRAVELS		GW	Well–Graded Gravel, Gravel–Sand Mixtures.
				GP	Poorly–Graded Gravel, Gravel–Sand Mixtures.
		GRAVELS WITH FINES		GM	Silty Gravel, Gravel–Sand–Silt Mixtures.
				GC	Clayey Gravel, Gravel–Sand–Clay Mixtures.
	SANDS	CLEAN SANDS		SW	Well–Graded Sand, Gravelly Sand.
				SP	Poorly–Graded Sand, Gravelly Sand.
		SANDS WITH FINES		SM	Silty Sand, Sand–Silt Mixtures.
				SC	Clayey Sand, Sand–Clay Mixtures.
FINE GRAINED SOILS	SILTS AND CLAYS LIQUID LIMIT LESS THAN 50%			ML	Inorganic Silt, Sandy or Clayey Silt.
				CL	Inorganic Clay of Low to Medium Plasticity, Sandy or Silty Clay.
				OL	Organic Silt and Clay of Low Plasticity.
	SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50%			MH	Inorganic Silt, Micaceous Silt, Plastic Silt.
				CH	Inorganic Clay of High Plasticity, Fat Clay.
				OH	Organic Clay of Medium to High Plasticity.
				PT	Peat, Muck and Other Highly Organic Soils.

BORING LOG SYMBOLS

- Standard 2–Inch OD Split–Spoon Sample
- California Modified 3–Inch OD Split–Spoon Sample
- Rock Core
- Shelby Tube 3–Inch OD Undisturbed Sample

GROUNDWATER SYMBOLS

- Groundwater After 24 Hours
- (7–3–07) Indicates Date of Reading
- Groundwater at Time of Drilling

TEST PIT LOG SYMBOLS

- BG Baggie Sample
- BK Bulk Sample
- RG Ring Sample

Shorthand Notation:
BGS = Below Existing Ground Surface
N.E. = None Encountered

STRATA
A Professional Services Corporation
Integrity from the Ground Up

USCS Description	DEPTH (ft)	U.S.C.S. CLASS	SYMBOL	Sample Type	SPT Blows Per 6 Inches	SPT $N_{(60)}$	Dry Density (pcf)	Moisture Content (%)	Pocket Pen. (tsf)	REMARKS Note: BGS = Below Ground Surface
(GP-GM) Poorly-Graded GRAVEL with Silt, Sand and Cobbles (Embankment). Reddish brown, medium dense, moist.	0	GP-GM								
(ML) SILT (Cover Soil). Tan, soft, moist.		ML			4 3 2	5	80.1	42.0		71% Passing the No. 200 Sieve. Atterberg LImits: LL=24; PI =0.
(ML) SILT (Tailings). Gray, soft, moist.	5									
	10	ML								
	15						85.1	44.2		100% Passing the No. 200 Sieve. Atterberg Limits: LL=33; PI=6.
	20									
(GP) Poorly-Graded GRAVEL with Sand, Cobbles and Boulders (Alluvium). Very dense, gray, moist.		GP			21 26 50/3.0"	50+				Boring terminated due to auger refusal.

Borehole Terminated at 24.2 Feet.

Client: TERRA1	**Boring Number:** B-4	STRATA A Professional Services Corporation Integrity from the Ground Up	**EXPLORATORY BORING LOG**
Project: C11104A	**Date Drilled:** 12-20-2011		
Drill Rig: BK-61	**Borehole Diameter:** 8"		
Depth to Groundwater: N.E.	**Logged By:** CWW		Sheet 1 Of 1

STRATA BH / TP / WELL - STRATA.GPJ - 1/24/12 16:26 - P:\GINT\PROJECTS\TERRA1 C11104A B-4 TO B-8.GPJ

USCS Description	DEPTH (ft)	U.S.C.S. CLASS	SYMBOL	Sample Type	SPT Blows Per 6 Inches	SPT $N_{(60)}$	Dry Density (pcf)	Moisture Content (%)	Pocket Pen. (tsf)	REMARKS Note: BGS = Below Ground Surface
(GP-GM) Poorly-Graded GRAVEL with Silt and Sand (Embankment). Reddish brown, medium dense, moist.	0	GP-GM								
(GC) Lean Clayey GRAVEL with Sand (Embankment). Reddish brown, medium dense, moist.	5	GC			22 28 43	43	125.2	13.2		28% Passing the No. 200 Sieve. Atterberg Limits: LL=28; PI=9.
	10									
(SP-SM) Poorly-Graded SAND with Silt (Embankment). Tan, loose, moist.	15	SP-SM			5 4 4	8				Looser at approximately 13 feet BGS based on driller feedback.
(ML) Sandy SILT (Tailings). Gray, soft, moist.		ML								
(SP-SM) Poorly-Graded SAND with Silt (Embankment). Tan, very loose, moist.		SP-SM								
(GM) Silty GRAVEL with Sand (Embankment with Tailings). Reddish brown to grey, loose.	20	GM			2 10 48	58				Tip of sample native. Drill chatter at 21.5 feet BGS.
(GP) Poorly-Graded GRAVEL with Sand, Cobbles and Boulders (Alluvium). Very dense, gray, moist.		GP			50/0.5"	50+				Alluvium interpreted; no sample recovery. Boring terminated due to auger refusal.

Borehole Terminated at 22.0 Feet.

Client: TERRA1	**Boring Number:** B-5	STRATA A Professional Services Corporation Integrity from the Ground Up	**EXPLORATORY BORING LOG**
Project: C11104A	**Date Drilled:** 12-20-2011		
Drill Rig: BK-61	**Borehole Diameter:** 8"		
Depth to Groundwater: N.E.	**Logged By:** CWW		Sheet 1 Of 1

STRATA BH / TP / WELL - STRATA.GPJ - 1/24/12 16:26 - P:\GINT\PROJECTS\TERRA1 C11104A B-4 TO B-8.GPJ

USCS Description	DEPTH (ft)	U.S.C.S. CLASS	SYMBOL	Sample Type	SPT Blows Per 6 Inches	SPT $N_{(60)}$	Dry Density (pcf)	Moisture Content (%)	Pocket Pen. (tsf)	REMARKS Note: BGS = Below Ground Surface
(GM) Silty GRAVEL with Sand (Embankment). Reddish brown, very dense, moist.	0	GM								
(SM) Silty SAND with Gravel (Cover Soil). Brown, very loose, moist.	5	SM								2 inches of recovery. Combined with cuttings for cover sample.
(ML) SILT (Tailings). Gray, soft, moist.	10									
	15									
	20	ML								
	25				0 0 1	1				
	30									
	35									

Client: TERRA1	**Boring Number:** B-6	STRATA A Professional Services Corporation Integrity from the Ground Up	**EXPLORATORY BORING LOG**
Project: C11104A	**Date Drilled:** 12-20-2011		
Drill Rig: BK-61	**Borehole Diameter:** 8"		
Depth to Groundwater: N.E.	**Logged By:** CWW		Sheet 1 Of 2

(Continued Next Page)

USCS Description	DEPTH (ft)	U.S.C.S. CLASS	SYMBOL	Sample Type	SPT Blows Per 6 Inches	SPT $N_{(60)}$	Dry Density (pcf)	Moisture Content (%)	Pocket Pen. (tsf)	REMARKS Note: BGS = Below Ground Surface
(ML) SILT (Tailings). Gray, soft, moist. *(continued)*	35	ML								
(GP) Poorly-Graded GRAVEL with Sand, Cobbles and Boulders (Alluvium). Very dense.		GP			50/4.0"	50+				Alluvium layer interpreted; No sample recovery. Boring terminated due to auger refusal.

Borehole Terminated at 38.1 Feet.

Client: TERRA1	**Boring Number:** B-6	STRATA A Professional Services Corporation Integrity from the Ground Up	**EXPLORATORY BORING LOG**
Project: C11104A	**Date Drilled:** 12-20-2011		
Drill Rig: BK-61	**Borehole Diameter:** 8"		
Depth to Groundwater: N.E.	**Logged By:** CWW		Sheet 2 Of 2

STRATA BH / TP / WELL - STRATA.GPJ - 1/24/12 16:26 - P:\GINT\PROJECTS\TERRA1 C11104A B-4 TO B-8.GPJ

USCS Description	DEPTH (ft)	U.S.C.S. CLASS	SYMBOL	Sample Type	SPT Blows Per 6 Inches	SPT $N_{(60)}$	Dry Density (pcf)	Moisture Content (%)	Pocket Pen. (tsf)	REMARKS Note: BGS = Below Ground Surface
(GP-GM) Poorly-Graded GRAVEL with Silt, Sand and Cobbles (Embankment). Reddish brown, medium dense, moist.	0	GP-GM								
(GC) Lean Clayey GRAVEL with Sand and Cobbles (Embankment). Reddish brown, very dense, moist.	5	GC			21 27 42	42	120.8	13.8		25% Passing the No. 200 Sieve. Atterberg Limits: LL=28; PI=9.
										Drill chatter (cobble at about 8 feet BGS).
	10				6 13 18	31				
(ML) Sandy SILT (Tailings). Gray, soft, moist.	15	ML								Drilling soft at 12 feet BGS.
(GM) Silty GRAVEL with Sand and Cobbles (Embankment). Reddish brown, medium dense, moist.	20	GM			6 8 6	14				Cobble encountered at 18 feet BGS.
(GP) Poorly-Graded GRAVEL with Sand, Cobbles and Boulders (Alluvium). Very dense, gray, moist.		GP			50/0.5"	50+				Alluvium interpreted; no sample recovery. Boring terminated due to auger refusal.

Borehole Terminated at 22.0 Feet.

Client: TERRA1	**Boring Number:** B-7	STRATA A Professional Services Corporation Integrity from the Ground Up	**EXPLORATORY BORING LOG**
Project: C11104A	**Date Drilled:** 12-20-2011		
Drill Rig: BK-61	**Borehole Diameter:** 8"		
Depth to Groundwater: N.E.	**Logged By:** CWW		Sheet 1 Of 1

STRATA BH / TP / WELL - STRATA.GPJ - 1/24/12 16:26 - P:\GINT\PROJECTS\TERRA1 C11104A B-4 TO B-8.GPJ

USCS Description	DEPTH (ft)	U.S.C.S. CLASS	SYMBOL	Sample Type	SPT Blows Per 6 Inches	SPT $N_{(60)}$	Dry Density (pcf)	Moisture Content (%)	Pocket Pen. (tsf)	REMARKS Note: BGS = Below Ground Surface
(GP-GM) Poorly-Graded GRAVEL with Silt, Sand, Cobbles and Boulders (Alluvium). Reddish brown, very dense, moist.	0	GP-GM			50/4.0"	50+		6.5		10% Passing the No. 200 Sieve. Atterberg Limits: LL=25; PI=3. Drill cutting sample obtained. Boring termianted due to auger refusal.
Borehole Terminated at 4.5 Feet.										

Client: TERRA1	**Boring Number:** B-8	STRATA A Professional Services Corporation Integrity from the Ground Up	**EXPLORATORY BORING LOG**
Project: C11104A	**Date Drilled:** 12-20-2011		
Drill Rig: BK-61	**Borehole Diameter:** 8"		
Depth to Groundwater: N.E.	**Logged By:** CWW		Sheet 1 Of 1

STRATA BH / TP / WELL - STRATA.GPJ - 1/24/12 16:26 - P:\GINT\PROJECTS\TERRA1 C11104A B-4 TO B-8.GPJ

APPENDIX C

INDEX LABORATORY TEST RESULT SUMMARY

Sample Location	Sample No.	Moisture Content, %	In-Situ Unit Weight, pcf	Percent Passing No. 200 Sieve	Atterberg Limits
B-4 at 1.0 to 2.5	SL122011-3	42.0	80.1	71.0	Liquid Limit = 24
					Plastic Index = 0
					Fines Class: ML
B-4 at 15.0 to 16.5	SL122011-4	44.2	85.1	100.0	Liquid Limit = 33
					Plastic Index = 6
					Fines Class: ML
B-5 at 5.0 to 6.5	SL122011-1	13.2	125.2	28.0	Liquid Limit = 28
					Plastic Index = 9
					Fines Class: CL
B-7 at 5.0 to 6.5	SL122011-2	13.8	120.8	25.0	Liquid Limit =28
					Plastic Index = 9
					Fines Class: CL
B-8 at 4.0 to 4.5	SL122011-5	6.5	N.P.	10.0	Liquid Limit = 25
					Plastic Index = 6
					Fines Class: ML

N.P. = Not performed due to sample disturbance and poor recovery.

Index Laboratory Test Summary

STRATA
A PROFESSIONAL SERVICES CORPORATION
Integrity from the Ground Up

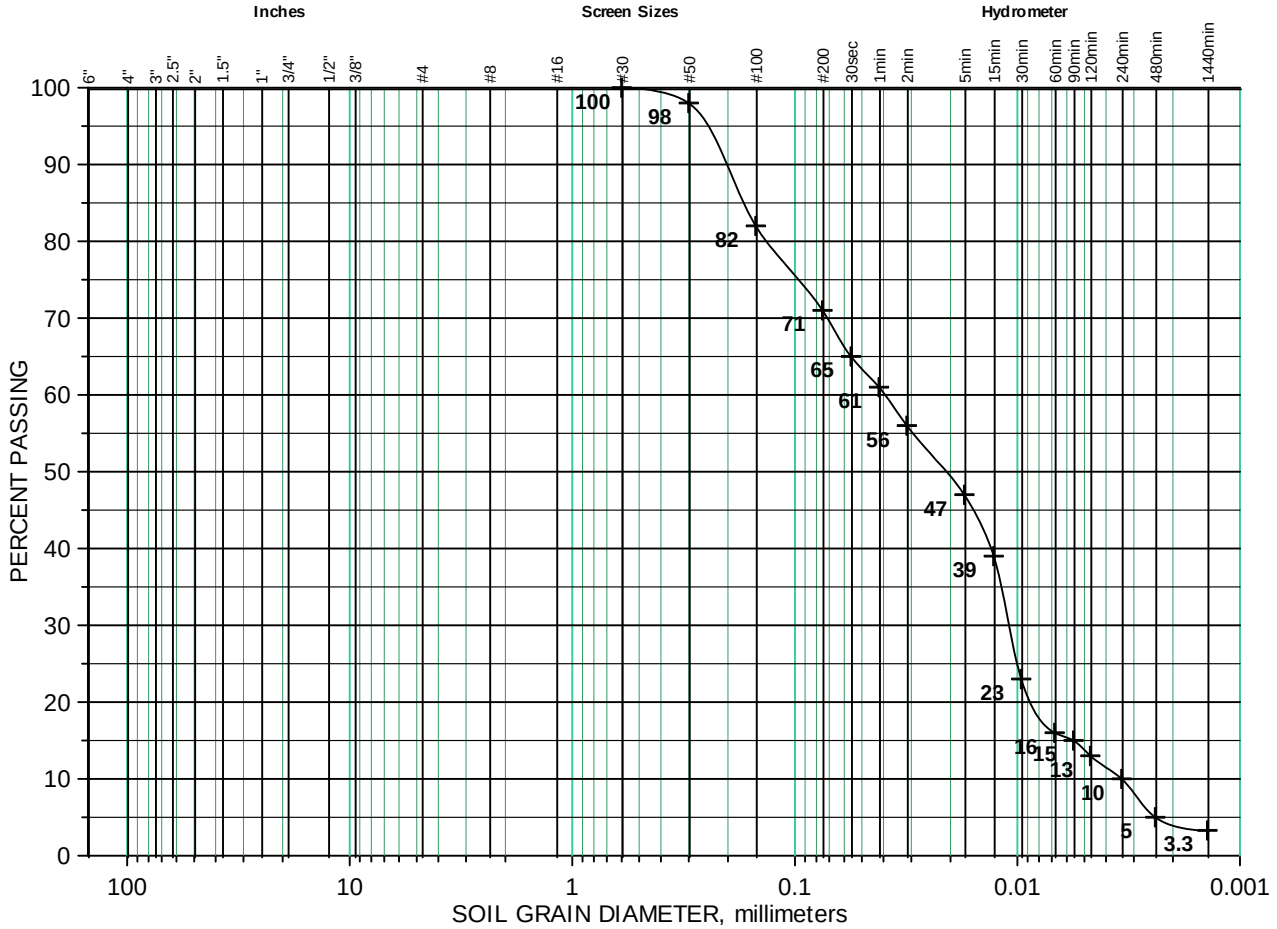
File: TERRA1 C11104A	Appendix C

GRADATION ANALYSIS

ASTM D-422

Project: Star Tailings Impoundment
Client: TerraGraphics Environmental Engineering, Inc.
File Name: TERRA1 C11104A
Lab Number: SL122011-3
Sample Identification: B-4 at 1.0 to 2.5 ft BGS
Sample Classification: Silt (Cover)
Date Tested: 1/13/12 By: CW
Atterberg Limits: LL = 24, PI = 0

Cobbles	Gravel		Sand			Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



Reviewed by: _____

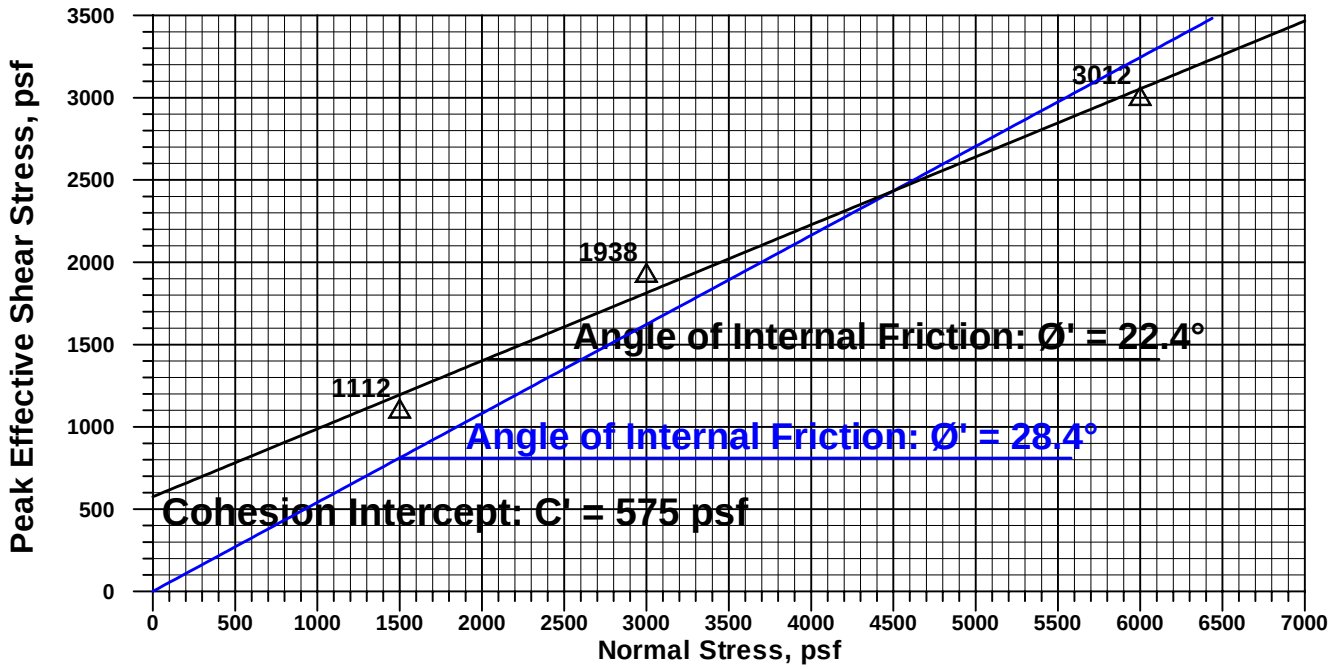
STRATA
A Professional Services Corporation
Integrity from the Ground Up

DIRECT SHEAR

ASTM D-3080

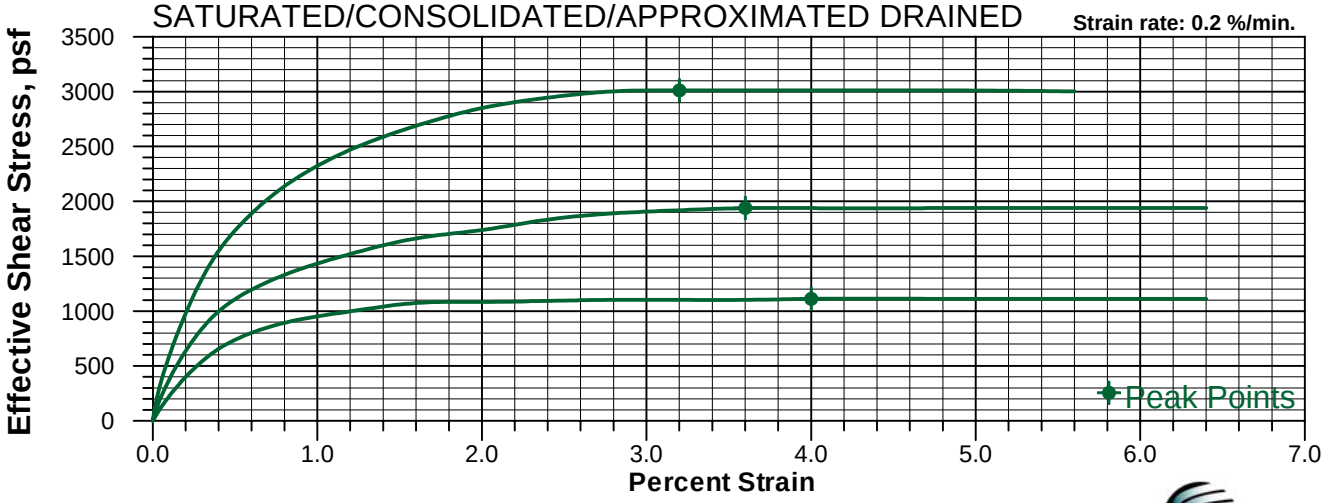
Project: Star Tailings Impoundment
Client: TerraGraphics Environmental Engineering, Inc.
Sample Identification: B-4 @ 1.0 - 2.5 ft BGS
Sample Classification: Silt (Cover)
In-Situ Dry Unit Weight = 80.1 pcf @ 42.0% moisture

File Name: TERRA1 C11104A
Lab Number: SL122011-3
Date Tested: 1/12/12 By: IR



SATURATED/CONSOLIDATED/APPROXIMATED DRAINED

Strain rate: 0.2 %/min.



Reviewed By: _____

STRATA
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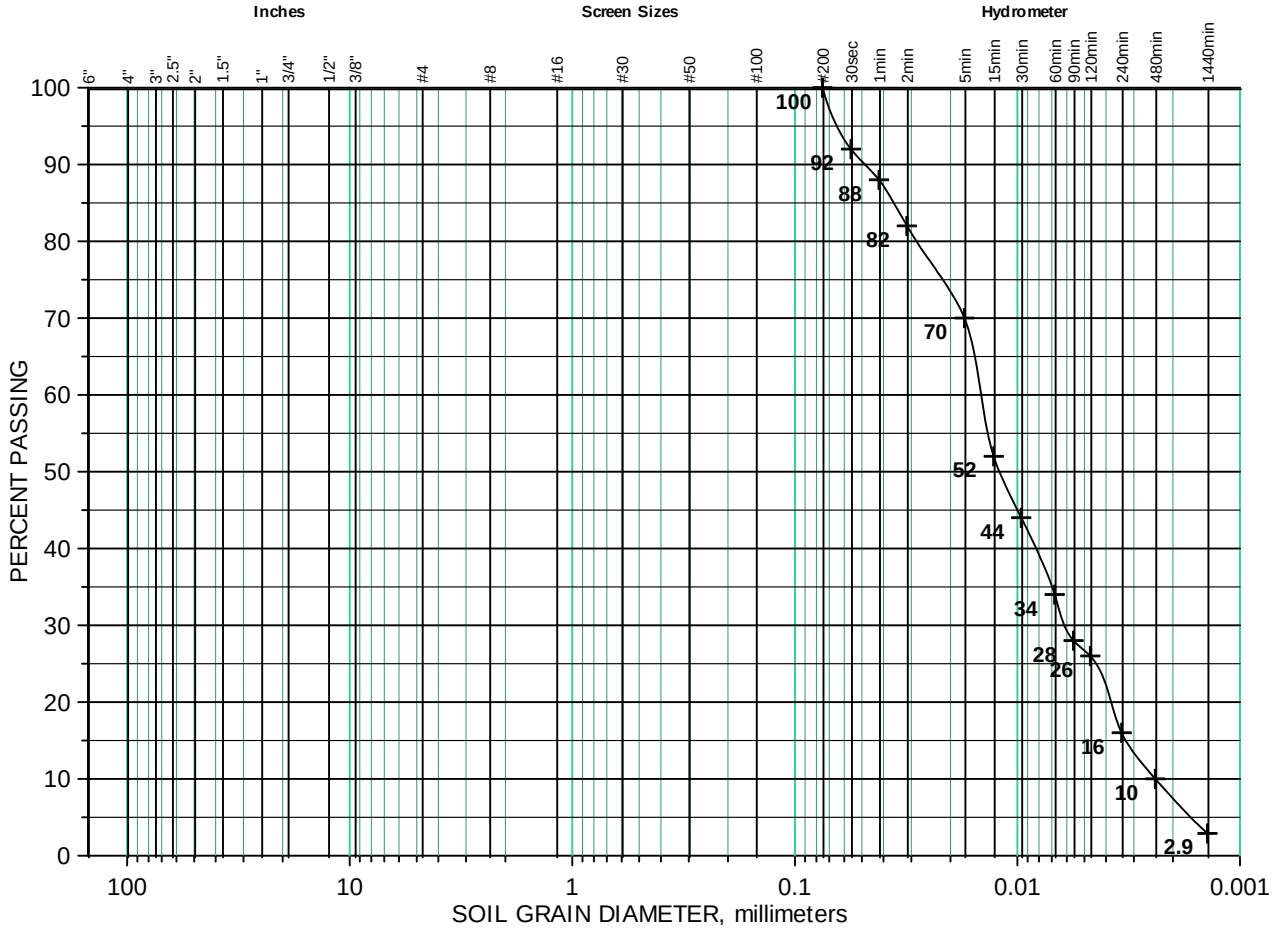
Integrity from the Ground Up

GRADATION ANALYSIS

ASTM D-422

Project: Star Tailings Impoundment
Client: TerraGraphics Environmental Engineering, Inc.
File Name: TERRA1 C11104A
Lab Number: SL122011-4
Sample Identification: B-4 at 15.0 to 16.5 ft BGS
Sample Classification: Silt (Tailings)
Date Tested: 1/13/12 By: CW
Atterberg Limits: LL = 33, PI = 6

Cobbles	Gravel		Sand			Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



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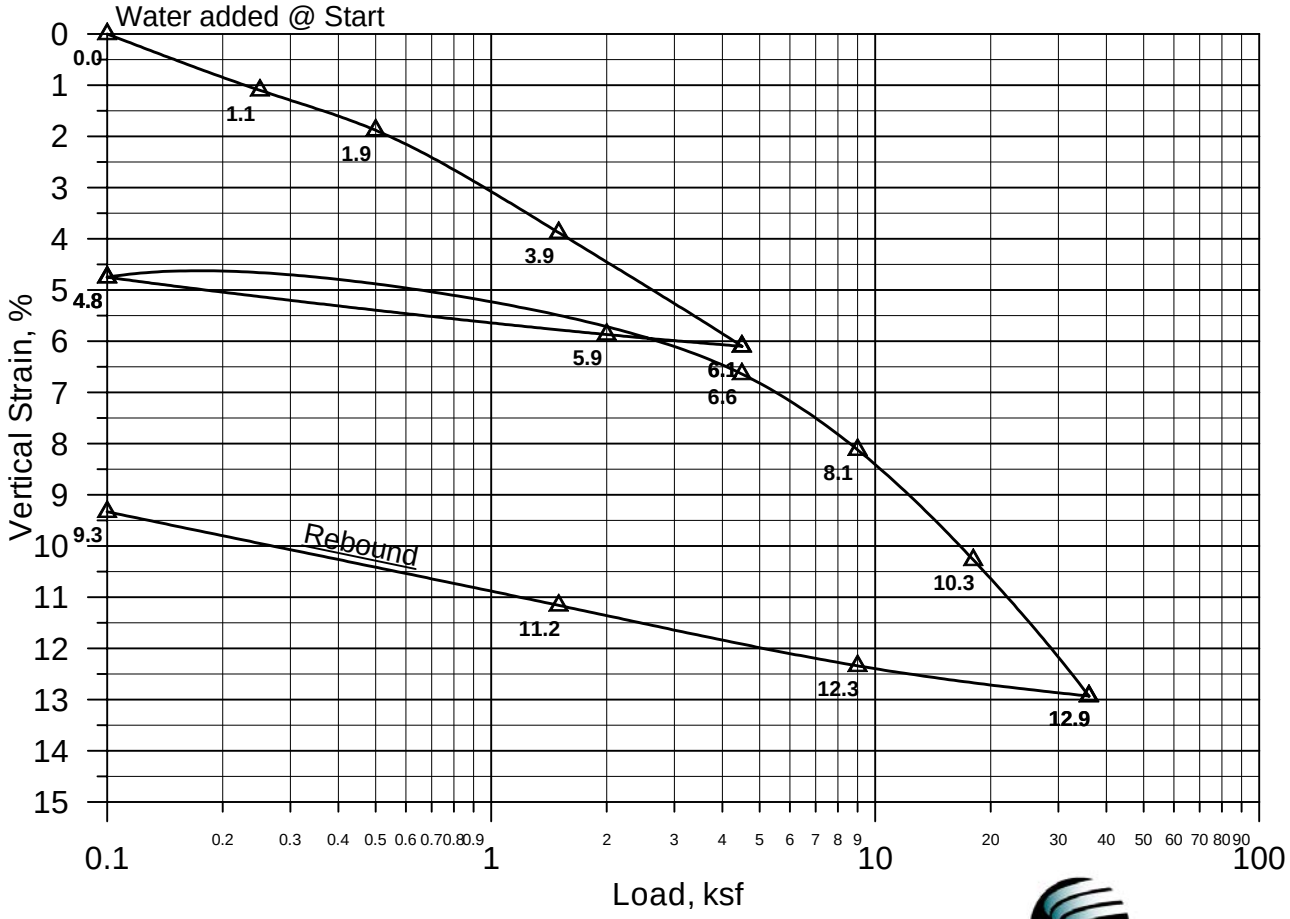
STRATA
A Professional Services Corporation
Integrity from the Ground Up

CONSOLIDATION TEST RESULTS

ASTM D-2435

Project: Star Tailings Impoundment
Client: TerraGraphics Environmental Engineering, Inc.
File Name: TERRA1 C11104A
Lab Number: SL122011-4
Sample Identification: B-4 @ 16.0 - 16.5 ft BGS
Sample Classification: Silt (Tailings)
Sample: In-Situ Tube (Condition: Good)
Date Tested: 1/11-23/12 By: IR
Sample Dry Unit Weight: 85.1 pcf
Moisture Content: 44.2%



Reviewed By: Adrian Lascano

STRATA
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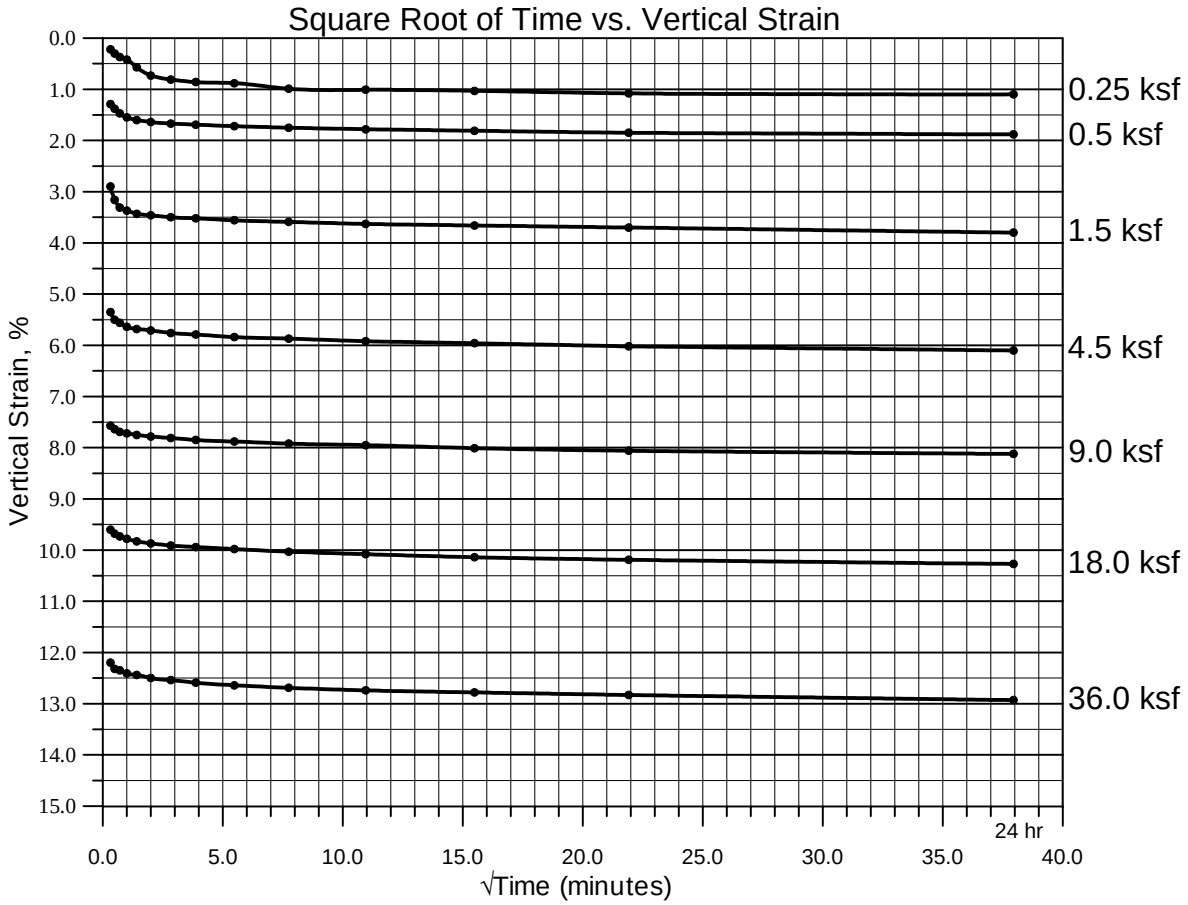
Integrity from the Ground Up

CONSOLIDATION TEST RESULTS

ASTM D-2435 (Time Rate)

Project: Star Tailings Impoundment
Client: TerraGraphics Environmental Engineering, Inc.
File Name: TERRA1 C11104A
Lab Number: SL122011-4
Sample Identification: B-4 @ 16.0 - 16.5 ft BGS
Sample Type: In-Situ Tube (Condition: Good)
Sample Classification: Silt (Tailings)
Date Tested: 1/11-23/12 By: IR
Sample Dry Unit Weight: 85.1 pcf
Moisture Content: 44.2%



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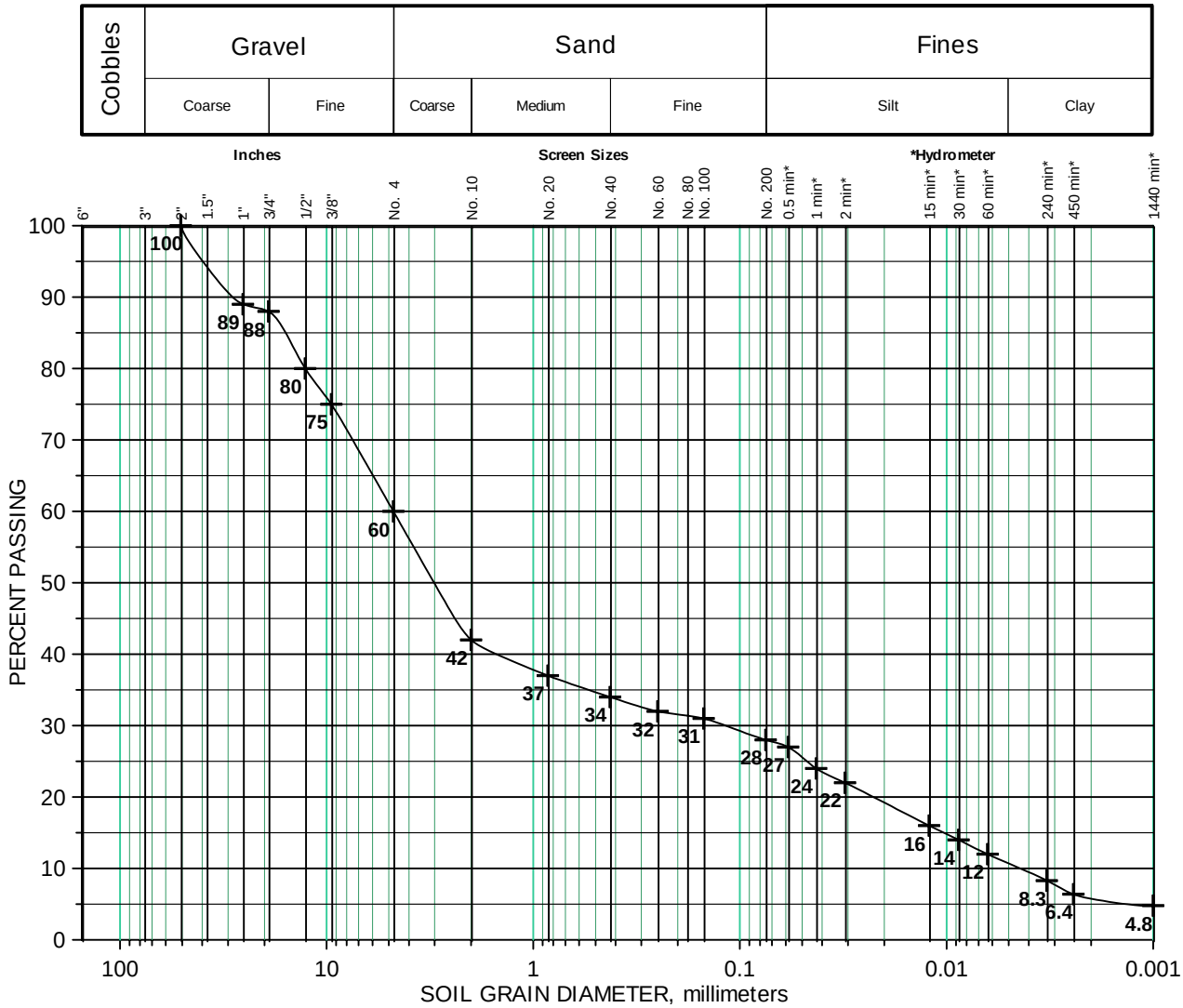
GRADATION ANALYSIS

ASTM D-422

Project: Star Tailings Impoundment
Client: TerraGraphics Environmental Engineering, Inc.
File Name: TERRA1 C11104A
Lab Number: SL122011-1
Sample Identification: B-5 @ 5.0 - 6.5 ft BGS
Sample Classification: Lean Clayey Gravel with Sand (Embankment)
Date tested: 1/11/12 By: IR
Atterberg Limits: LL = 28, PI = 9



Reviewed by: Adrian Lascano

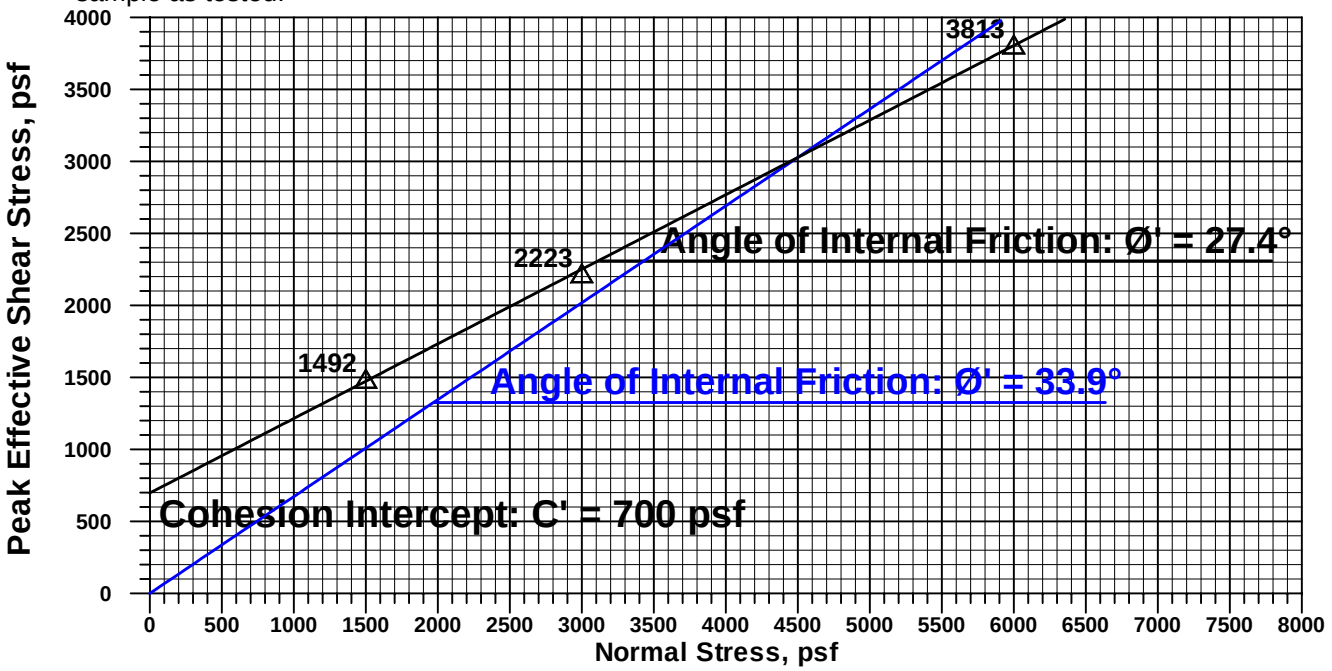
STRATA
A Professional Services Corporation
Integrity from the Ground Up

DIRECT SHEAR
ASTM D-3080

Project: Star Tailings Impoundment
Client: TerraGraphics Environmental Engineering, Inc.
Sample Identification: B-5 @ 5.0 - 6.0 ft BGS
Sample Classification*: Sandy Lean Clay (Embankment)
Remolded Dry Unit Weight* = 113.0 pcf @ 15.2% moisture
Atterberg Limits: LL = 28, PI = 9

File Name: TERRA1 C11104A
Lab Number: SL122011-1
Date Tested: 1/12/12 By: IR

*Remold unit weight based on a one-point ASTM D-698 Proctor at approximate optimum moisture content performed on the minus #10 sample portion. Test specimens were remolded to 95% utilizing the minus #10 material to comply with ASTM procedures. Internal friction angles are typically higher with the plus #10 portion included. The coarse portion (plus #10) of this sample is 58%. Sample classification is based on sample as tested.



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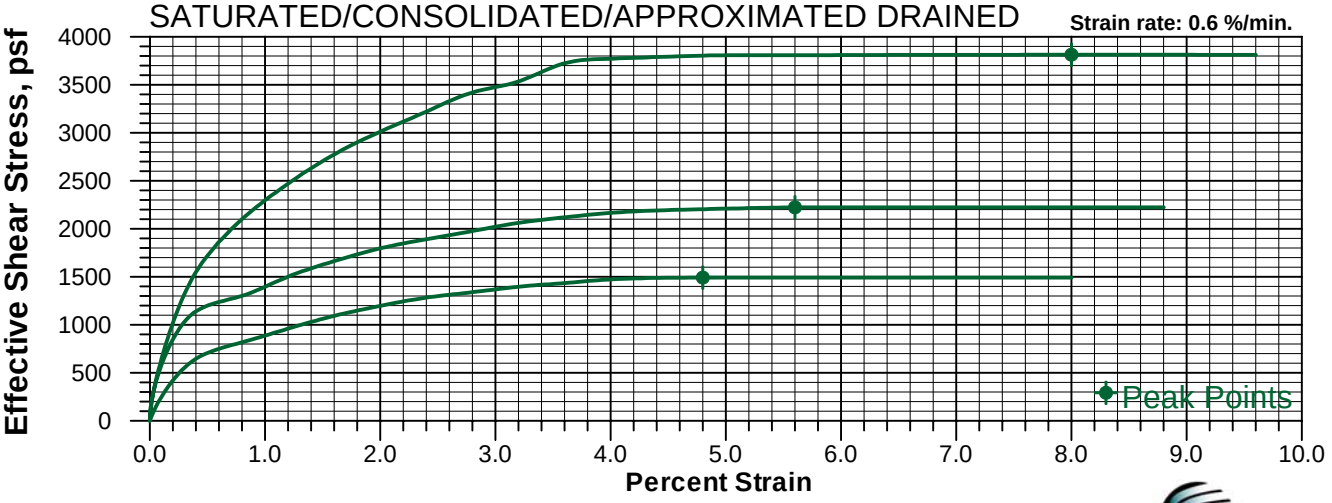

Reviewed By: Adrian Glascock

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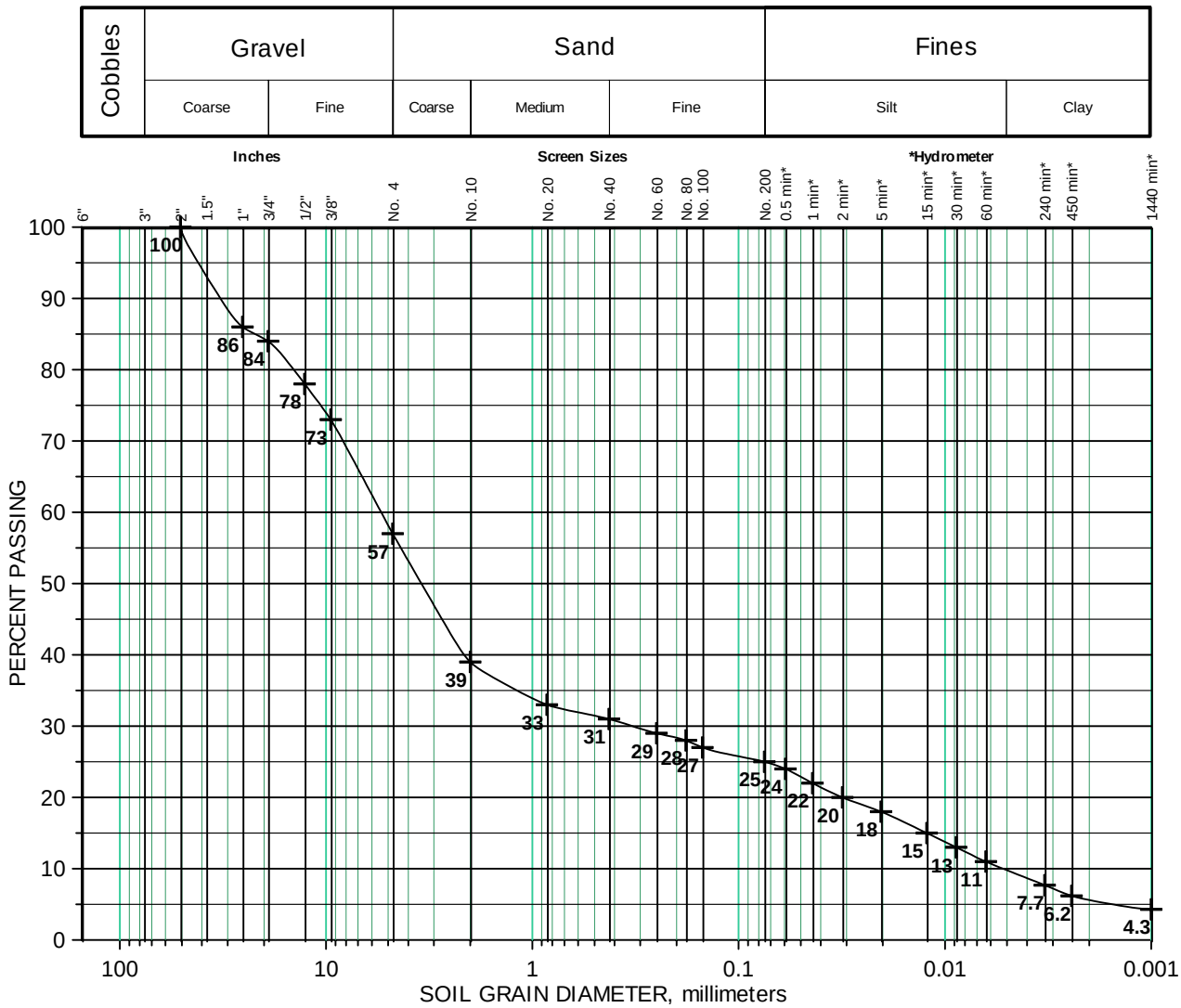
Integrity from the Ground Up

GRADATION ANALYSIS

ASTM D-422

Project: Star Tailings Impoundment
Client: TerraGraphics Environmental Engineering, Inc.
File Name: TERRA1 C11104A
Lab Number: SL122011-2
Sample Identification: B-7 @ 5.0 - 6.5 ft BGS
Sample Classification: Lean Clayey Gravel with Sand (Embankment)
Date tested: 1/11/12 By: IR
Atterberg Limits: LL = 28, PI = 9



Reviewed by: Adrian Clasicomo

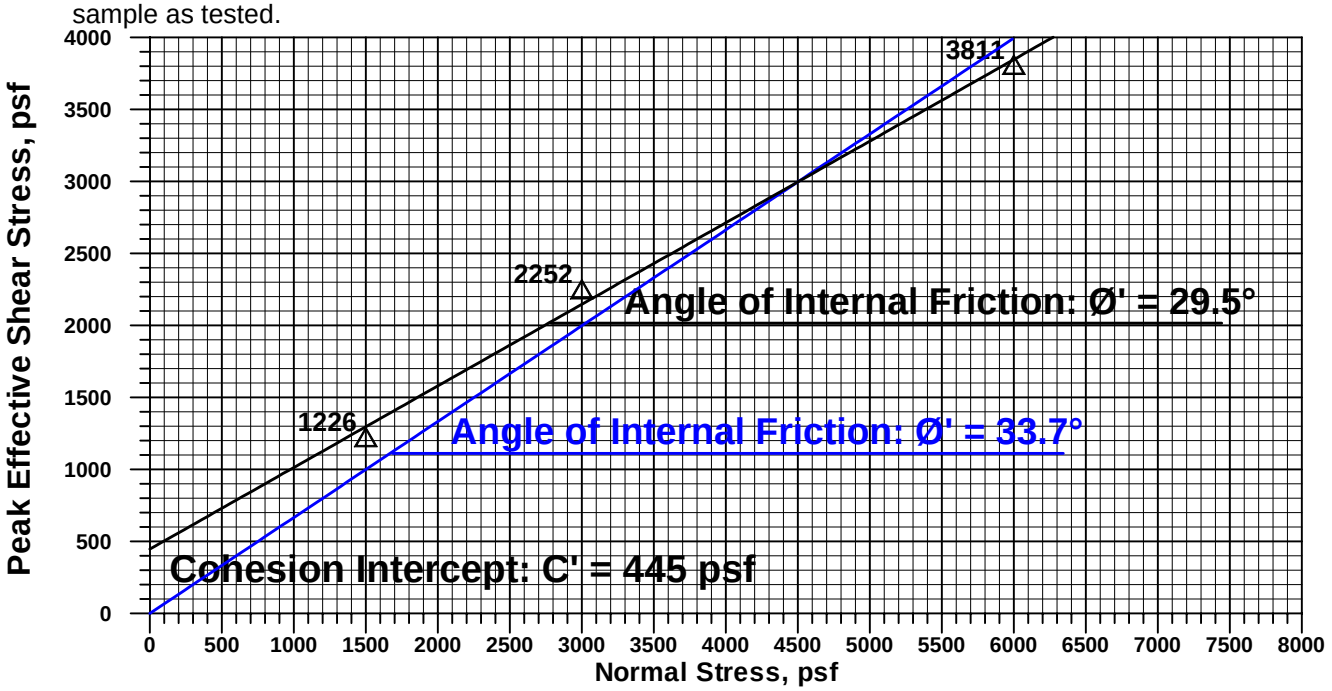
STRATA
A Professional Services Corporation
Integrity from the Ground Up

DIRECT SHEAR
ASTM D-3080

Project: Star Tailings Impoundment
Client: TerraGraphics Environmental Engineering, Inc.
Sample Identification: B-7 @ 5.0 - 6.5 ft BGS
Sample Classification*: Sandy Lean Clay (Embankment)
Remolded Dry Unit Weight* = 112.3 pcf @ 15.4% moisture
Atterberg Limits: LL = 28, PI = 9

File Name: TERRA1 C11104A
Lab Number: SL122011-2
Date Tested: 1/17/12 By: IR

*Remold unit weight based on a one-point ASTM D-698 proctor at approximate optimum moisture content performed on the minus #10 sample portion. Test specimens were remolded to 95% utilizing the minus #10 material to comply with ASTM procedures. Internal friction angles are typically higher with the plus #10 portion included. The coarse portion (plus #10) of this sample is 61%. Sample classification is based on sample as tested.



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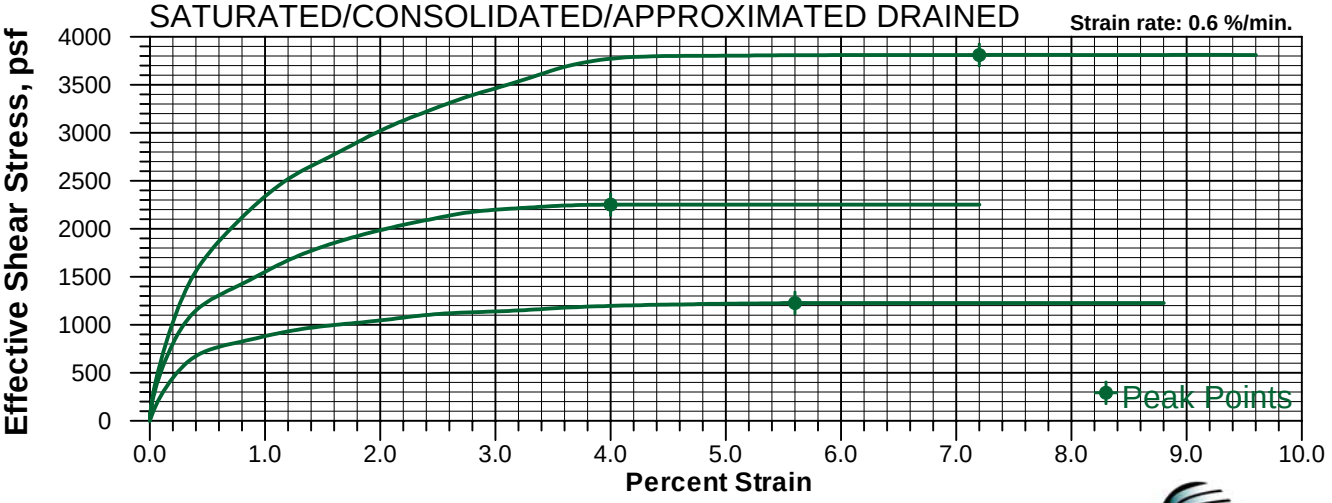


Reviewed By: Adrian Lascano

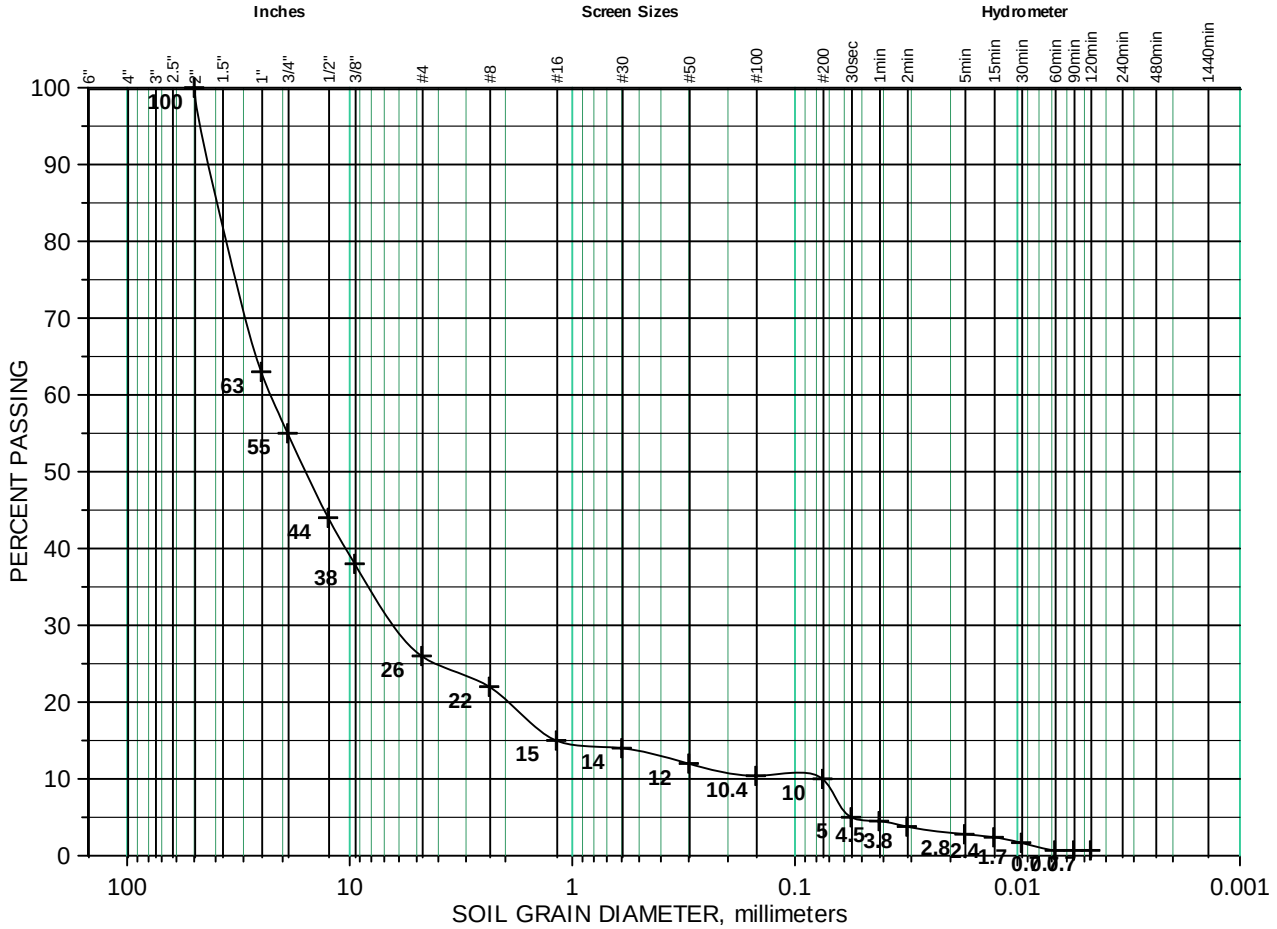
STRATA
A Professional Services Corporation
Integrity from the Ground Up

GRADATION ANALYSIS

ASTM D-422

Project: Star Tailings Impoundment
Client: TerraGraphics Environmental Engineering, Inc.
File Name: TERRAI C01104A
Lab Number: SL122011-5
Sample Identification: B-8 at 4.0 to 4.5 ft BGS
Sample Classification: Gravel with Sand and Silt - Poorly Graded (Alluvium)
Date Tested: 1/13/12 By: CW
Atterberg Limits: LL = 25, PL = 22, PI = 3

Cobbles	Gravel		Sand			Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



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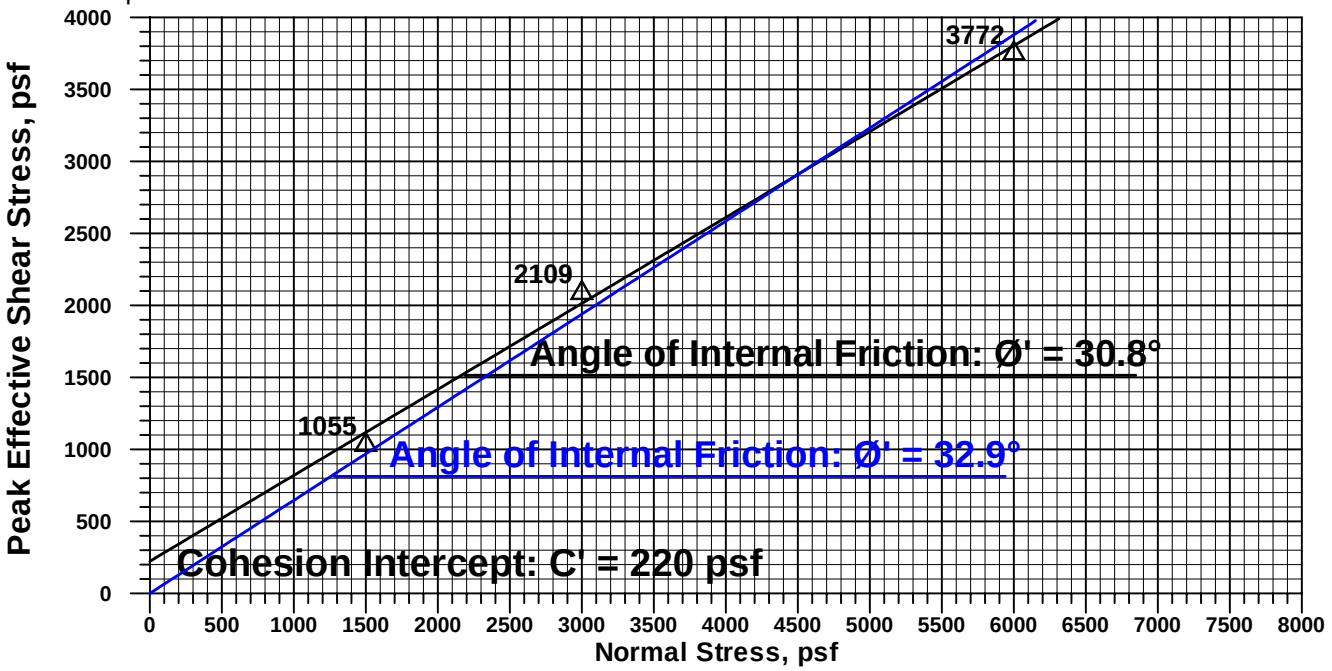
A Professional Services Corporation
Integrity from the Ground Up

DIRECT SHEAR
ASTM D-3080

Project: Star Tailings Impoundment
Client: TerraGraphics Environmental Engineering, Inc.
Sample Identification: B-8 @ 4.0 - 4.5 ft BGS
Sample Classification*: Silty Sand (Alluvium)
Remolded Dry Unit Weight* = 109.1 pcf @ 13.8% moisture

File Name: TERRA1 C11104A
Lab Number: SL122011-5
Date Tested: 1/17/12 By: IR

*Remold unit weight based on a one-point ASTM D-698 proctor at approximate optimum moisture content performed on the minus #10 sample portion. Test specimens were remolded to 90% utilizing the minus #10 material to comply with ASTM procedures. Internal friction angles are typically higher with the plus #10 portion included. The coarse portion (plus #10) of this sample is 82%. Sample classification is based on sample as tested.



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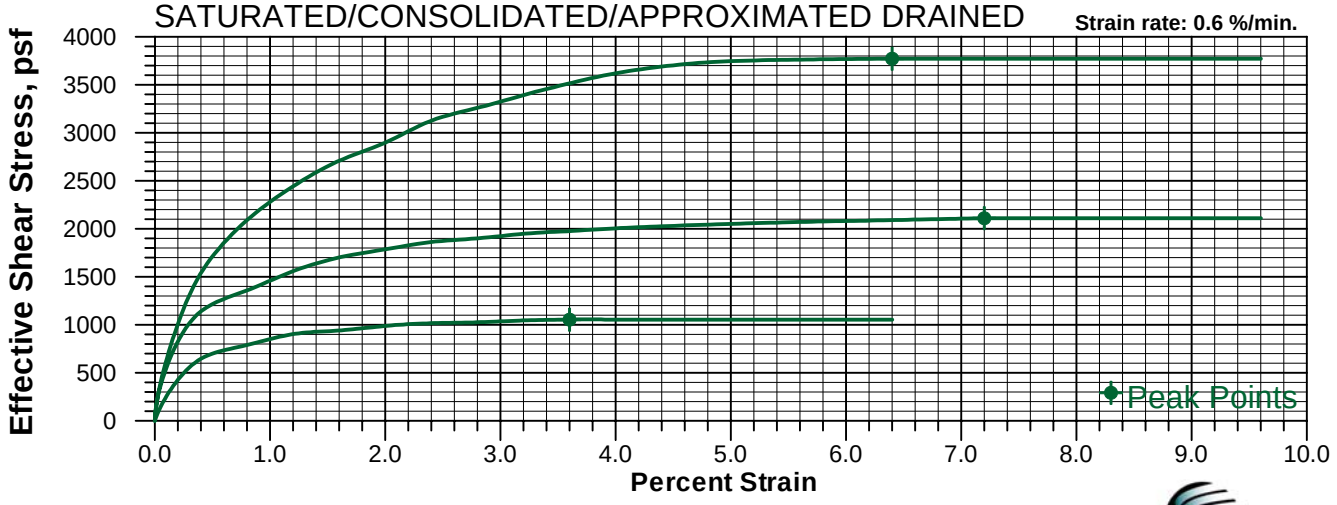


Reviewed By: _____

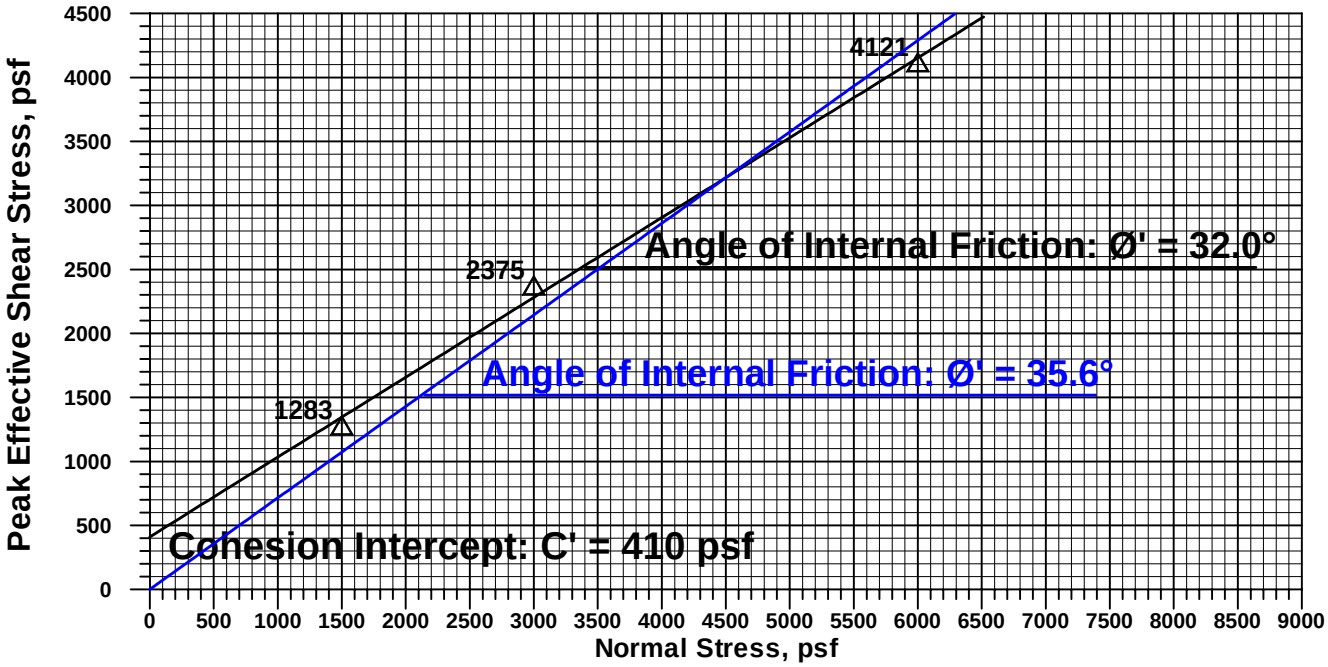
STRATA
A Professional Services Corporation
Integrity from the Ground Up

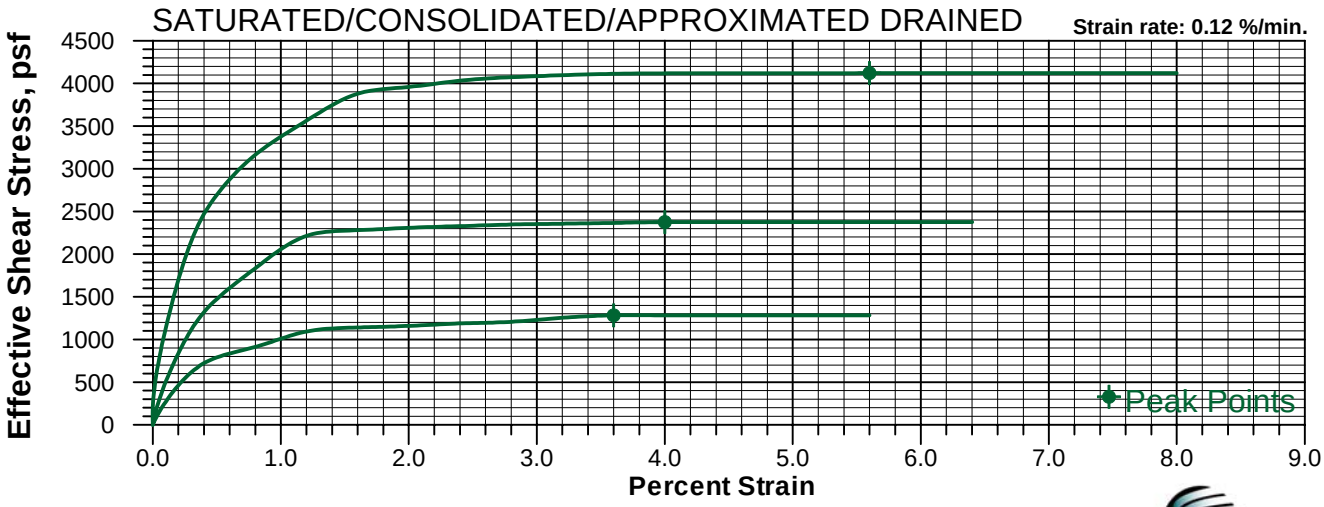
DIRECT SHEAR
ASTM D-3080

Project: Star Tailings Impoundment
Client: TerraGraphics Environmental Engineering, Inc.
Sample Identification: B-8 @ 4.0 - 4.5 ft
Sample Classification*: Silty Sand (Alluvium)
Remolded Dry Unit Weight* = 121.0 pcf @ 13.8% moisture

File Name: TERRA1 C11104A
Lab Number: SL122011-5
Date Tested: 1/18/12 By: IR

*Remold unit weight based on a one-point ASTM D-698 proctor at approximate optimum moisture content performed on the minus #10 sample portion. Test specimens were remolded to 100% utilizing the minus #10 material to comply with ASTM procedures. Internal friction angles are typically higher with the plus #10 portion included. The coarse portion (plus #10) of this sample is 82%. Sample classification is based on sample as tested.





Reviewed By: _____

STRATA
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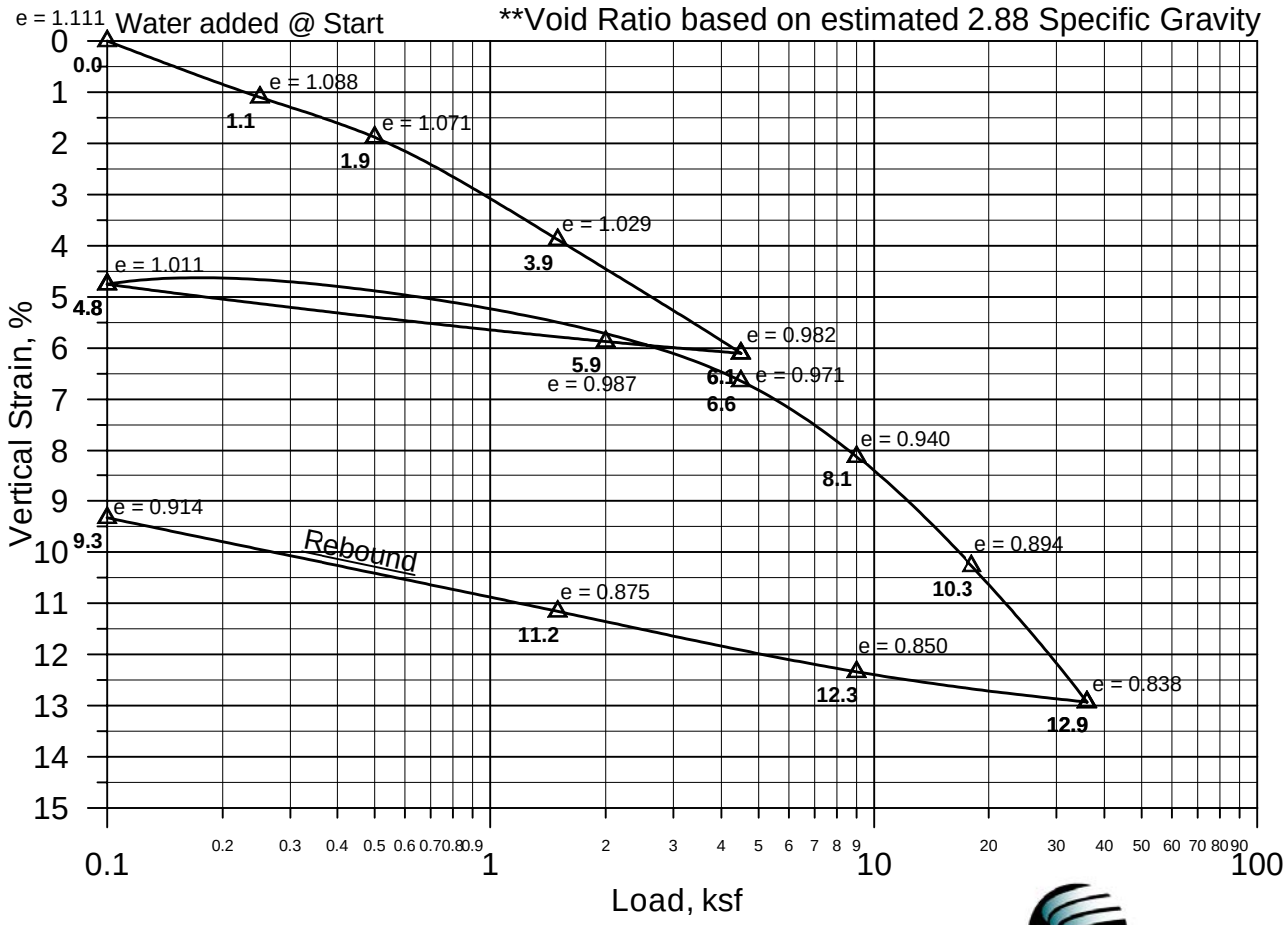
CONSOLIDATION TEST RESULTS

ASTM D-2435

Project: Star Tailings Impoundment
Client: TerraGraphics Environmental Engineering, Inc.
File Name: TERRA1 C11104A
Lab Number: SL122011-4
Sample Identification: B-4 @ 16.0 - 16.5 ft BGS
Sample Classification: Silt (Tailings)
Sample: In-Situ Tube (Condition: Good)
Date Tested: 1/11-23/12 By: IR
Sample Dry Unit Weight: 85.1 pcf
Moisture Content: 44.2%

**Note: Strata, Inc assumes no liability for void ratio calculations, they are provided at clients request.



Reviewed By: Adrian Lascano

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Appendix I

Design Calculations

Preliminary list of Calculations to be performed during the intermediate LBCR design:

1. 100-year, 24-hour and 25-year, 24-hour rain on snow flow event calculations
2. Runon/runoff control channel capacity and erosion control calculations
3. Pavement calculations
4. Cover drainage layer transmissivity calculation
5. Cover geomembrane puncture protection calculation
6. Cover veneer slope stability analysis
7. Cover drainage layer toe drain capacity and erosion control calculations

CDM Smith Calculation Form

Directions: Complete one form for each calculation brief

Client:	CDA Trust	**Job No.** 117100-91059	**Calculations By:** Ryan Osterman
Project:	LBCR 30% Design	**Checked By/Date:** Cody Lechleitner / 2/6/13	**Date:** 2/5/2013
Detail:	_____	**Reviewed By/Date** _____	**Calc #:** 1
			Revision No./Date: 0

Calculation Brief Title: LBCR Design Storm Intensities (Rain on Snow)

1.0 Purpose/Objective:

This documents the calculations for the peak storm intensities for the 25-year, 24-hour and 100-year, 1-hour rain events, both causing a 100-year melt event for the LBCR 30% design.

2.0 Procedure: Outline the steps followed and approach.

1. Collect snow water equivalence data from the Humboldt Snotel site of Idaho for the water years of 1982 to 2012 to calculate the 100-year peak melt event.
2. Locate equation for the 1 hour 100 year rain event for Idaho Region 2 and identify and quantify the variables- i.e. obtain data for the 6 and 24 hour 100 year rain events and the general elevation for the general area of the site (NOAA, 1973) (Google).
3. Interpolate the 25-year, 24-hour precipitation amount from the NOAA Atlas 2 isopluvials (see Appendix A).
4. Calculate the combined 25-year, 24-hour rain and 100-year snowmelt (rain-on-snow) intensity to use in the design of temporary stormwater controls.
5. Calculate the combined 100-year, 1-hour rain and 100-year snowmelt (rain-on-snow) intensity to use in the design of permanent stormwater controls.

3.0 References/Data Sources:

1. NOAA (1973), NOAA Atlas 2, Precipitation-Frequency Atlas of the Western United States, Volume 5-Idaho, 1973
2. Google Earth, Accessed July 31, 2012
3. NRCS (2012) NRCS National Water and Climate Center Idaho Snotel Map, Accessed July 23, 2012, <http://www.wcc.nrcs.usda.gov/snotel/Idaho/idaho.html>
4. Devore, Jay. *Applied Statistics for Engineers and Scientists*. Pacific Grove, California: Brooks/Cole Publishing Company, 1999. Print.

4.0 Assumptions and Limitations:

A. List assumptions and basis.

1. Reliable sources for equations and data- i.e. (NOAA Atlas, Google Earth-elevation data)
2. Loss in snow water equivalence is due to snow melt
3. Snow melt occurs over a 12 hour window of warmth (daylight hours)
4. Rainfall intensity is assumed to be of even intensity throughout the storm.

5.0 Calculations:

1. Collect snow water equivalence data from the Humboldt Snotel site in Idaho for the water years of 1982 to 2012 to calculate the 100-year peak melt event (NRCS, 2012).

Water Year	Max Melt (in.)	Log Max Melt (in.)
1982	1.1	0.0414
1983	1.0	0.0000
1984	0.8	-0.0969
1985	1.3	0.1139
1986	1.2	0.0792
1987	1.1	0.0414
1988	0.3	-0.5229
1989	1.5	0.1761
1990	1.4	0.1461
1991	0.9	-0.0458
1992	0.7	-0.1549
1993	1.3	0.1139
1994	1.3	0.1139
1995	4.2	0.6232
1996	0.6	-0.2218
1997	1.1	0.0414

Water Year	Max Melt (in.)	Log Max Melt (in.)
1998	0.7	-0.1549
1999	1.1	0.0414
2000	0.8	-0.0969
2001	0.9	-0.0458
2002	1.2	0.0792
2003	0.6	-0.2218
2004	0.8	-0.0969
2005	0.5	-0.3010
2006	0.6	-0.2218
2007	0.5	-0.3010
2008	1.3	0.1139
2009	0.9	-0.0458
2010	0.7	-0.1549
2011	1.2	0.0792
2012	1.0	0.0000

Using the data above to calculate the average peak snowmelt and assuming that snowmelt follows a Log-Pearson Type III (LPIII) distribution, it then becomes possible to calculate the 100-year melt event using the following equation (Devore).

$$X_{100} = 10^{Z*SD+\mu}$$

Where:
X_{100} = 100 year melting event in inches
Z = value associated with an exceedance value of .01 and a skew value of .5
SD = standard deviation of the log peak snowmelts from water years 1982 to 2012
μ= average log value of snowmelt for water years 1982 to 2012

Description	Max Melt (in.)
AVERAGE	-0.0283496
STDEV	0.200184
SKEW	0.5
Z value	2.68572

Description	Value
100 Year Event	3.231

Because the available data does not span a significant time period, the highest recorded value of snowmelt (4.2 inches) will be used as a conservative value moving forward.

2. Locate equation for the 1 hour 100 year rain event for Idaho Region 2 and identify and quantify the variables- i.e. obtain data for the 6 and 24 hour 100 year rain events and the general elevation for the general area of the site (NOAA, 1973) (Google)

Using an equation from the NOAA Atlas and quantifying the variables using the precipitation-frequency maps provided in the atlas and Google Earth, it is possible to calculate the intensity of a 1 hour 100 year rain event.

$$Y_{100} = 0.338 + 0.670\left[(X_3)\left(\frac{X_3}{X_4}\right)\right] + 0.001Z$$

Where:
Y_{100}= 100 year 1 hour estimated value
X_3=100 year 6 hour value from precipitation-frequency maps
X_4=100 year 24 hour value from precipitation-frequency maps
Z= point elevation in hundreds of feet

Variable	Value
X_3	2.12 inches
X_4	4.27 inches
Z	30.3 Hundred feet

It has been established that there is a standard error of approximately .141 inches with the value that is produced with this equation. In order to obtain a conservative value for Y_{100}, the standard error of .141 inches will be added to the value produced in the equation becoming $Y_{100conservative}$.

Variable	Value
Y_{100}	1.21 Inches
$Y_{100conservative}$	1.36 Inches

3. Interpolate the 25-year, 24-hour precipitation amount from the NOAA Atlas 2 isopluvials (see Appendix A).

From Figure 28 (Appendix A) the 25-year, 24-hour precipitation amount is estimated to be 3.47 inches.

4. Calculate the combined 25-year, 24-hour rain and 100-year snowmelt (rain-on-snow) intensity to use in the design of temporary stormwater controls.

$$i\ (in/hr) = precip\ amount\ (in)/time\ (hr)$$

25 Year 24 Hour Storm Event		
Type	Total (in)	Intensity (in/hr)
Precip	3.47	0.145
Melt	4.20	0.350
Sum	7.67	0.495

5. Calculate the combined 100-year, 1-hour rain and 100-year snowmelt (rain-on-snow) intensity to use in the design of permanent stormwater controls.

$$i\ (in/hr) = precip\ amount\ (in)/time\ (hr)$$

100 Year 1 Hour Storm Event		
Type	Total (in)	Intensity (in/hr)
Precip	1.36	1.360
Melt	4.20	0.350
Sum	5.56	1.710

6.0 Conclusions/Results:

A. List results concisely and tie back to 1.0 Purpose/Objective.

1. The combined 25-year, 24-hour rain and 100-year snowmelt (rain-on-snow) intensity is estimated to be 0.495 in/hr.

2. The combined 100-year, 1-hour rain and 100-year snowmelt (rain-on-snow) intensity is estimated to be 1.710 in/hr.

7.0 Appendices:

Appendix A: Figure 28 (NOAA 1973)

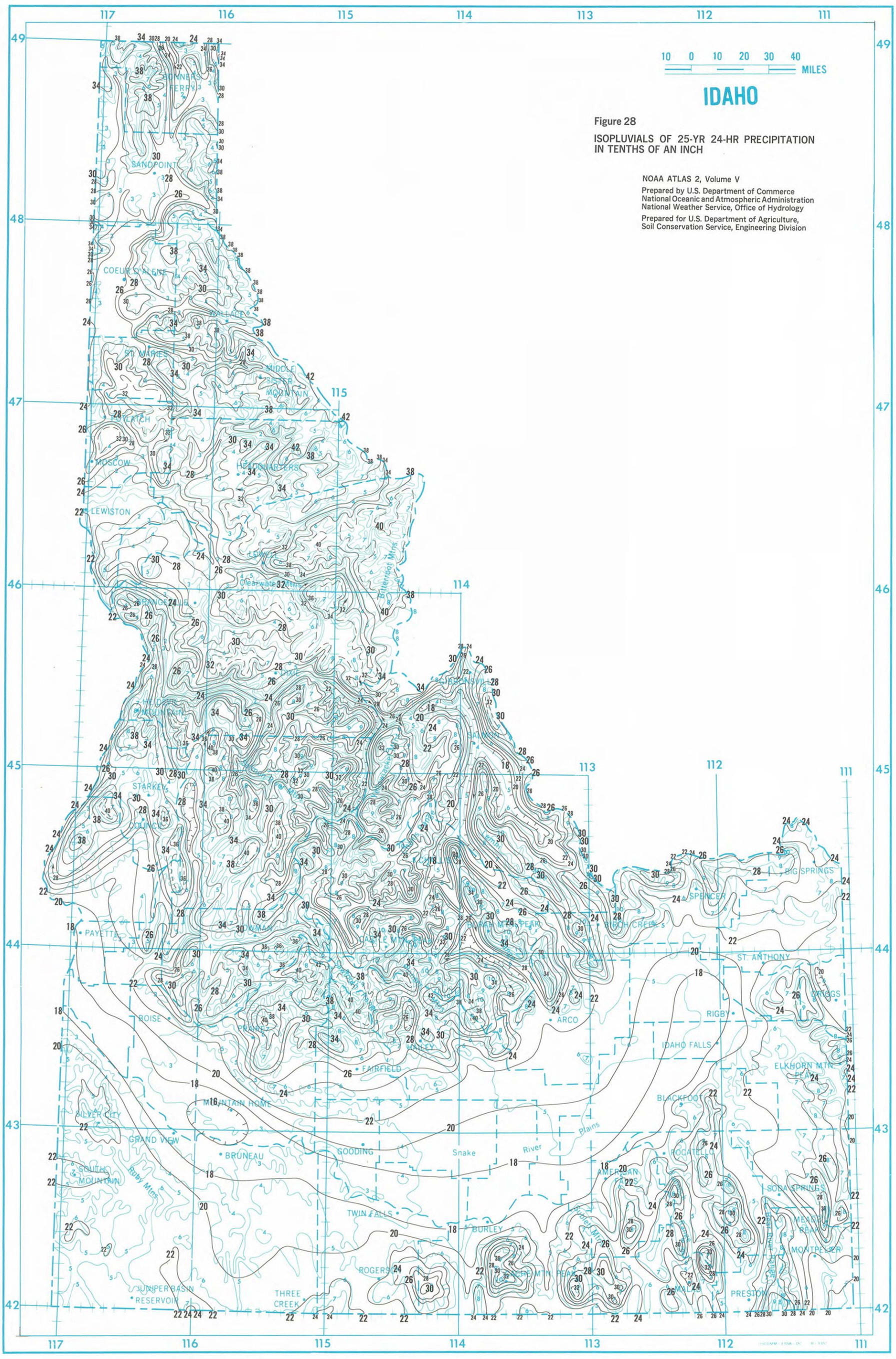

Figure 28

ISOPLUVIALS OF 25-YR 24-HR PRECIPITATION IN TENTHS OF AN INCH

NOAA ATLAS 2, Volume V

Prepared by U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service, Office of Hydrology

Prepared for U.S. Department of Agriculture,
Soil Conservation Service, Engineering Division

Appendix J

ARAR Summary Tables

CDM Smith

Table 13-1

Chemical Specific ARARs and TBCs for Human Health and Ecological Receptors in the Upper Basin Record of Decision (ROD) Amendment, Upper Basin of the Cour d'Alene River, Waste Consolidation Area (WCA)

Citation	Summary of Requirements	Evaluation	Regulatory Description	Design Basis Document
Groundwater				
Idaho Water Quality Standards and Wastewater Treatment Requirements (IDAPA 58.01.02)	**Designates uses of waters of the state and water quality standards protective of those uses. This regulation adopts water quality criteria for individual chemicals based on protection of beneficial uses.**	**Applicable where more stringent than federal water quality standards, and as they apply to the operation of and discharges from remedial activities that involve the collection, treatment, and discharge of groundwater and surface water.**		
IDAPA 58.01.02.051	Water Quality Standards: Antidegredation Policy	The Idaho Water Quality Standards are applicable to the groundwater and surface water that will monitored to assess antidegredation of water quality from the WCA operations.	Relates to the maintenance of existing water quality and existing water uses.	
IDAPA 58.01.02.070.03	Water Quality Standards: Application of Standards: Application of Standards to Point Source Discharges	The Idaho Water Quality Standards are applicable if point source discharges occur from the construction or operation of the WCA.	Identifies the application of standards to point source discharges will be in accordance with Sections 400 and 401.	
IDAPA 58.01.02.080.01	Water Quality Standards: Violation of Water Quality Standards: Discharges Which Result in Water Quality Standards Violation	The Idaho Water Quality Standards are applicable if discharges occur from the construction or operation of the WCA.	Identifies pollution discharge restrictions such as no pollutant shall be discharged in concentrations o in a manner that will or can be expected to result in violation of water quality standards applicable to the receiving water body or downstream waters; or will injure designated or existing beneficial uses.	
IDAPA 58.01.02.080.03	Water Quality Standards: Violation of Water Quality Standards: Temperature Exemption	The Idaho Water Quality Standards are applicable if discharges occur from the construction or operation of the WCA.	Provides temperature exemption criteria for Section 250 (Surface Water Quality Criteria for Aquatic Life Use Designations). Exemption if temperature exceeds criteria set forth in Section 250 on a day where the air temperature exceeds the 90th percentile of a yearly series of the maximum weekly maximum air temperature calculated over the historic record measured at the nearest weather station.	
IDAPA 58.01.02.090	Water Quality Standards: Analytical Procedures	The Idaho Water Quality Standards are applicable if discharges occur from the construction or operation of the WCA.	Identifies chemical and physical, metals, and biological procedures to follow when determining compliance with standards.	
IDAPA 58.01.02.110.10	Water Quality Standards: Panhandle Basin: South Fork Coeur d'Alene Subbasin	The Idaho Water Quality Standards are applicable if discharges occur from the construction or operation of the WCA.	The nearest water body to the WCA site is Ninemile Creek that discharges into the South Fork of the Coeur d'Alene River near the city of Wallace. This section provides a hydrologic unit code (HUC) index for the South Fork Coeur d'Alene Subbasin (HUC 17010302). It also provides the aquatic life and recreation surface water uses for the water body units within the subbasin. Ninemile Creek that flows adjacent to the WCA site is identified as unit P-14 and the aquatic life beneficial use is COLD and the recreation beneficial use is secondary contact recreation (SCR).	
IDAPA 58.01.02.210.01(a) and (b); IDAPA 58.01.02.210.02; IDAPA 58.01.02.210.03 (c) i, ii, iii, and v; IDAPA 58.01.02.210.04; and IDAPA 58.01.02.210.05	Water Quality Standards: Numeric Criteria for Toxic Substances for Waters Designated for Aquatic Life, Recreation, or Domestic Water Supply Use	The Idaho Water Quality Standards are applicable if discharges occur from the construction or operation of the WCA.	Establishes numeric criteria for toxic substances (e.g., Sb, As, Cd, Pb, Zn) for water designated for aquatic life and recreation use (e.g., Coeur d'Alene River) pursuant to 40 CFR 131.36 (Toxics Criteria for those states not complying with Clean Water Act Section 303(c)(2)(B)).	
IDAPA 58.01.02.250.01; IDAPA 58.01.02.250.02(a), (b), (e), (f), and (g)	Water Quality Standards: Surface Water Quality Criteria for Aquatic Life Use Designations	The Idaho Water Quality Standards are applicable if surface water discharges occur from the construction or operation of the WCA.	Establishes criteria for surface water quality designated for aquatic life use. More specifically, cold water aquatic life criteria including criteria for dissolved oxygen, water temperature, turbidity, and salmonoid spawning	
IDAPA 58.01.02.251	Water Quality Standards: Surface Water Quality Criteria for Recreation Use Designations	The Idaho Water Quality Standards are applicable if surface water discharges occur from the construction or operation of the WCA.	Establishes criteria for surface water quality designated for recreation use. More specifically, criteria for E. Coli Bacteria.	
IDAPA 58.01.02.260	Water Quality Standards: Variances from Water Quality Standards	The Idaho Water Quality Standards are applicable if discharges occur from the construction or operation of the WCA.	Specifies variance requirements (e.g., meeting the standard is unattainable based on the grounds that naturally occurring pollutant concentrations prevent the attainment of the standard).	
IDAPA 58.01.02.400.01; IDAPA 58.01.02.400.02 (a); IDAPA 58.01.02.400	Water Quality Standards: Rules Governing Point Source Discharges	The Idaho Water Quality Standards are applicable if point source discharges occur from the construction or operation of the WCA.	Identifies the implementation policy (i.e., failure to meet general or specific water quality criteria is a violation of water quality standards and no new point source can discharge pollutants to a special resource water if pollutants will result in the degradation of ambient water quality). Also, provides limitations to point source restrictions (i.e., point source discharge regulated by NPDES permit will not be subject to additional restrictions).	
IDAPA 58.01.02.401.01 (a),(b),(d), and (e); IDAPA 58.01.02.401.02	Water Quality Standards: Point Source Wastewater Treatment Requirements	The Idaho Water Quality Standards are applicable if point source discharges occur from the construction or operation of the WCA.	Specifies temperature and turbidity requirements for wastewaters discharged to surface waters.	
Idaho Rules for Public Drinking Water Systems (IDAPA 58.01.08)	**Adopts national primary drinking water regulations that are no less stringent than the federal regulations in effect under 40 CFR Part 141. These rules provide a degree of assurance that public systems that use wither groundwater or surface water are protected from contamination and maintained free form contaminants.**	**Surface water and groundwater may be used as drinking water within areas of the Upper Basing and, to the extent that the Idaho Rules for Public Drinking Water Systems are more stringent than federal law, they are relevant and appropriate for the Upper Basin. However, because the Selected Remedy is an interim remedy that is not intended to fully address surface water and groundwater contamination, the Idaho Rules for Public Drinking Water Systems are outside the scope of and need not be attained by, the Selected Remedy.**		
IDAPA 58.01.08.050.01 (a)(b)	Maximum Contaminant Levels (MCLs) and Maximum Residual Disinfectant Levels: Inorganic Contaminants	The requirements of Idaho's MCL's are relevant and appropriate to assess groundwater quality impacts from WCA operations.	40 CFR 141.11 and 40 CFR 141.62 are incorporated by reference. 40 CFR 141.11 and 40 CFR 141.62 establish MCLs for inorganic metals and nitrate	
IDAPA 58.01.08.250.02	Maximum Contaminant Level Goals and Maximum Residual Disinfection Level Goals: Inorganic Contaminants	The requirements of Idaho's MCL's are relevant and appropriate to assess groundwater quality impacts from WCA operations.	40 CFR 141.51 is herein incorporated by reference. 40 CFR 141.51 establishes MCLGs for inorganic metals and nitrate.	
IDAPA 58.01.08.350.01	Control of Lead and Copper	The requirements of Idaho's copper and lead in tap water are relevant and appropriate to assess groundwater quality impacts from WCA operations.	40 CFR 141.80, revised as of July 1, 2000, is herein incorporated by reference. 40 CFR 141.8 establishes the action level for lead in tap water	
IDAPA 58.01.08.400.03	Secondary MCLs: Secondary Maximum Contaminant Levels	The requirements of Idaho's secondary MCL's are relevant and appropriate to assess groundwater quality impacts from WCA operations.	40 CFR 143.3 is incorporated by reference. 40 CFR 143.3 establishes the secondary MCLs for chloride, sulfate, and zinc	
Safe Drinking Water Act(SDWA) of 1974 (42 USC 300(f)et seq). National Primary Drinking Water Standards, 40 CFR 141.61 and Maximum Contaminant levels for Inorganic Contaminants, 40 CFR 141.62	**Establishes maximum contaminant levels (MCLs) as criteria for groundwater and surface water that are or may be used for drinking water. The standards are designed to protect human health from the adverse effects of organic contaminants in the drinking water.**	**Surface water and ground water may be used as drinking water within areas of the Upper Basin, and the SDWA, the National Primary Drinking Water Standards, and the MCLs for inorganic contaminants are relevant and appropriate for the Upper Basin. However, because the Selected Remedy is an interim remedy that is not intended to fully address surface water and groundwater contamination, the SWDA and indentified regulations are outside the scope of, and need not be attained by, the Selected Remedy.**		
42 USC 300f	Definitions	The definitions are relevant and appropriate to the operations of the WCA.	Provides definitions for terms used in IDAPA 58.01.08 and 40 CFR Part 141 and 143	
40 CFR Part 141.11 (a and b)	Maximum Contaminant Levels for Inorganic Chemicals	The federal SDWA MCLs for inorganic chemicals are not applicable as the affected aquifer beneath the WCA is not used for public water drinking water systems. They are relevant and appropriate to the groundwater monitoring wells at the site.	Identifies that the MCL for arsenic will be 0.05 mg/L for community water systems until January 23, 2006 (see 66 FR 7061).	

Citation	Summary of Requirements	Evaluation	Regulatory Description	Design Basis Document
40 CFR Part 141.51(b)	Maximum Contaminant Level Goals for Inorganic Contaminants	The federal SDWA MCLs for inorganic chemicals are not applicable as the affected aquifer beneath the WCA is not used for public water drinking water systems. They are relevant and appropriate to the groundwater monitoring wells at the site.	Identifies the MCLGs for the following constituents: Antimony (0.006 mg/L) Arsenic (0 mg/L); value effective Jan. 23, 2006 Cadmium (0.005 mg/L) Lead (0 mg/L) Nitrate as N (10 mg/L)	
40 CFR Part 141.61(a)	National Primary Drinking Water Regulations: Maximum Contaminant Levels and Maximum Residual Disinfectant Levels; Maximum Contaminant Levels for Organic Contaminants	The federal SDWA MCLs for organic chemicals are not applicable as the affected aquifer beneath the WCA is not used for public water drinking water systems. They are relevant and appropriate to the groundwater monitoring wells at the site.	Provides the following maximum contaminant levels for organic contaminants as they apply to community and non-transient, non-community water systems. Identifies the MCLs for the following constituents: Benzene (0.005 mg/L) Vinyl Chloride (0.002 mg/L) Carbon Tetra Chloride (0.005 mg/L) Trichloroethylene (0.005 mg/L) Toluene (1 mg/L)	
40 CFR Part 141.62(b)	National Primary Drinking Water Regulations: Maximum Contaminant Levels and Maximum Residual Disinfectant Levels; Maximum Contaminant Levels for Inorganic Contaminants	The federal NPDWR MCLs for inorganic chemicals are not applicable as the affected aquifer beneath the WCA is not used for public water drinking water systems. They are relevant and appropriate to the groundwater monitoring wells at the site.	Provides the maximum contaminant levels for inorganic contaminants as they apply to community water systems and non-transient, non-community water systems. Identifies the MCLs for the following constituents: Antimony (0.006 mg/L) Arsenic (0.010 mg/L) Cadmium (0.005 mg/L) Mercury (0.002 mg/L) Selenium (0.05 mg/L) Chromium (01. mg/L)	
40 CFR Part 141.80 (c)(1) and (c)(2)	National Primary Drinking Water Standards, Control of Lead and Copper: General Requirements: Lead and Copper Action Levels	The federal NPDWR MCLs for inorganic chemicals are not applicable as the affected aquifer beneath the WCA is not used for public water drinking water systems. They are relevant and appropriate to the groundwater monitoring wells at the site.	Identifies the action level for lead as 0.015 mg/L (e.g., if the "90th percentile" lead level is greater than 0.015 mg/L). Identifies the action level for copper as 1.3 mg/L (i.e. , if the “90th percentile” copper level is greater than 1.3 mg/L).	
40 CFR Part 143.3	National Secondary Drinking Water Regulations, Secondary Maximum Contaminant Levels	The federal NSDWR MCLs for inorganic chemicals are not applicable as the affected aquifer beneath the WCA is not used for public water drinking water systems. They are relevant and appropriate to the groundwater monitoring wells at the site.	Identifies the secondary MCLs for the following: Chloride (250 mg/L) Sulfate (250 mg/L) Zinc (5 mg/L) Iron (0.3 mg/L) Manganese (0.05 mg/L) Silver (0.1 mg/L)	
Surface Water				
Idaho Water Quality Standards and Wastewater Treatment Requirements-Salmonoid Sight Feeding Standard (IDAPA 58.01.02.250 and 284)	**This standard (50 NT acute and 25 NT chronic above background) is often used to assess the effectiveness of erosion abatement efforts. South Fork Coeur d'Alene River subbasin aquatic life criteria for cadmium, lead, and zinc.**	**Applicable where more stringent that federal water quality standards, and as they apply to the operation of and discharges from remedial activities that involve the collection, treatment, and discharge of groundwater and surface water. In addition, these standards, to the extent that they are more stringent than federal standards are relevant and appropriate as cleanup standards for surface water within the Upper Basin. However, because the Selected Remedy is an interim remedy that in not intended to fully address surface water contamination, these standards are outside the scope of, and need not be attained by, the Selected Remedy.**		
IDAPA 58.01.02.250	Surface Water Quality Criteria for Aquatic Life Use Designations	The requirements of Idaho's surface water aquatic life criteria are applicable if surface water discharges occur from the WCA.	Establishes general, cold water, seasonal cold water, warm water, and modified criteria that applies to all aquatic life use designations for surface water not varying from human activity.	
IDAPA 58.01.02.284 (01 through 04)	South Cour d'Alene Subbasin, Subsection 110.09, HUC 17010302, Aquatic Life Criteria for Cadmium, Lead, and Zinc	The requirements of the Cour d'Alene Subbasin surface water aquatic life criteria are applicable if surface water discharges occur from the WCA.	Establishes the following criteria dependent upon the hardness, expressed as mg/l of calcium carbonate, of the water. Criterion maximum concentrations (CMC), one (1) hour average concentrations, and criterion continuous concentrations (CCC), four (4) day average concentrations, of the dissolved metals (in µg/l) are not to exceed, more than once every three (3) years, the values calculated using the following equations: Cadmium: CMC = $0.973 \times e^{[(1.0166 \times \ln(\text{hardness})) - 3.924]}$ CCC = $[1.101672 - (\ln(\text{hardness}) \times 0.041838] \times e^{[(0.7852 \times \ln(\text{hardness})) - 3.490]}$ Lead: CMC = $e^{[(0.9402 \times \ln(\text{hardness})) + 1.1834]}$ CCC = $e^{[(0.9402 \times \ln(\text{hardness})) - 0.9875]}$ Zinc: CMC = $e^{[(0.6624 \times \ln(\text{hardness})) + 2.2235]}$ CCC = $e^{[(0.6624 \times \ln(\text{hardness})) + 2.2235]}$ The maximum hardness allowed for use in the equations above shall not be greater than four hundred (400) mg/l even if the actual ambient hardness is greater than four hundred (400) mg/l. The criteria described above apply to the South Fork Coeur d’Alene River subbasin, units P-11 and P-13. In addition to the waters listed in subsection 284.04.b, the criteria described in Section 284 apply to all surface waters within the subbasin, except for natural lakes, for which the statewide criteria given in Section 210 apply.	
Clean Water Act (33 USC 1251 et seg.), "Water Quality Standards, " 40 CFR 131, National Recommended Water Quality Criteria-2006	**Establishes numeric water quality criteria for the protection of human health and aquatic organisms. Toxic criteria for the protection of aquatic life are provided in the water quality criteria regulations [40 CFR 131.36(b)(1)], which supersede criteria adopted by the state except where the state criteria are more stringent than the federal criteria.**	**Relevant and appropriate as they apply to the operation of and discharges from remedial activities that involve the collection, treatment, and discharge of groundwater and surface water. In addition, these standards are relevant and appropriate as cleanup standards for surface water within the Upper Basin. However, because the Selected remedy is an interim remedy that in not intended to fully address surface water contamination, these standards are outside the scope of and need not be attained by the Selected Remedy.**		
40 CFR Part 131.1 - Scope	Federally Promulgated Water Quality Standards: Water Quality Standards	The federal water quality standards are applicable if point source discharges occur from the WCA. They are relevant and appropriate to the groundwater monitoring wells at the site.	Establishes requirements and procedures for developing, reviewing, revising, and approving water quality standards by the States as authorized by section 303(c) of the Clean Water Act.	
40 CFR Part 131.33(a)	Federally Promulgated Water Quality Standards: Water Quality Standards -Idaho	The federal water quality standards are applicable if point source discharges occur from the WCA. They are relevant and appropriate to the groundwater monitoring wells at the site.	Establishes a temperature criteria of 10 °C, expressed as an average of daily maximum temperatures over a seven-day period, to certain water bodies during the months of June, July, August and September for bull trout.	

Citation	Summary of Requirements	Evaluation	Regulatory Description	Design Basis Document
40 CFR Part 131.36(b)(1)	Federally Promulgated Water Quality Standards; Toxics criteria for those states not complying with Clean Water Act section 303(c)(2)(B).	The federal water quality standards are applicable if point source discharges occur from the WCA. They are relevant and appropriate to the groundwater monitoring wells at the site.	This section is not a general promulgation of the section 304(a) criteria for priority toxic pollutants but is restricted to specific pollutants in specific States.	
Soil				
None				
Sediment				
None				

Table 13-2

Location-Specific ARARs and TBCs for Ecological Receptor in the Upper Basin Record of Decision (ROD) Amendment, Upper Basin of the Cour d'Alene River, Waste Consolidation Area (WCA)

Citation	Summary of Requirement	Evaluation	Regulatory Discussion	Design Basis Document
Federal				
American Indian Religious Freedom Act (42 USC 1996 et seq)	**Protects religious, ceremonial, and burial sites and the free practice of religions by Native American Groups.**	**The substantive requirements are applicable to those area where remedial action is selected that include religious, ceremonial, and burial sites.**		
42 USC Section 1996 (Executive Order No. 13007 Section 1)	Protection and Preservation of Traditional Religions of Native Americans: Indian Sacred Sites: Accommodation of Sacred Sites	The requirements of the federal Protection and Preservation of Traditional Religions of Native American are applicable to the WCA.	In managing Federal lands, each executive branch agency with statutory or administrative responsibility for the management of Federal lands shall, to the extent practicable, permitted by law, and not clearly inconsistent with essential agency functions, (1) accommodate access to and ceremonial use of Indian sacred sites by Indian religious practitioners, and (2) avoid adversely affecting the physical integrity of such sacred sites. Where appropriate, agencies shall maintain the confidentiality of sacred sites.	
42 USC Section 1996 (Executive Order No. 13007 Section 2)	Protection and Preservation of Traditional Religions of Native Americans: Indian Sacred Sites: Procedures	The requirements of the federal Protection and Preservation of Traditional Religions of Native American are applicable to the WCA.	Each executive branch agency with statutory or administrative responsibility for the management of Federal lands shall, as appropriate, promptly implement procedures for the purposes of carrying out the provisions of section 1 of this order, including, where practicable and appropriate, procedures to ensure reasonable notice is provided of proposed actions or land management policies that may restrict future access to or ceremonial use of, or adversely affect the physical integrity of, sacred sites.	
Native American Graves Protection and Repatriation Act (25 USC 3001 et seq., 43 CFR 10)	**Protects Native American burial sites and funerary objects. If Native American graves are discovered within remediation areas, project activities must cease and consultation must take place with the affected Tribe. Covered objects may be repatriated by the tribe.**	**The substantive requirements are applicable to those areas where remedial action is selected that includes Native American burial sites and funerary objects.**		
25 USC Section 3001 (a)(b)	Native American Graves Protection and Repatriation Act	The requirements of the federal Native American Greaves Protection and Repatriation Act are applicable to the WCA.	Establishes short title and definitions	
25 USC Section 3002 (d)	Ownership: Inadvertent Discovery of Native American Remains and Objects	The requirements of the federal Inadvertent Discovery of Native American Remains and Objects are applicable to the WCA.	If the discovery occurred in connection with an activity, including (but not limited to) construction, mining, logging, and agriculture, the person shall cease the activity in the area of the discovery, make a reasonable effort to protect the items discovered before resuming such activity, and provide notice under this subsection. Following the notification under this subsection, and upon certification by the Secretary of the department or the head of any agency or instrumentality of the United States or the appropriate Indian tribe or Native Hawaiian organization that notification has been received, the activity may resume after 30 days of such certification.	
43 CFR Part 7 Subpart A Section 7.1	Protection of Archaeological Resources: Uniform Regulations: Purpose	The requirements of the federal Protection of Archaeological Resources Uniform Regulation are applicable to the WCA.	The regulations in this part implement provisions of the Archaeological Resources Protection Act of 1979, as amended (16 U.S.C. 470aa–mm) by establishing the uniform definitions, standards, and procedures to be followed by all Federal land managers in providing protection for archaeological resources, located on public lands and Indian lands of the United States.	
43 CFR Part 7 Subpart A Section 7.4	Protection of Archaeological Resources: Uniform Regulations: Prohibited Acts and Criminal Penalties	The requirements of the federal Protection of Archaeological Resources Uniform Regulation are applicable to the WCA.	Under section 6(a) of the Act, no person may excavate, remove, damage, or otherwise alter or deface, or attempt to excavate, remove, damage, or otherwise alter or deface any archaeological resource located on public lands or Indian lands unless such activity is pursuant to a permit issued under § 7.8 or exempted by § 7.5(b) of this part.	
43 CFR Part 7 Subpart A Section 7.5(a)	Protection of Archaeological Resources: Uniform Regulations: Permit Requirements and Exceptions	The requirements of the federal Protection of Archaeological Resources Uniform Regulation are applicable to the WCA.	Any person proposing to excavate and/or remove archaeological resources from public lands or Indian lands, and to carry out activities associated with such excavation and/or removal, shall apply to the Federal land manager for a permit for the proposed work, and shall not begin the proposed work until a permit has been issued.	
43 CFR Part 7 Subpart A Section 7.5(b)	Protection of Archaeological Resources: Uniform Regulations: Permit Requirements and Exceptions	The requirements of the federal Protection of Archaeological Resources Uniform Regulation are applicable to the WCA.	No permit shall be required under this part for any person conducting activities on the public lands under other permits, leases, licenses, or entitlements for use, when those activities are exclusively for purposes other than the excavation and/or removal of archaeological resources, even though those activities might incidentally result in the disturbance of archaeological resources.	
43 CFR Part 7 Subpart A Section 7.6	Protection of Archaeological Resources: Uniform Regulations: Application for Permits and Information Collection	The requirements of the federal Protection of Archaeological Resources Uniform Regulation are applicable to the WCA.	Any person may apply to the appropriate Federal land manager for a permit to excavate and/or remove archaeological resources from public lands or Indian lands and to carry out activities associated with such excavation and/or removal. This regulation also establishes permit application requirements such as the application must include a statement of the nature and extent of work proposed, a location map, and the name of the individual proposed to be responsible for the work and evidence of their ability to initiate, conduct and, complete the work.	
43 CFR Part 7 Subpart A Section 7.7	Protection of Archaeological Resources: Uniform Regulations: Notification to Indian Tribes of Possible Harm to, or Destruction of, Sites on Public Lands having Religious or Cultural Importance	The requirements of the federal Protection of Archaeological Resources Uniform Regulation are applicable to the WCA.	If the issuance of a permit under this part may result in harm to, or destruction of, any Indian tribal religious or cultural site on public lands, as determined by the Federal land manager, at least 30 days before issuing such a permit the Federal land manager shall notify any Indian tribe which may consider the site as having religious or cultural importance.	
43 CFR Part 7 Subpart A Section 7.8	Protection of Archaeological Resources: Uniform Regulations: Issuance of Permits	The requirements of the federal Protection of Archaeological Resources Uniform Regulation are applicable to the WCA.	The Federal land manager may issue a permit, for a specified period of time appropriate to the work to be conducted, upon determining that the applicant is appropriately qualified, as evidenced by training, education, and/or experience, and possesses demonstrable competence in archaeological theory and methods, and in collecting, handling, analyzing, evaluating, and reporting archaeological data, relative to the type and scope of the work proposed, and also meets a set of minimum qualifications.	

Citation	Summary of Requirements	Evaluation	Regulatory Description	Design Basis Document
43 CFR Part 10 Subpart B Section 10.5 (b) (1)	Native American Graves Protection and Repatriation Regulations: Initiation of Consultation	The requirements of the federal Native American Graves Protection and Repatriation Regulations are applicable to the WCA.	Upon receiving notice of, or otherwise becoming aware of, an inadvertent discovery or planned activity that has resulted or may result in the intentional excavation or inadvertent discovery of human remains, funerary objects, sacred objects, or objects of cultural patrimony on Federal lands, the responsible Federal agency official must, as part of the procedures described in § § 10.3 and 10.4 take appropriate steps to identify the lineal descendant, Indian tribe, or Native Hawaiian organization entitled to custody of the human remains, funerary objects, sacred objects, or objects of cultural patrimony pursuant to § 10.6 and § 10.14.	
43 CFR Part 10 Subpart B Section 10.5 (b) (2)	Native American Graves Protection and Repatriation Regulations: Initiation of Consultation	The requirements of the federal Native American Graves Protection and Repatriation Regulations are applicable to the WCA.	The Federal agency official must provide a notice which includes a proposed time and place for meetings or consultation to further consider the intentional excavation or inadvertent discovery, the Federal agency's proposed treatment of the human remains, funerary objects, sacred objects, or objects of cultural patrimony that may be excavated, and the proposed disposition of any intentionall excavated or inadvertently discovered human remains, funerary objects, sacred objects, or objects of cultural patrimony.	
43 CFR Part 10 Subpart B Section 10.5 (c)	Native American Graves Protection and Repatriation Regulations: Provision of Information	The requirements of the federal Native American Graves Protection and Repatriation Regulations are applicable to the WCA.	During the consultation process, as appropriate, the Federal agency official must provide, in writing, a list of all lineal descendants and Indian tribes or Native Hawaiian organizations that are being, or have been, consulted and an indication that additional documentation used to identify affiliation will be supplied upon request to the lineal descendants and the officials of Indian tribes or Native Hawaiian organizations that are or are likely to be affiliated with the human remains, funerary objects, sacred objects, or objects of cultural patrimony excavated intentionally or discovered inadvertently on Federal lands.	
43 CFR Part 10 Subpart B Section 10.5 (d)	Native American Graves Protection and Repatriation Regulations: Requests for Information	The requirements of the federal Native American Graves Protection and Repatriation Regulations are applicable to the WCA.	During the consultation process, Federal agency officials must request, as appropriate, the following information from Indian tribes or Native Hawaiian organizations that are, or are likely to be, affiliate pursuant to § 10.6 (a) with intentionally excavated or inadvertently discovered human remains, funerary objects, sacred objects, or objects of cultural patrimony. (1) Name and address of the Indian tribe official to act as representative in consultations related to particular human remains, funerary objects, sacred objects, or objects of cultural patrimony; (2) Names and appropriate methods to contact lineal descendants who should be contacted to participate in the consultation process; (3) Recommendations on how the consultation process should be conducted; and (4) Kinds of cultural items that the Indian tribe or Native Hawaiian organization considers likely to be unassociated funerary objects, sacred objects, or objects of cultural patrimony.	
43 CFR Part 10 Subpart A Section 10.5 (e)	Native American Graves Protection and Repatriation Regulations: Written Plan of Action	The requirements of the federal Native American Graves Protection and Repatriation Regulations are applicable to the WCA.	Following consultation, the Federal agency official must prepare, approve, and sign a written plan of action. A copy of this plan of action must be provided to the lineal descendants, Indian tribes and Native Hawaiian organizations involved. Lineal descendants and Indian tribe official(s) may sign the written plan of action as appropriate. At a minimum, the plan of action must comply with § 10.3 (b)(1) and document the criteria listed in this section.	
43 CFR Part 10 Subpart A Section 10.5 (f)	Native American Graves Protection and Repatriation Regulations: Comprehensive Agreements	The requirements of the federal Native American Graves Protection and Repatriation Regulations are applicable to the WCA.	Whenever possible, Federal Agencies should enter into comprehensive agreements with Indian tribes or Native Hawaiian organizations that are affiliated with human remains, funerary objects, sacred objects, or objects of cultural patrimony and have claimed, or are likely to claim, those human remains, funerary objects, sacred objects, or objects of cultural patrimony excavated intentionally or discovered inadvertently on Federal lands.	
43 CFR Part 10 Subpart A Section 10.6 (a)	Native American Graves Protection and Repatriation Regulations: Custody: Priority of Custody	The requirements of the federal Native American Graves Protection and Repatriation Regulations are applicable to the WCA.	This section relates to the custody of human remains, funerary objects, sacred objects, or objects of cultural patrimony excavated intentionally or discovered inadvertently in Federal or tribal lands after November 16, 1990. For the purposes of this section, custody means ownership or control of human remains, funerary objects, sacred objects, or objects of cultural patrimony excavated intentionally or discovered inadvertently in Federal or tribal lands after November 16, 1990.	
43 CFR Part 10 Subpart A Section 10.6 (b)	Native American Graves Protection and Repatriation Regulations: Custody	The requirements of the federal Native American Graves Protection and Repatriation Regulations are applicable to the WCA.	Custody of human remains, funerary objects, sacred objects, or objects of cultural patrimony and other provisions of the Act apply to all intentional excavations and inadvertent discoveries made afte November 16, 1990, including those made before the effective date of these regulations.	
43 CFR Part 10 Subpart A Section 10.6 (c)	Native American Graves Protection and Repatriation Regulations: Custody: Final Notice, Claims, and Disposition with Respect to Federal Lands	The requirements of the federal Native American Graves Protection and Repatriation Regulations are applicable to the WCA.	Upon determination of the lineal descendant, Indian tribe, or Native Hawaiian organization that under these regulations appears to be entitled to custody of particular human remains, funerary objects, sacred objects, or objects of cultural patrimony excavated intentionally or discovered inadvertently on Federal lands, the responsible Federal agency official must, subject to the notice required herein and the limitations of § 10.15, transfer custody of the objects to the lineal descendant Indian tribe, or Native Hawaiian organization following appropriate procedures, which must respect traditional customs and practices of the affiliated Indian tribes or Native Hawaiian organizations in each instance.	
National Historic Preservation Act [16 USC 470 et seq,; 36 CFR Parts 60,63, 800; 40 CFR 6.301(b)]	**Federal agencies must identify possible effects of proposed remedial activities on historic properties (cultural resources). If historic properties or landmarks eligible for, or include in, the National Register of Historic Places exist within remediation areas, remediation activities must be designed to minimize the effect on such properties or landmarks.**	**The substantive requirements are applicable to those areas where remedial actions are undertaken that include historic properties, cultural resources, or landmarks that are eligible for, or included in, the National Register of Historic Places.**		
16 USC Section 470aa	Chapter 1B Archaeological Resources Protection: Congressional Findings and Declaration of Purpose	The requirements of the federal Archaeological Resources Protection are applicable to the WCA.	The purpose of this chapter is to secure, for the present and future benefit of the American people, the protection of archaeological resources and sites which are on public lands and Indian lands, and to foster increased cooperation and exchange of information between governmental authorities, the professional archaeological community, and private individuals having collections of archaeological resources and data which were obtained before October 31, 1979.	

Citation	Summary of Requirements	Evaluation	Regulatory Description	Design Basis Document
16 USC Section 470cc	Chapter 1B Archaeological Resources Protection: Excavation and Removal	The requirements of the federal Archaeological Resources Protection are applicable to the WCA.	Any person may apply to the Federal land manager for a permit to excavate or remove any archaeological resource located on public lands or Indian lands and to carry out activities associated with such excavation or removal. The application shall be required, under uniform regulations under this chapter, to contain such information as the Federal land manager deems necessary, including information concerning the time, scope, and location and specific purpose of the proposed work.	
16 USC Section 470hh	Chapter 1B Archaeological Resources Protection: Confidentiality of Information Concerning Nature and Location of Archaeological Resources	The requirements of the federal Archaeological Resources Protection are applicable to the WCA.	Information concerning the nature and location of any archaeological resource for which the excavation or removal requires a permit or other permission under this chapter or under any other provision of Federal law may not be made available to the public under subchapter II of chapter 5 of title 5 or under any other provision of law unless the Federal land manager concerned determines tha such disclosure would-- (1) further the purposes of this chapter or the Act of June 27, 1960 (16 U.S.C. 469-469c) [16 U.S.C. 469-469c-1], and (2) not create a risk of harm to such resources or to the site at which such resources are located.	
16 USC Section 470f	Chapter 1A Historic Sites, Buildings, Objects, and Antiquities: Subchapter II National Historic Preservation: Part A Programs: Effect of Federal undertakings upon property listed in National Register; comment by Advisory Council on Historic Preservation	The requirements of the federal Historic Sites, Buildings, Objects, and Antiquities, National Historic Preservation, Effect of Federal undertakings upon property listed in National Register are applicable to the WCA.	The head of any Federal agency having direct or indirect jurisdiction over a proposed Federal or federally assisted undertaking in any State and the head of any Federal department or independent agency having authority to license any undertaking shall, prior to the approval of the expenditure of any Federal funds on the undertaking or prior to the issuance of any license, as the case may be, take into account the effect of the undertaking on any district, site, building, structure, or object that is included in or eligible for inclusion in the National Register. The head of any such Federal agency shall afford the Advisory Council on Historic Preservation established under part B of this subchapte a reasonable opportunity to comment with regard to such undertaking.	
36 CFR Part 60.2 (a)	National Park Service, Department of the Interior: National Register of Historic Places: Effects of Listing Under Federal Law	The requirements of the federal National Park Service, Department of the Interior National Register of Historic Places are applicable to the WCA.	Federal agencies undertaking a project having an effect on a listed or eligible property must provide the Advisory Council on Historic Preservation a reasonable opportunity to comment pursuant to section 106 of the National Historic Preservation Act of 1966, as amended.	
36 CFR Part 60.4	National Park Service, Department of the Interior: National Register of Historic Places: Criteria for Evaluation	The requirements of the federal National Park Service, Department of the Interior National Register of Historic Places are applicable to the WCA.	Identifies criteria that must be applied to evaluate properties (other than areas of the National Park System and National Historic Landmarks) for the National Register. The criteria shall be used in evaluating properties for nomination to the National Register, by NPS in reviewing nominations, and for evaluating National Register eligibility of properties.	
36 CFR Part 60.6	National Park Service, Department of the Interior: National Register of Historic Places: Nominations by the State Historic Preservation Officer under approved State Historic Preservation Programs	The requirements of the federal National Park Service, Department of the Interior National Register of Historic Places are applicable to the WCA.	The State Historic Preservation Office (SHPO) is responsible for identifying and nominating eligible properties to the National Register. All nominations from the State shall be submitted in accord with the State priorities, which shall be consistent with an approved State historic preservation plan. The State shall consult with local authorities in the nomination process. The State notice also gives owners of private property an opportunity to concur in or object to listing.	
36 CFR Part 63	National Park Service, Department of the Interior: Determinations of Eligibility for Inclusion in the National Register of Historic Places: Purpose and Authorities	The requirements of the federal National Park Service, Department of the Interior Determinations of Eligibility for Inclusion in the National Register of Historic Places are applicable to the WCA	These regulations have been developed to assist Federal agencies in identifying and evaluating the eligibility of properties for inclusion in the National Register. The regulations explain how to request determinations of eligibility under section 2(b) of Executive Order 11593 and the regulations of the Advisory Council on Historic Preservation (36 CFR part 800) for implementation of sections 1(3) and 2(b) of Executive Order 11593 and the National Historic Preservation Act of 1966, as amended Federal agencies request determinations of eligibility in considering historic properties on lands under their jurisdiction or control or on lands to be affected by proposed actions.	
36 CFR Part 800.1 (a)	Advisory Council on Historic Preservation: Protection of Historic Properties: Purpose and Participants: Purposes: Purposes of the Section 106 Process	The requirements of the federal Advisory Council on Historic Preservation, Protection of Historic Properties are applicable to the WCA.	Section 106 of the National Historic Preservation Act requires Federal agencies to take into account the effects of their undertakings on historic properties and afford the Council a reasonable opportunity to comment on such undertakings. The procedures in this part define how Federal agencies meet these statutory responsibilities. The section 106 process seeks to accommodate historic preservation concerns with the needs of Federal undertakings through consultation among the agency official and other parties with an interest in the effects of the undertaking on historic properties, commencing at the early stages of project planning. The goal of consultation is to identify historic properties potentially affected by the undertaking, assess its effects and seek ways to avoid, minimize, or mitigate any adverse effects on historic properties.	
36 CFR Part 800.1 (c)	Advisory Council on Historic Preservation: Protection of Historic Properties: Purpose and Participants: Purposes: Timing	The requirements of the federal Advisory Council on Historic Preservation, Protection of Historic Properties are applicable to the WCA.	The agency official must complete the section 106 process "prior to the approval of the expenditure of any Federal funds on the undertaking or prior to the issuance of any license." This does not prohibit agency official from conducting or authorizing nondestructive project planning activities before completing compliance with section 106, provided that such actions do not restrict the subsequent consideration of alternatives to avoid, minimize, or mitigate the undertaking's adverse effects on historic properties. The agency official shall ensure that the section 106 process is initiated early in the undertaking's planning, so that a broad range of alternatives may be considered during the planning process for the undertaking.	
36 CFR Part 800.2 (a)	Advisory Council on Historic Preservation: Protection of Historic Properties: Participants in the Section 106 Process: Agency Official	The requirements of the federal Advisory Council on Historic Preservation, Protection of Historic Properties are applicable to the WCA.	It is the statutory obligation of the Federal agency to fulfill the requirements of section 106 and to ensure that an agency official with jurisdiction over an undertaking takes legal and financial responsibility for section 106 compliance in accordance with subpart B of this part. The agency official may be a State, local, or tribal government official who has been delegated legal responsibilit for compliance with section 106 in accordance with Federal law.	

Citation	Summary of Requirements	Evaluation	Regulatory Description	Design Basis Document
36 CFR Part 800.2 (a) (1)	Advisory Council on Historic Preservation: Protection of Historic Properties: Participants in the Section 106 Process: Agency Official: Professional Standards	The requirements of the federal Advisory Council on Historic Preservation, Protection of Historic Properties are applicable to the WCA.	Each Federal agency responsible for the protection of historic resources, including archeological resources, to ensure that all actions taken by employees or contractors of the agency shall meet professional standards under regulations developed by the Secretary.	
36 CFR Part 800.2 (a) (3)	Advisory Council on Historic Preservation: Protection of Historic Properties: Participants in the Section 106 Process: Agency Official: Use of Contractors	The requirements of the federal Advisory Council on Historic Preservation, Protection of Historic Properties are applicable to the WCA.	Consistent with applicable conflict of interest laws, the agency official may use the services of applicants, consultants, or designees to prepare information, analyses, and recommendations under this part. The agency official remains legally responsible for all required findings and determinations. If a document or study is prepared by a non-Federal party, the agency official is responsible for ensuring that its content meets applicable standards and guidelines.	
36 CFR Part 800.2 (a) (4)	Advisory Council on Historic Preservation: Protection of Historic Properties: Participants in the Section 106 Process: Agency Official: Consultation	The requirements of the federal Advisory Council on Historic Preservation, Protection of Historic Properties are applicable to the WCA.	The agency official shall involve the consulting parties described in paragraph (c) of this section in findings and determinations made during the section 106 process. The agency official should plan consultations appropriate to the scale of the undertaking and the scope of Federal involvement and coordinated with other requirements of other statutes, as applicable, such as the National Environmental Policy Act, the Native American Graves Protection and Repatriation Act, the American Indian Religious Freedom Act, the Archeological Resources Protection Act, and agency-specific legislation. The Council encourages the agency official to use to the extent possible existing agency procedures and mechanisms to fulfill the consultation requirements of this part.	
36 CFR Part 800.2 (c) (1)	Advisory Council on Historic Preservation: Protection of Historic Properties: Participants in the Section 106 Process: Consulting Parties: State Historic Preservation Office	The requirements of the federal Advisory Council on Historic Preservation, Protection of Historic Properties are applicable to the WCA.	SHPO reflects the interests of the State and its citizens in the preservation of their cultural heritage. In accordance with section 101(b)(3) of the act, the SHPO advises and assists Federal agencies in carrying out their section 106 responsibilities and cooperates with such agencies, local governments, and organizations and individuals to ensure that historic properties are taken into consideration at all levels of planning and development.	
36 CFR Part 800.2 (c) (2) (B) (ii)	Advisory Council on Historic Preservation: Protection of Historic Properties: Participants in the Section 106 Process: Consulting Parties: Consultation on Historic Properties of Significance to Indian Tribes and Native Hawaiian Organizations	The requirements of the federal Advisory Council on Historic Preservation, Protection of Historic Properties are applicable to the WCA.	Section 101(d)(6)(B) of the act requires the agency official to consult with any Indian tribe or Native Hawaiian organization that attaches religious and cultural significance to historic properties that may be affected by an undertaking. This requirement applies regardless of the location of the historic property. Such Indian tribe or Native Hawaiian organization shall be a consulting party.	
36 CFR Part 800.2 (c) (3)	Advisory Council on Historic Preservation: Protection of Historic Properties: Participants in the Section 106 Process: Consulting Parties: Representatives of Local Governments	The requirements of the federal Advisory Council on Historic Preservation, Protection of Historic Properties are applicable to the WCA.	A representative of a local government with jurisdiction over the area in which the effects of an undertaking may occur is entitled to participate as a consulting party. Under other provisions of Federal law, the local government may be authorized to act as the agency official for purposes of section 106.	
36 CFR Part 800.2 (c) (5)	Advisory Council on Historic Preservation: Protection of Historic Properties: Participants in the Section 106 Process: Consulting Parties: Additional Consulting Parties	The requirements of the federal Advisory Council on Historic Preservation, Protection of Historic Properties are applicable to the WCA.	Certain individuals and organizations with a demonstrated interest in the undertaking may participate as consulting parties due to the nature of their legal or economic relationship to the undertaking or affected properties, or their concern with the undertaking's effects on historic properties.	
36 CFR Part 800.2 (c) (5) (d)	Advisory Council on Historic Preservation: Protection of Historic Properties: Participants in the Section 106 Process: Consulting Parties: Additional Consulting Parties: The Public	The requirements of the federal Advisory Council on Historic Preservation, Protection of Historic Properties are applicable to the WCA.	The views of the public are essential to informed Federal decision-making in the section 106 process. The agency official shall seek and consider the views of the public in a manner that reflects the nature and complexity of the undertaking and its effects on historic properties, the likely interest of the public in the effects on historic properties, confidentiality concerns of private individuals and businesses, and the relationship of the Federal involvement to the undertaking. The agency official must, except where appropriate to protect confidentiality concerns of affected parties, provide the public with information about an undertaking and its effects on historic properties and seek public comment and input. Members of the public may also provide views on their own initiative for the agency official to consider in decision-making.	
36 CFR Part 800.3	Advisory Council on Historic Preservation: Protection of Historic Properties: The Section 106 Process: Initiation of the Section 106 Process	The requirements of the federal Advisory Council on Historic Preservation, Protection of Historic Properties are applicable to the WCA.	Identifies steps for initiating the 106 process such as establish the undertaking, coordinate with other reviews, identify the appropriate SHPO/THPO, plan to involve the public, identify other consulting parties, and expediting consultation.	
36 CFR Part 800.4 (a)	Advisory Council on Historic Preservation: Protection of Historic Properties: The Section 106 Process: Identification of Historic Properties: Determine Scope of Identification Efforts	The requirements of the federal Advisory Council on Historic Preservation, Protection of Historic Properties are applicable to the WCA.	In consultation with the SHPO/THPO, the agency official shall: determine and document the area of potential effects; review existing information on historic properties within the area of potential effects; seek information, as appropriate, from consulting parties, and other individuals and organizations likely to have knowledge of, or concerns with, historic properties in the area, and identify issues relating to the undertaking's potential effects on historic properties; and gather information from any Indian tribe or Native Hawaiian organization identified pursuant to §800.3(f) to assist in identifying properties, including those located off tribal lands, which may be of religious and cultural significance to them and may be eligible for the National Register.	

Citation	Summary of Requirements	Evaluation	Regulatory Description	Design Basis Document
36 CFR Part 800.4 (b)	Advisory Council on Historic Preservation: Protection of Historic Properties: The Section 106 Process: Identification of Historic Properties: Identify Historic Properties: Level of Effort	The requirements of the federal Advisory Council on Historic Preservation, Protection of Historic Properties are applicable to the WCA.	The agency official shall take the steps necessary to identify historic properties within the area of potential effects. The agency official shall make a reasonable and good faith effort to carry out appropriate identification efforts, which may include background research, consultation, oral history interviews, sample field investigation, and field survey. The agency official shall take into account past planning, research and studies, the magnitude and nature of the undertaking and the degree of Federal involvement, the nature and extent of potential effects on historic properties, and the likely nature and location of historic properties within the area of potential effects.	
36 CFR Part 800.4 (c)	Advisory Council on Historic Preservation: Protection of Historic Properties: The Section 106 Process: Identification of Historic Properties: Evaluate Historic Significance	The requirements of the federal Advisory Council on Historic Preservation, Protection of Historic Properties are applicable to the WCA.	The agency official shall apply the National Register criteria (36 CFR part 63) to properties identified within the area of potential effects that have not been previously evaluated for National Register eligibility. If the agency official determines any of the National Register criteria are met and the SHPO/THPO agrees, the property shall be considered eligible for the National Register for section 106 purposes. If the agency official determines the criteria are not met and the SHPO/THPO agrees, the property shall be considered not eligible.	
36 CFR Part 800.4 (d)	Advisory Council on Historic Preservation: Protection of Historic Properties: The Section 106 Process: Identification of Historic Properties: Results of Identification and Evaluation	The requirements of the federal Advisory Council on Historic Preservation, Protection of Historic Properties are applicable to the WCA.	If the agency official finds that either there are no historic properties present or there are historic properties present but the undertaking will have no effect upon them , the agency official shall provide documentation of this finding to the SHPO/THPO. The agency official shall notify all consulting parties, including Indian tribes and Native Hawaiian organizations, and make the documentation available for public inspection prior to approving the undertaking. If the agency official finds that there are historic properties which may be affected by the undertaking, the agency official shall notify all consulting parties, including Indian tribes or Native Hawaiian organizations, invite their views on the effects, and assess adverse effects, if any.	
36 CFR Part 800.5	Advisory Council on Historic Preservation: Protection of Historic Properties: The Section 106 Process: Assessment of Adverse Effects	The requirements of the federal Advisory Council on Historic Preservation, Protection of Historic Properties are applicable to the WCA.	In consultation with the SHPO/THPO and any Indian tribe or Native Hawaiian organization that attaches religious and cultural significance to identified historic properties, the agency official shall apply the criteria of adverse effect to historic properties within the area of potential effects. The agency official shall consider any views concerning such effects which have been provided by consulting parties and the public.	
36 CFR Part 800.6	Advisory Council on Historic Preservation: Protection of Historic Properties: The Section 106 Process: Resolution of Adverse Effects	The requirements of the federal Advisory Council on Historic Preservation, Protection of Historic Properties are applicable to the WCA.	The agency official shall consult with the SHPO/THPO and other consulting parties, including Indian tribes and Native Hawaiian organizations, to develop and evaluate alternatives or modifications to the undertaking that could avoid, minimize, or mitigate adverse effects on historic properties. The agency shall also notify the Council and determine Council participation; involve consulting parties; provide documentation; involve the public; and address restrictions on disclosure of information.	
36 CFR Part 800.8 (a)	Advisory Council on Historic Preservation: Protection of Historic Properties: The Section 106 Process: Compliance with the National Environmental Policy Act: General Principles	The requirements of the federal Advisory Council on Historic Preservation, Protection of Historic Properties are applicable to the WCA.	Federal agencies are encouraged to coordinate compliance with section 106 and the procedures in this part with any steps taken to meet the requirements of the National Environmental Policy Act (NEPA). Agencies should consider their section 106 responsibilities as early as possible in the NEPA process, and plan their public participation, analysis, and review in such a way that they can meet the purposes and requirements of both statutes in a timely and efficient manner. The determination of whether an undertaking is a "major Federal action significantly affecting the quality of the human environment," and therefore requires preparation of an environmental impact statement (EIS) under NEPA, should include consideration of the undertaking's likely effects on historic properties. A finding of adverse effect on a historic property does not necessarily require an EIS under NEPA.	
36 CFR Part 800.110	Advisory Council on Historic Preservation: Protection of Historic Properties: The Section 106 Process: Special Requirements for Protecting National Historic Landmarks	The requirements of the federal Advisory Council on Historic Preservation, Protection of Historic Properties are applicable to the WCA.	Section 110(f) of the act requires that the agency official, to the maximum extent possible, undertake such planning and actions as may be necessary to minimize harm to any National Historic Landmark that may be directly and adversely affected by an undertaking. The agency official shall request the Council to participate in any consultation to resolve adverse effects on National Historic Landmarks conducted under §800.6. The agency official shall notify the Secretary of any consultation involving National Historic Landmark and invite the Secretary to participate in the consultation where there may be an adverse effect.	
37 CFR Part 800.111	Advisory Council on Historic Preservation: Protection of Historic Properties: The Section 106 Process: Documentation Standards	The requirements of the federal Advisory Council on Historic Preservation, Protection of Historic Properties are applicable to the WCA.	The agency official shall ensure that a determination, finding, or agreement under the procedures in this subpart is supported by sufficient documentation to enable any reviewing parties to understand its basis. Finding of no adverse effect or adverse affect. Documentation shall include: a description of the undertaking, specifying the Federal involvement, and its area of potential effects, including photographs, maps, and drawings, as necessary; a description of the steps taken to identify historic properties; a description of the affected historic properties, including information on the characteristics that qualify them for the National Register; a description of the undertaking's effects on historic properties; an explanation of why the criteria of adverse effect were found applicable or inapplicable, including any conditions or future actions to avoid, minimize, or mitigate adverse effects; and copies or summaries of any views provided by consulting parties and the public.	
37 CFR Part 800.113	Advisory Council on Historic Preservation: Protection of Historic Properties: The Section 106 Process: Post-Review Discoveries	The requirements of the federal Advisory Council on Historic Preservation, Protection of Historic Properties are applicable to the WCA.	An agency official may develop a programmatic agreement pursuant to §800.14(b) to govern the actions to be taken when historic properties are discovered during the implementation of an undertaking. If historic properties are discovered or unanticipated effects on historic properties are found after the agency official has completed the section 106 process without establishing a process under paragraph (a) of this section, the agency official shall make reasonable efforts to avoid, minimize, or mitigate adverse effects to such properties.	

Citation	Summary of Requirements	Evaluation	Regulatory Description	Design Basis Document
40 CFR 6.301 (b)	Historic, architectural, archeological, and cultural sites	The requirements of the federal historic, architectural, archeological, and cultural sites are applicable to the WCA.	Requires that if an EPA undertaking affects any property with historic, architectural, archeological or cultural value that is listed on or eligible for listing on the National Register of Historic Places, the responsible official shall comply with the procedures for consultation and comment promulgated by the Advisory Council on Historic Preservation in 36 CFR part 800. The responsible official must identify properties affected by the undertaking that are potentially eligible for listing on the National Register and shall request a determination of eligibility from the Keeper of the National Register, Department of the Interior, under the procedures in 36 CFR part 63.	
Endangered Species Act (16 USC 1531 et seq.)	**Requires federal agencies to ensure that actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of species designated as threatened or endangered by the U.S. Fish and Wildlife Service or the National Marine Fisheries Service.**	**Applicable to areas where remedial action is selected that may provide habitat to threatened or endangered species**		
16 USC Section 1531	Congressional findings and declaration of purposes and policy	The requirements of the federal congressional findings and declaration are applicable to the WCA.	The purposes of this chapter is to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved, to provide a program for the conservation of such endangered species and threatened species, and to take such steps as may be appropriate to achieve the purposes of the treaties and conventions set forth in subsection (a) of this section.	
50 CFR Part 402 Subpart A Section 402.01	Interagency Cooperation--Endangered Species Act of 1973, As Amended: General: Scope	The requirements of the federal Interagency Cooperation, Endangered Species Act are applicable to the WCA.	Grants authority to and imposes requirements upon Federal agencies regarding endangered or threatened species of fish, wildlife, or plants ("listed species") and habitat of such species that has been designated as critical ("critical habitat"). Requires every Federal agency, in consultation with and with the assistance of the Secretary, to insure that any action it authorizes, funds, or carries out, in the United States or upon the high seas, is not likely to jeopardize the continued existence of any listed species or results in the destruction or adverse modification of critical habitat.	
50 CFR Part 402 Subpart A Section 402.08	Interagency Cooperation--Endangered Species Act of 1973, As Amended: General: Designation of Non-Federal Representative	The requirements of the federal Interagency Cooperation, Endangered Species Act are applicable to the WCA.	A Federal agency may designate a non-Federal representative to conduct informal consultation or prepare a biological assessment by giving written notice to the Director of such designation. If a biological assessment is prepared by the designated non-Federal representative, the Federal agency shall furnish guidance and supervision and shall independently review and evaluate the scope and contents of the biological assessment. The ultimate responsibility for compliance with section 7 remains with the Federal agency.	
50 CFR Part 402 Subpart B Section 402.10	Interagency Cooperation--Endangered Species Act of 1973, As Amended: Consultation Procedures: Conference on Proposed Species or Proposed Critical Habitat	The requirements of the federal Interagency Cooperation, Endangered Species Act are applicable to the WCA.	Each Federal agency shall confer with the Service on any action which is likely to jeopardize the continued existence of any proposed species or result in the destruction or adverse modification of proposed critical habitat. The conference is designed to assist the Federal agency and any applicant in identifying and resolving potential conflicts at an early stage in the planning process.	
50 CFR Part 402 Subpart B Section 402.11	Interagency Cooperation--Endangered Species Act of 1973, As Amended: Consultation Procedures: Early Consultation	The requirements of the federal Interagency Cooperation, Endangered Species Act are applicable to the WCA.	If a prospective applicant has reason to believe that the prospective action may affect listed species o critical habitat, it may request the Federal agency to enter into early consultation with the Service. The prospective applicant must certify in writing to the Federal agency that (1) it has a definitive proposal outlining the action and its effects and (2) it intends to implement its proposal, if authorized	
50 CFR Part 402 Subpart B Section 402.12 (a)	Interagency Cooperation--Endangered Species Act of 1973, As Amended: Consultation Procedures: Biological Assessment: Purpose	The requirements of the federal Interagency Cooperation, Endangered Species Act are applicable to the WCA.	A biological assessment shall evaluate the potential effects of the action on listed and proposed species and designated and proposed critical habitat and determine whether any such species or habitat are likely to be adversely affected by the action and is used in determining whether formal consultation or a conference is necessary.	
50 CFR Part 402 Subpart B Section 402.12 (b)	Interagency Cooperation--Endangered Species Act of 1973, As Amended: Consultation Procedures: Biological Assessment: Preparation Requirement	The requirements of the federal Interagency Cooperation, Endangered Species Act are applicable to the WCA.	The procedures of this section are required for Federal actions that are "major construction activities." The biological assessment shall be completed before any contract for construction is entered into and before construction begins	
50 CFR Part 402 Subpart B Section 402.12 (c)	Interagency Cooperation--Endangered Species Act of 1973, As Amended: Consultation Procedures: Biological Assessment: Request for Information	The requirements of the federal Interagency Cooperation, Endangered Species Act are applicable to the WCA.	The Federal agency or the designated non-Federal representative shall convey to the Director either (1) a written request for a list of any listed or proposed species or designated or proposed critical habitat that may be present in the action area; or (2) a written notification of the species and critical habitat that are being included in the biological assessment.	
50 CFR Part 402 Subpart B Section 402.12 (d)	Interagency Cooperation--Endangered Species Act of 1973, As Amended: Consultation Procedures: Biological Assessment: Director's Response	The requirements of the federal Interagency Cooperation, Endangered Species Act are applicable to the WCA.	In addition to listed and proposed species, the Director will provide a list of candidate species that may be present in the action area. If the Director advises that no listed species or critical habitat may be present, the Federal agency need not prepare a biological assessment and further consultation is not required. If a listed species or critical habitat may be present in the action area, the Director will provide a species list or concur with the species list provided. The Director also will provide availabl information (or references thereto) regarding these species and critical habitat, and may recommend discretionary studies or surveys that may provide a better information base for the preparation of an assessment.	
50 CFR Part 402 Subpart B Section 402.12 (f)	Interagency Cooperation--Endangered Species Act of 1973, As Amended: Consultation Procedures: Biological Assessment: Contents	The requirements of the federal Interagency Cooperation, Endangered Species Act are applicable to the WCA.	The contents of a biological assessment are at the discretion of the Federal agency and will depend on the nature of the Federal action. The following may be considered for inclusion: (1) The results of an on-site inspection of the area affected by the action to determine if listed or proposed species are present or occur seasonally. (2) The views of recognized experts on the species at issue. (3) A review of the literature and other information. (4) An analysis of the effects of the action on the species and habitat, including consideration of cumulative effects, and the results of any related studies. (5) An analysis of alternate actions considered by the Federal agency for the proposed action.	

Citation	Summary of Requirements	Evaluation	Regulatory Description	Design Basis Document
Migratory Bird Treaty Act (16 USC 703 et seq)	**Protects all migratory bird species. It shall be unlawful at any time, by and means or in any manner, to pursue, hunt, take, capture, kill, attempt to take, capture, or kill, possess, offer for sale, sell, offer to barter, barter, offer to purchase, purchase, deliver for shipment, ship, export, import, cause to be shipped, exported, or imported, deliver for transportation, transport or cause to be transported, carry or cause to be carried, or receive for shipment, transportation, carriage, or export, any migratory bird, any part, nest, or egg of any such bird, or any product, whether or not manufactured, which consists, or is composed in whole or part of any such bird or any part, nest, or egg thereof.**	**The prohibition is relevant and appropriate to areas of the Site where remedial action is selected that may provide habitat to migratory birds.**		
16 USC Section 703	Taking, killing, or possessing migratory birds unlawful	The requirements of the federal taking, killing, or possessing migratory birds are applicable to the WCA. The mortality of migratory birds due to ingestion of contaminated sediment is not a permitted take under the MBTA. The MBTA and its implementing regulations are relevant and appropriate for protecting migratory bird species identified within the Coeur d'Alene Basin.	It shall be unlawful at any time, by any means or in any manner, to pursue, hunt, take, capture, kill, attempt to take, capture, or kill any migratory bird, any part, nest, or eggs of any such bird, or any product, whether or not manufactured, which consists, or is composed in whole or part, of any such bird or any part, nest, or egg thereof, included in the terms of the conventions between the United States and Great Britain, the United Mexican States, the Government of Japan, and the Union of Soviet Socialist Republics.	
Executive Order 13186, Responsibilities of Federal Agencies to Protect Migratory Birds (66 FR 3853)	**Encourages federal agencies to integrate migratory bird conservation principles into plans and actions.**	**TBC**		
66 FR 3853 Section 1 (signed January 10, 2001)	Responsibilities of Federal Agencies to Protect Migratory Birds: Policy	The requirements of the Federal Agencies Statutes to Protect Migratory Birds is TBC. It is not an ARAR because it is not a formally promulgated regulation.	Migratory birds are of great ecological and economic value to this country and to other countries. They contribute to biological diversity...throughout the United States and other countries. The United States has recognized the critical importance of this shared resource by ratifying international bilateral conventions for the conservation of migratory birds. These migratory bird conventions impose substantive obligations on the United States for the conservation of migratory birds and their habitats, and through the Migratory Bird Treaty Act (Act), the United States has implemented these migratory bird conventions with respect to the United States. This Executive Order directs executive departments and agencies to take certain actions to further implement the Act.	
66 FR 3853 Section 2 (d) (signed January 10, 2001)	Responsibilities of Federal Agencies to Protect Migratory Birds: Definitions	The requirements of the Federal Agencies Statutes to Protect Migratory Birds is TBC. It is not an ARAR because it is not a formally promulgated regulation.	Migratory bird means any bird listed in 50 CFR 10.13.	
66 FR 3853 Section 2 (e) (signed January 10, 2001)	Responsibilities of Federal Agencies to Protect Migratory Birds: Definitions	The requirements of the Federal Agencies Statutes to Protect Migratory Birds is TBC. It is not an ARAR because it is not a formally promulgated regulation.	Migratory bird resources means migratory birds and the habitats upon which they depend.	
66 FR 3853 Section 2 (h) (signed January 10, 2001)	Responsibilities of Federal Agencies to Protect Migratory Birds: Definitions.	The requirements of the Federal Agencies Statutes to Protect Migratory Birds is TBC. It is not an ARAR because it is not a formally promulgated regulation.	Action means a program, activity, project, official policy (such as a rule or regulation), or formal plan directly carried out by a Federal agency. Each Federal agency will further define what the term "action" means with respect to its own authorities and what programs should be included in the agency-specific Memoranda of Understanding required by this order. Actions delegated to or assumed by nonfederal entities, or carried out by nonfederal entities with Federal assistance, are not subject to this order. Such actions, however, continue to be subject to the Migratory Bird Treaty Act.	
66 FR 3853 Section 2 (i) (signed January 10, 2001)	Responsibilities of Federal Agencies to Protect Migratory Birds: Definitions.	The requirements of the Federal Agencies Statutes to Protect Migratory Birds is TBC. It is not an ARAR because it is not a formally promulgated regulation.	Species of concern refers to those species listed in the periodic report "Migratory Nongame Birds of Management Concern in the United States," priority migratory bird species as documented by established plans (such as Bird Conservation Regions in the North American Bird Conservation Initiative or Partners in Flight physiographic areas), and those species listed in 50 C.F.R. 17.11.	
66 FR 3853 Section 3 (a) (signed January 10, 2001)	Responsibilities of Federal Agencies to Protect Migratory Birds: Federal	The requirements of the Federal Agencies Statutes to Protect Migratory Birds is TBC. It is not an ARAR because it is not a formally promulgated regulation.	Each Federal agency taking actions that have, or are likely to have, a measurable negative effect on migratory bird populations is directed to develop and implement, within 2 years, a Memorandum of Understanding (MOU) with the USFWS that shall promote the conservation of migratory bird populations.	
66 FR 3853 Section 5 (a) (signed January 10, 2001)	Responsibilities of Federal Agencies to Protect Migratory Birds: Application and Judicial Review	The requirements of the Federal Agencies Statutes to Protect Migratory Birds is TBC. It is not an ARAR because it is not a formally promulgated regulation.	This order and the MOU to be developed by the agencies do not require changes to current contracts, permits, or other third party agreements.	
Bald and Golden Eagle Protection Act (16 USC 668; 50 CFR 22)	**Provides for the protection of the bald eagle and the golden eagle by prohibiting the unpermitted taking, possession, sale, purchase, barter, offer to sell, purchase, or barter, transport, export or import of any bald or golden eagle, alive or dead, including any part, nest, or egg [16 USC 668(a); 50 CFR 22]. "Take" includes pursue, shoot at, poison, wound, kill, capture, trap, collect, molest, or disturb [16 USC 688(c); 50 CFR 22.3]**	**The prohibition is relevant and appropriate to those areas where remedial action is selected that provide habitat to Bald and Golden Eagles.**		
16 USC 668 (a through d)	Bald and Golden Eagle Protection Act, Subchapter II, Protection of Bald and Golden Eagles	The Bald and Golden Eagle Protection Act is relevant and appropriate to the construction and operations of the WCA.	Establishes taking and using of the bald and golden eagle for scientific, exhibition, and religious purposes; enforcement provisions; definitions and availability of appropriations for Migratory Bird Treaty Act	
50 CFR 22	Title 50 -Wildlife and Fisheries, Chapter I, United States Fish and Wildlife Services, Department of the Interior, Subchapter B - Taking, Possession, Transportation, Sale, Purchase, Barter, Exportations, and Importation of Wildlife and Plants	The Wildlife and Fisheries Taking, Possession, Transportation, Sale, Purchase, Barter, Exportations, and Importation of Wildlife and Plants is relevant and appropriate to the construction and operations of the WCA.	Establishes introduction, general requirements, eagle permits, and depredation control orders on golden eagles	

Citation	Summary of Requirements	Evaluation	Regulatory Description	Design Basis Document
Fish and Wildlife Act of 1980 [16 USC 661 et seq.; 40 FR 6.302(g)].	**Requires consultation with the US Fish and Wildlife Service (and the Idaho Department of Fish and Game) when any modification of a stream or other water body greater than 10 hectares is proposed, requires adequate provisions for protections of fish and wildlife, including permanent or temporary mitigation.**	**The substantive requirements are applicable to remedial actions that cause a modification of a stream or other water body that is greater than 10 hectares to ensure the protection of fish, and may include actions necessary to protect fish and wildlife from impacts associated with such modification.**		
40 CFR Part 6.302(g)	Wetlands, floodplains, important farmlands, coastal zones, wild and scenic rivers, fish and wildlife, and endangered species: Fish and Wildlife	The Fish and Wildlife Act is applicable if the construction and operations of the WCA will control or modify any natural stream or water body.	Requires Federal agencies involved in actions that will result in the control or structural modification of any natural stream or body of water for any purpose, to take action to protect the fish and wildlife resources which may be affected by the action.	
Rivers and Harbors Act of 1988 (33 USC 401 et seq.; 33 CFR 320-330)	**Prohibits unauthorized obstruction or alteration of navigable waters**	**The substantive requirements are applicable to remedial actions in or near navigable waters and prohibit unauthorized obstruction and alteration of navigable waters; and include remedial actions that entail excavation, dredging, and/or disposal activities in navigable water of the United States as well as remedial actions that may alter or modify the course, condition, location, or capacity of a navigable water of the United States.**		
33 CFR Part 320	Title 33--Navigation and Navigable Waters, Chapter II - Corp of Engineers, Department of the Army, Department of Defense, Part 320 - General Regulatory Policies	The Navigation and Navigable Waters Regulatory Policies are applicable if the WCA involves control or modify any natural stream or water body.	This part identifies the various federal statutes which require that Department of the Army (DA) permits be issued before these activities can be lawfully undertaken and related Federal laws and the general policies applicable to the review of those activities. This includes activities that alter or modify the course, condition, location, or capacity of a navigable water of the United States (part 322) 33 CFR Part 320.1 (b) (3).	
33 CFR Part 321	Permits for Dams and Dikes in Navigable Waters of the United States	The Permits for Dams and Dikes in Navigable Waters of the United States are applicable i dams or dikes are constructed in Ninemile Creek as part of the construction and operation of the WCA.	Establishes general, definitions, and special policies and procedures for construction of dams and dikes in navigable water of the United States	
33 CFR Part 322.3 (a) and (c)	Permits for Structures or Work in or Affecting Navigable Waters of the United States	The Permits for Structures or Work in or Affecting Navigable Waters of the United States are applicable if construction in or filling of the affected navigable water occurs adjacent to the WCA.	DA permits are required under section 10 for structures and/or work in or affecting navigable waters of the United States except as otherwise provided in Sec. 322.4. If an activity is not exempted by section 322.4 of this part or authorized by a general permit, an individual section 10 (33 USC 403) permit will be required for the proposed activity.	
33 CFR Part 322.5 (g)	Permits for Structures or Work in or Affecting Navigable Waters of the United States	The Permits for Structures or Work in or Affecting Navigable Waters of the United States are applicable if construction in or filling of the affected navigable water occurs adjacent occurs to the WCA.	A canal or similar artificial waterway is subject to the regulatory authorities discussed in Sec. 322.3, of this part, if it constitutes a navigable water of the United States, or if it is connected to navigable waters of the United States in a manner which affects their course, location, condition, or capacity, or if at some point in its construction or operation it results in an effect on the course, location, condition, or capacity of navigable waters of the United States.	
33 CFR Part 323.2 (d)(1)ii	Permits for Discharges of Dredged or Fill Material into Waters of the United States	The Permits for Discharge of Dredged or Fill Materials in Waters of the United States are applicable if construction in or filling of the affected navigable water occurs adjacent to the WCA.	Defines that the term discharge of dredged material means ... runoff or overflow from a contained land or water disposal area.	
33 CFR Part 324	Permits for Ocean Dumping of Dredged Materials	The Permits for Ocean Dumping of Dredged or Fill Materials are applicable if construction in or filling of the affected navigable water occurs adjacent to the WCA.	Establishes the general requirements, definitions, activities requiring permits, and special procedures for permitting ocean dumping of dredged material.	
33 CFR Part 325	Processing of Department of the Army Permits	The Processing by DA is applicable if the WCA triggers specified obligations.	Establishes the applications for permits; processing of applications; public notice; conditioning of permits; forms of permits; duration of permits; modification, suspension, or revocation of permits; authority to issue or deny permits; authority to determine jurisdiction; and publicity.	
33 CFR Part 326.4, 326.5 and 326.6	Enforcement	The Enforcement is applicable if the WCA triggers specified obligations.	Establishes purpose, policy, unauthorized activities, supervision of authorized activities, legal action, and class I administrative penalties.	
33 CFR Part 327	Public Hearings	The Public Hearing is applicable if the WCA triggers specified obligations.	Establishes the purpose, applicability, definitions, general policies, presiding officer. legal adviser, representation, conduct of hearings. filing of the transcript of the public hearing, authority of the presiding officer, and public notice.	
33 CFR Part 328.3 (a)(3)	Definition of Waters of the United States	The definition of water of the United States is applicable and includes Ninemile Creek.	Defines waters of the United States as all other waters such as intrastate lakes, rivers, streams (including intermittent streams), mudflats, sand flats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds, the use, degradation or destruction of which could affect interstate or foreign commerce.	
33 CFR Part 329	Definition of Navigable Waters of the United States	The definition of navigable waters of the United States is applicable and includes Ninemile Creek.	Defines navigable waters of the United States are those waters that are subject to the ebb and flow of the tide and/or are presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce.	
33 CFR Part 330	Nationwide Permit Program	The Nationwide Permit Program is applicable if a DA Permit is required for activity conducted at the WCA.	Establishes purpose and policy; definitions; activities occurring before certain dates; conditions, limitations, and restrictions; issuing, modifying, suspending, or revoking nationwide permits and authorizations; and authorization by nationwide permit.	
Clean Water Act of 1977 (Sections 404 and 401)-Dredge or Fill Requirements (33 USC 1251-1376;33 CFR parts 320-330; 40 CFR Part 230)	**Establishes requirements that limit the discharge of dredged or fill material into navigable waters and associated wetlands. EPA guidelines for discharge of dredged or fill materials in 40 CFR part 230 specify consideration of alternatives that have less adverse impacts and prohibit discharges that would result in exceedance of surface water quality standards exceed and of toxic effluent standards, and jeopardy of threatened or endangered species. Special consideration required for "special aquatic sites" defined to include wetlands.**	**The substantive requirements are applicable to remedial actions in or near navigable waters of the United States.**		
33 USC § 1251-1376	Restoration and maintenance of chemical, physical and biological integrity of the nation's waters	The objective to restore and maintain the Nation's water is applicable to the WCA.	Establishes an objective to restore and maintain the chemical, physical, and biological integrity of the Nation's waters.	

Citation	Summary of Requirements	Evaluation	Regulatory Description	Design Basis Document
33 USC § 1344 (a)	Navigation and Navigable Waters: Water Pollution Prevention and Control: Permits and Licenses: Permits for dredged or fill materials: Discharge into navigable waters at specifie disposal sites	The requirements for the federal Navigation and Navigable Waters, Water Pollution Prevention and Control for dredged or fill materials is applicable if dredging or filling of waterways occurs in the construction of the WCA.	The Secretary may issue permits, after notice and opportunity for public hearings for the discharge of dredged or fill material into the navigable waters at specified disposal sites.	
33 CFR parts 320-330	See ARAR discussion under the previous heading for Rivers and Harbors Act of 1988 (33 CFR 320-330)			
40 CFR Part 230 Section 404 (b)1	Guidelines for Specification of Disposal Sites of Dredged or Fill Material	The requirements for the federal Guidelines for Specification of Disposal Sites of Dredged or Fill Material are applicable if the WCA site meets the definition of a disposal site and will discharge into waters of the United States.	The Guidelines are applicable to the specification of disposal sites for discharges of dredged or fill material into waters of the United States. The term disposal site means that portion of the "waters of the United States" where specific disposal activities are permitted and consist of a bottom surface area and any overlying volume of water. In the case of wetlands on which surface water is not present, the disposal site consists of the wetland surface area.	
Protection of Wetlands [Executive Order 11990; 40 CFR 6.302(a); 40 CFR Part 6, Appendix A]	**Requires federal agencies to take action to avoid adversely impacting wetlands, minimize wetland destruction, and preserve wetlands enhancement and restoration.**	**TBC**		
Executive Order 11990 Section 1(a)	Protection of Wetlands (signed May 24, 1977)	The requirements of the federal Protection of Wetlands are TBC. It is not an ARAR because it is not a formally promulgated regulation.	Requires that each agency take action to minimize the destruction, loss, or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands.	
Executive Order 11990 Section 2(a)	Protection of Wetlands (signed May 24, 1977)	The requirements of the federal Protection of Wetlands are TBC. It is not an ARAR because it is not a formally promulgated regulation.	Requires that each agency, to the extent permitted by law, shall avoid undertaking or providing assistance for new construction in wetlands unless the head of the agency finds (1) there is no practicable alternative to such construction and (2) the proposed action includes all practicable measures to minimize harm to wetlands which may result from such use.	
Executive Order 11990 Section 2(b)	Protection of Wetlands (signed May 24, 1977)	The requirements of the federal Protection of Wetlands are TBC. It is not an ARAR because it is not a formally promulgated regulation.	Requires that each agency provide opportunity for public review of any plans or proposals for new construction in wetlands.	
Executive Order 11990 Section 5	Protection of Wetlands (signed May 24, 1977)	The requirements of the federal Protection of Wetlands are TBC. It is not an ARAR because it is not a formally promulgated regulation.	Identifies the factors that should be considered when determining a proposal's effect on the survival and quality of the wetlands.	
40 CFR Part 6.302(a)	Wetlands, floodplains, important farmlands, coastal zones, wild and scenic rivers, fish and wildlife, and endangered species: Wetlands Protection	The requirements of the federal Protection of Wetlands are TBC. It is not an ARAR because it is not a formally promulgated regulation.	Requires Federal agencies conducting certain activities to avoid, to the extent possible, the adverse impacts associated with the destruction or loss of wetlands and to avoid support of new construction in wetlands if a practicable alternative exists. USEPA's Statement of Procedures on Floodplain Management and Wetlands Protection (dated January 5, 1979, incorporated as Appendix A hereto) requires USEPA programs to determine if proposed actions will be in or will affect wetlands. If so, the responsible official shall prepare a floodplains/wetlands assessment, which will be part of the environmental assessment or environmental impact statement. The responsible official shall either avoid adverse impacts or minimize them if no practicable alternative to the action exists.	
Appendix A to 40 CFR Part 6: Section 1(a)	Statement of Procedures on Floodplain Management and Wetlands Protection: General	The requirements of the federal Protection of Wetlands are TBC. It is not an ARAR because it is not a formally promulgated regulation.	States requirements of Executive Order 11988 "Floodplain Management"	
Appendix A to 40 CFR Part 6: Section 1(b)	Statement of Procedures on Floodplain Management and Wetlands Protection: General	The requirements of the federal Protection of Wetlands are TBC. It is not an ARAR because it is not a formally promulgated regulation.	States requirements of Executive Order 11990 "Protection of Wetlands"	
Appendix A to 40 CFR Part 6: Section 3 (b)	Statement of Procedures on Floodplain Management and Wetlands Protection: Policy	The requirements of the federal Protection of Wetlands are TBC. It is not an ARAR because it is not a formally promulgated regulation.	Requires that the floodplain management goals be incorporated into the planning, regulatory and decision-making processes. These goals include: reduce the hazard and risk of flood loss; avoid direct or indirect adverse impacts on floodplains; where there is no practical alternative to locating in a floodplain, minimize the impact of floods on human safety, health, and welfare, and the natural environment; restore and preserve natural and beneficial values served by floodplains; require the construction of USEPA structures and facilities to be in accordance with the standards and criteria, of the regulations promulgated pursuant to the NFIP; identify floodplains which require restoration and preservation and recommend management programs necessary to protect these floodplains and to include such considerations as part of ongoing planning programs; and provide the public with early and continuing information concerning floodplain management and with opportunities for participating in decision making including the (evaluation of) tradeoffs among competing alternatives.	
Appendix A to 40 CFR Part 6: Section 3 (c)	Statement of Procedures on Floodplain Management and Wetlands Protection: Policy	The requirements of the federal Protection of Wetlands are TBC. It is not an ARAR because it is not a formally promulgated regulation.	The Agency shall incorporate wetlands protection considerations into its planning, regulatory, and decision-making processes. It shall minimize the destruction, loss, or degradation of wetlands and preserve and enhance the natural and beneficial values of wetlands. Agency activities shall continue to be carried out consistent with the Administrator's Decision Statement No. 4 dated February 21, 1973 entitled "USEPA Policy to Protect the Nation's Wetlands."	
Appendix A to 40 CFR Part 6: Section 5 (a)	Statement of Procedures on Floodplain Management and Wetlands Protection: Applicability	The requirements of the federal Protection of Wetlands are TBC. It is not an ARAR because it is not a formally promulgated regulation.	Discusses the applicability of the Executive Orders. Apply to activities of Federal agencies pertainin to...(2) providing Federally undertaken, financed, or assisted construction and improvements, and (3) conducting Federal activities and programs affecting land use....	
Appendix A to 40 CFR Part 6: Section 6 (a)	Statement of Procedures on Floodplain Management and Wetlands Protection: Requirements	The requirements of the federal Protection of Wetlands are TBC. It is not an ARAR because it is not a formally promulgated regulation.	Identifies requirements such as floodplain/wetlands determination; early public notice; floodplain/wetlands assessment; public review of assessments; minimize, restore, or preserve; and agency decision including a Statement of Findings.	

Citation	Summary of Requirements	Evaluation	Regulatory Description	Design Basis Document
Appendix A to 40 CFR Part 6: Section 6 (c)	Statement of Procedures on Floodplain Management and Wetlands Protection: Requirements	The requirements of the federal Protection of Wetlands are TBC. It is not an ARAR because it is not a formally promulgated regulation.	Discusses additional floodplain management provisions such as USEPA-controlled structures and facilities must be constructed according to NFIP criteria; undertake accepted flood proofing and flood protection measures; and wherever feasible, restore and preserve floodplains so their natural and beneficial uses are realized and considered.	
Considering Wetlands at CERCLA Site Guidance (OSWER 9280.03, May 1994)	**Provides guidance for considering potential impacts for response actions on wetlands at CERCLA sites.**	**TBC**		
USEPA/540/R-94/019; OSWER 9280.0-03; Section 3.1.1	Considering Wetlands at CERCLA Sites (May 1994): CWA Section 404 as a Potential ARAR	The requirements of the federal Protection of Wetlands are TBC. It is not an ARAR because it is not a formally promulgated regulation.	Under Section 404, a response action that will result in a discharge of dredged or fill material into a wetland is applicable and is therefore an ARAR.	
USEPA/540/R-94/019; OSWER 9280.0-03; Section 4.4	Considering Wetlands at CERCLA Sites (May 1994): Potential Impacts from Response Actions	The requirements of the federal Protection of Wetlands are TBC. It is not an ARAR because it is not a formally promulgated regulation.	Site managers should consider the potential impacts of the proposed remedy to on-site and adjacent wetland resources.	
USEPA/540/R-94/019; OSWER 9280.0-03; Section 5	Considering Wetlands at CERCLA Sites (May 1994): Role of the Natural Resources Trustees	The requirements of the federal Protection of Wetlands are TBC. It is not an ARAR because it is not a formally promulgated regulation.	CERCLA Section 104(j)(2), Section 517(c), and Section 111(a) and (b) place certain limitations on the restoration, rehabilitation and acquisition of property using Fund monies.	
Protection of Floodplains {Executive Order 11988; 40 CFR 6.302(b); 40 CFR Part 6, Appendix A)	**Requires federal agencies to evaluate the potential effects of actions they may take in a floodplain to avoid the adverse impacts associated with direct and indirect development of a floodplain.**	**TBC**		
Executive Order 11988 Section 1	Floodplain Management (signed May 24, 1977)	The requirements of the federal Floodplain Management are TBC. It is not an ARAR because it is not a formally promulgated regulation. The WCA site was observed for potential wetlands by a qualified wetlands delineator on October 28, 2009. The wetlands delineation revealed neither jurisdictional nor non-jurisdictional wetlands and the likelihood of wetlands developing at this site is very low. The WCA site is located outside the Floodplain and no encroachment of the Floodplain will occur.	Requires that each agency take action to reduce the risk of flood loss, minimize the impact of floods on human safety, health, and welfare; and restore and preserve the natural and beneficial values served by floodplains.	
Executive Order 11988 Section 2 (a)	Floodplain Management (signed May 24, 1977)	The requirements of the federal Floodplain Management are TBC. It is not an ARAR because it is not a formally promulgated regulation. The WCA site was observed for potential wetlands by a qualified wetlands delineator on October 28, 2009. The wetlands delineation revealed neither jurisdictional nor non-jurisdictional wetlands and the likelihood of wetlands developing at this site is very low. The WCA site is located outside the Floodplain and no encroachment of the Floodplain will occur.	Each agency has a responsibility to evaluate any potential effects of any actions it may take in a floodplain such as: before taking an action, determining whether the action will occur in a floodplain if located in a floodplain, the agency shall consider alternatives to avoid adverse effects and incompatible development in the floodplains; if the action will be sited in a floodplain, the action will be designed to minimize potential harm to or within the floodplain and prepare and circulate an explanatory notice.	
Executive Order 11988 Section 3	Floodplain Management (signed May 24, 1977)	The requirements of the federal Floodplain Management are TBC. It is not an ARAR because it is not a formally promulgated regulation. The WCA site was observed for potential wetlands by a qualified wetlands delineator on October 28, 2009. The wetlands delineation revealed neither jurisdictional nor non-jurisdictional wetlands and the likelihood of wetlands developing at this site is very low. The WCA site is located outside the Floodplain and no encroachment of the Floodplain will occur.	Agencies with responsibilities for Federal real property and facilities shall: require the construction of Federal structures and facilities in a floodplain be in accordance with NFIP criteria and accepted flood proofing and flood protection measures be applied.	
40 CFR Part 6.302(b)	Wetlands, floodplains, important farmlands, coastal zones, wild and scenic rivers, fish and wildlife, and endangered species: Floodplain Management	The requirements of the federal Floodplain Management are TBC. It is not an ARAR because it is not a formally promulgated regulation. The WCA site was observed for potential wetlands by a qualified wetlands delineator on October 28, 2009. The wetlands delineation revealed neither jurisdictional nor non-jurisdictional wetlands and the likelihood of wetlands developing at this site is very low. The WCA site is located outside the Floodplain and no encroachment of the Floodplain will occur.	Requires Federal agencies to evaluate the potential effects of actions they may take in a floodplain to avoid, to the extent possible, adverse effects associated with direct and indirect development of a floodplain. Requires USEPA programs to determine whether an action will be located in or will affect a floodplain. If so, the responsible official shall prepare a floodplain/wetlands assessment. The responsible official shall either avoid adverse impacts or minimize them if no practicable alternative exists.	
Appendix A to 40 CFR Part 6: Section 1(a)	Statement of Procedures on Floodplain Management and Wetlands Protection: General	The requirements of the federal Floodplain Management are TBC. It is not an ARAR because it is not a formally promulgated regulation. The WCA site was observed for potential wetlands by a qualified wetlands delineator on October 28, 2009. The wetlands delineation revealed neither jurisdictional nor non-jurisdictional wetlands and the likelihood of wetlands developing at this site is very low. The WCA site is located outside the Floodplain and no encroachment of the Floodplain will occur.	States requirements of Executive Order 11988 "Floodplain Management"	
Appendix A to 40 CFR Part 6: Section 1(b)	Statement of Procedures on Floodplain Management and Wetlands Protection: General	The requirements of the federal Floodplain Management are TBC. It is not an ARAR because it is not a formally promulgated regulation. The WCA site was observed for potential wetlands by a qualified wetlands delineator on October 28, 2009. The wetlands delineation revealed neither jurisdictional nor non-jurisdictional wetlands and the likelihood of wetlands developing at this site is very low. The WCA site is located outside the Floodplain and no encroachment of the Floodplain will occur.	States requirements of Executive Order 11990 "Protection of Wetlands"	
Appendix A to 40 CFR Part 6: Section 3 (b)	Statement of Procedures on Floodplain Management and Wetlands Protection: Policy	The requirements of the federal Floodplain Management are TBC. It is not an ARAR because it is not a formally promulgated regulation. The WCA site was observed for potential wetlands by a qualified wetlands delineator on October 28, 2009. The wetlands delineation revealed neither jurisdictional nor non-jurisdictional wetlands and the likelihood of wetlands developing at this site is very low. The WCA site is located outside the Floodplain and no encroachment of the Floodplain will occur.	Requires that the floodplain management goals be incorporated into the planning, regulatory and decision-making processes. These goals include: reduce the hazard and risk of flood loss; avoid direct or indirect adverse impacts on floodplains; where there is no practical alternative to locating in a floodplain, minimize the impact of floods on human safety, health, and welfare, and the natural environment; restore and preserve natural and beneficial values served by floodplains; require the construction of USEPA structures and facilities to be in accordance with the standards and criteria, of the regulations promulgated pursuant to the NFIP; identify floodplains which require restoration and preservation and recommend management programs necessary to protect these floodplains and to include such considerations as part of ongoing planning programs; and provide the public with early and continuing information concerning floodplain management and with opportunities for participating in decision making including the (evaluation of) tradeoffs among competing alternatives.	

Citation	Summary of Requirements	Evaluation	Regulatory Description	Design Basis Document
Appendix A to 40 CFR Part 6: Section 3 (c)	Statement of Procedures on Floodplain Management and Wetlands Protection: Policy	The requirements of the federal Floodplain Management are TBC. It is not an ARAR because it is not a formally promulgated regulation. The WCA site was observed for potential wetlands by a qualified wetlands delineator on October 28, 2009. The wetlands delineation revealed neither jurisdictional nor non-jurisdictional wetlands and the likelihood of wetlands developing at this site is very low. The WCA site is located outside the Floodplain and no encroachment of the Floodplain will occur.	The Agency shall incorporate wetlands protection considerations into its planning, regulatory, and decision-making processes. It shall minimize the destruction, loss, or degradation of wetlands and preserve and enhance the natural and beneficial values of wetlands. Agency activities shall continue to be carried out consistent with the Administrator's Decision Statement No. 4 dated February 21, 1973 entitled "USEPA Policy to Protect the Nation's Wetlands."	
Appendix A to 40 CFR Part 6: Section 5 (a)	Statement of Procedures on Floodplain Management and Wetlands Protection: Applicability	The requirements of the federal Floodplain Management are TBC. It is not an ARAR because it is not a formally promulgated regulation. The WCA site was observed for potential wetlands by a qualified wetlands delineator on October 28, 2009. The wetlands delineation revealed neither jurisdictional nor non-jurisdictional wetlands and the likelihood of wetlands developing at this site is very low. The WCA site is located outside the Floodplain and no encroachment of the Floodplain will occur.	Discusses the applicability of the Executive Orders. Apply to activities of Federal agencies pertainin to...(2) providing Federally undertaken, financed, or assisted construction and improvements, and (3) conducting Federal activities and programs affecting land use....	
Appendix A to 40 CFR Part 6: Section 6 (a)	Statement of Procedures on Floodplain Management and Wetlands Protection: Requirements	The requirements of the federal Floodplain Management are TBC. It is not an ARAR because it is not a formally promulgated regulation. The WCA site was observed for potential wetlands by a qualified wetlands delineator on October 28, 2009. The wetlands delineation revealed neither jurisdictional nor non-jurisdictional wetlands and the likelihood of wetlands developing at this site is very low. The WCA site is located outside the Floodplain and no encroachment of the Floodplain will occur.	Identifies requirements such as floodplain/wetlands determination; early public notice; floodplain/wetlands assessment; public review of assessments; minimize, restore, or preserve; and agency decision including a Statement of Findings.	
Appendix A to 40 CFR Part 6: Section 6 (c)	Statement of Procedures on Floodplain Management and Wetlands Protection: Requirements	The requirements of the federal Floodplain Management are TBC. It is not an ARAR because it is not a formally promulgated regulation. The WCA site was observed for potential wetlands by a qualified wetlands delineator on October 28, 2009. The wetlands delineation revealed neither jurisdictional nor non-jurisdictional wetlands and the likelihood of wetlands developing at this site is very low. The WCA site is located outside the Floodplain and no encroachment of the Floodplain will occur.	Discusses additional floodplain management provisions such as USEPA-controlled structures and facilities must be constructed according to NFIP criteria; undertake accepted flood proofing and flood protection measures; and wherever feasible, restore and preserve floodplains so their natural and beneficial uses are realized and considered.	
RCRA: Location Standards for Hazardous Waste Facilities- 100 Year Floodplains [42 USC 6901; 40 CFR 264.18(b)]	**Hazardous waste treatment, storage, and disposal facilities (TSDFs) located in a 100-year floodplain must be designed, constructed, operated, and maintained to prevent washout of any 100-year floodplain.**	**The substantive requirements are relevant and appropriate to the siting, design, construction, and operations of repositories within the 100-year floodplain to prevent washout.**		
42 USC 6901	Congressional findings	The federal hazardous waste location requirements are relevant and appropriate. The WCA is not defined as a TSDF. Pursuant to 40 CFR §261.4 (b)(7) (Bevill Amendment), solid wastes from the extraction, beneficiation, and processing of ores and minerals are excluded from the RCRA Subtitle C requirements for managing hazardous wastes.	Sets forth Congress findings with respect to solid waste, environment and health, materials, and energy.	
40 CFR 264.18(b)	Location standards for TSDFs.	The federal hazardous waste location requirements are relevant and appropriate. The WCA is not defined as a TSDF. Pursuant to 40 CFR §261.4 (b)(7) (Bevill Amendment), solid wastes from the extraction, beneficiation, and processing of ores and minerals are excluded from the RCRA Subtitle C requirements for managing hazardous wastes.	A (TSDF) facility located in a 100-year floodplain must be designed, constructed, operated, and maintained to prevent washout or any hazardous waste by a 100-year flood, unless the owner or operator can demonstrate to EPA that procedures are in effect which will cause the waste to be removed safely, before flood waters can reach the facility, to a location where the wastes will not be vulnerable to flood waters; or for existing surface impoundments, waste piles, land treatment units, landfills, and miscellaneous units, no adverse effects on human health or the environment will result if washout occurs.	
State				
Idaho Water Quality and Wastewater Treatment-Hazardous and Deleterious Material Storage [Idaho Statute 39-105 and 39-3601 et seq.; IDAPA 58.01.02.800]	**Hazardous and deleterious materials must not be stored, disposed of, or accumulated adjacent to or in the immediate vicinity of state waters, unless adequate measures and controls are provided to ensure that those materials will not enter state waters as a result of high water, precipitation runoff, wind, storage facility failure, accidents in operation, or unauthorized third-party activities.**	**The substantive requirement that are more stringent than federal requirements are relevant and appropriate to remedial actions that result in the consolidation of mine waste containing hazardous substances in repositories or otherwise buried beneath protective barriers (e.g. capped).**		
Idaho Statute 39-105	Powers and Duties of the Director	The state water quality and wastewater treatment requirements are relevant and appropriate. The WCA construction and operations will not store, dispose or accumulate hazardous or deleterious materials adjacent to or in the immediate vicinity of state waters.	Establishes the Director's rights, powers and duties regarding environmental protection functions vested in the department of health and welfare, and its director, administered by the division of environmental quality.	
Idaho Statute 39-3601	Declaration of Policy and Statement of Legislative intent.	The state water quality and wastewater treatment requirements are relevant and appropriate. The WCA construction and operations will not store, dispose or accumulate hazardous or deleterious materials adjacent to or in the immediate vicinity of state waters.	Establishes that the legislature, recognizing that surface water is one of the state's most valuable natural resources, has approved the adoption of water quality standards and authorized the director of the department of environmental quality in accordance with the provisions of this chapter, to implement these standards.	
IDAPA 58.01.02.800 (01 and 02)	Hazardous and Deleterious Material Storage	The state water quality and wastewater treatment requirements are relevant and appropriate. The WCA construction and operations will not store, dispose or accumulate hazardous or deleterious materials adjacent to or in the immediate vicinity of state waters.	Establishes rules that state hazardous and deleterious materials must not be stored, disposed of, or accumulated adjacent to or in the immediate vicinity of state waters unless adequate measures and controls are provided to insure that those materials will not enter state waters as a result of high water, precipitation runoff, wind, storage facility failure, accidents in operation, or unauthorized third party activities. Criteria to be evaluated and delineation of materials are defined.	
Idaho Siting of Hazardous Waste Disposal Facility (Idaho Code 39-5801 et seq.) and Idaho Rules and Standards for Hazardous Waste (IDAPA 58.01.05)	**The remedial action will be designed to satisfy some of the technical criteria in the Idaho Hazardous Waste Siting Management Plan as adopted by the Idaho State Legislature. Consideration will be given in remedy design to general considerations referenced by the Hazardous Waste Facility Siting Act. However, a siting license for an onsite hazardous waste disposal facility is not required**	**The substantive requirements that are more stringent than federal requirements are relevant and appropriate to the design and siting of repositories.**		

Citation	Summary of Requirements	Evaluation	Regulatory Description	Design Basis Document
Idaho Code 39-5801	Statutes, Regulations, Consultations, and Other Requirements: Idaho Hazardous Waste Facility Siting Act	The Idaho HW siting standards are relevant and appropriate. The WAC construction and operations will not store, dispose or accumulate hazardous or deleterious materials adjacent to or in the immediate vicinity of state waters. A siting application and review/approval of the WCA is not required by a panel of representatives from the nearest community. This Act applies to commercial facilities. Therefore, it would be applicable to any privatized facilities used for waste processing and facilities disposition.	This act requires commercial facilities to obtain a hazardous waste facility siting license prior to commencing construction. A panel including representatives of the nearest community is convened to review and approve the siting application. This Act applies to commercial facilities.	
IDAPA 58.01.05.005 (40 CFR Part 261.3(f)(2))	Idaho Rules and Standards for Hazardous Waste: Identification and Listing of Hazardous Waste: Definition of Hazardous Waste	The Idaho HW standards are relevant and appropriate. Pursuant to 40 CFR §261.4 (b)(7) (Bevill Amendment), solid wastes from the extraction, beneficiation, and processing of ores and minerals are excluded from the RCRA Subtitle C requirements for managing hazardous wastes. EPA and the Trust must determine whether exclusions and/or enforcement actions are relevant and appropriate.	Identifies materials that are not subject to regulation under 40 CFR parts 260, 261 to 266, 268, or 270. This includes hazardous debris as defined in 40 CFR Part 268 that has been treated using one of the required extraction or destruction technologies specified in Table 1 of 40 CFR Part 268.45. Persons claiming this exclusion in an enforcement action will have the burden of proving by clear and convincing evidence that the material meets all of the exclusion requirements; or debris as defined in 40 CFR Part 268 that the Regional Administrator, considering the extent of contamination, has determined is no longer contaminated with hazardous waste.	
IDAPA 58.01.05.008 (40 CFR Part 264 Subpart B: 264.13)	Idaho Rules and Standards for Hazardous Waste: Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities: General Facility Standards: General Waste Analysis	The Idaho HW standards are relevant and appropriate. Pursuant to 40 CFR §261.4 (b)(7) (Bevill Amendment), solid wastes from the extraction, beneficiation, and processing of ores and minerals are excluded from the RCRA Subtitle C requirements for managing hazardous wastes. EPA and the Trust must determine if the waste material being place in the WCA requires characterization.	Before an owner or operator treats, stores, or disposes of any hazardous wastes, or nonhazardous wastes if applicable under § 264.113(d), he must obtain a detailed chemical and physical analysis of a representative sample of the wastes. At a minimum, the analysis must contain all the information which must be known to treat, store, or dispose of the waste in accordance with this part and part 268 of this chapter. The analysis must be repeated as necessary to ensure that it is accurate and up to date.	
IDAPA 58.01.05.008 (40 CFR Part 264 Subpart L	Idaho Rules and Standards for Hazardous Waste: Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities: 40 CFR Part 264 Subpart L—Waste Piles	The substantive requirements for temporary consolidation and accumulation of contaminated mining wastes in waste piles are relevant and appropriate. Pursuant to 40 CFR §261.4 (b)(7) (Bevill Amendment), solid wastes from the extraction, beneficiation, and processing of ores and minerals are excluded from the RCRA Subtitle C requirements for managing hazardous wastes. The ROD Amendment is expected to incorporate an adaptive management approach, which will allow flexibility in the remedial design. EPA and the Trust must determine which (if any) of the substantive waste pile requirements are to be adopted.	Establishes applicability; design and operating requirements; action leakage rate, response actions; monitoring and inspection; special requirements for ignitable or reactive waste; special requirements for incompatible wastes; and closure and post-closure care for waste piles. The regulation apply to owners and operators of facilities that store or treat hazardous waste in piles.	
IDAPA 58.01.05.008 (40 CFR Part 264 Subpart N: 264.301b)	Idaho Rules and Standards for Hazardous Waste: Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities: Landfills: Design and Operating Requirements	The substantive requirements for temporary consolidation and accumulation of contaminated mining wastes in landfills are relevant and appropriate. Pursuant to 40 CFR §261.4 (b)(7) (Bevill Amendment), solid wastes from the extraction, beneficiation, and processing of ores and minerals are excluded from the RCRA Subtitle C requirements for managing hazardous wastes. The ROD Amendment is expected to incorporate an adaptive management approach, which will allow flexibility in the remedial design. EPA and the Trust must determine which (if any) of the substantive landfill requirements are to be adopted.	Relates to an exemption of a liner system for landfills if owner/operator can demonstrate to the Regional Administrator that alternative design and operating practices, together with location characteristics, will prevent the migration of hazardous constituents into the groundwater or surface water at any future time. The regulations apply to owners and operators of facilities that dispose of hazardous waste in landfills.	
IDAPA 58.01.05.008 (40 CFR Part 264 Subpart N: 264.301d)	Idaho Rules and Standards for Hazardous Waste: Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities: Landfills: Design and Operating Requirements	The substantive requirements for temporary consolidation and accumulation of contaminated mining wastes in landfills are relevant and appropriate. Pursuant to 40 CFR §261.4 (b)(7) (Bevill Amendment), solid wastes from the extraction, beneficiation, and processing of ores and minerals are excluded from the RCRA Subtitle C requirements for managing hazardous wastes. The ROD Amendment is expected to incorporate an adaptive management approach, which will allow flexibility in the remedial design. EPA and the Trust must determine which (if any) of the substantive landfill requirements are to be adopted.	Relates to an exemption of a liner system for landfills if owner/operator can demonstrate to the Regional Administrator that alternative design and operating practices, together with location characteristics, will prevent the migration of hazardous constituents into the groundwater or surface water at any future time and will allow the detection of leaks of hazardous constituents through the top liner at least as effectively. The regulations apply to owners and operators of facilities that dispose of hazardous waste in landfills.	
IDAPA 58.01.05.008 (40 CFR Part 264 Subpart N: 264.301g - k)	Idaho Rules and Standards for Hazardous Waste: Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities: Landfills: Design and Operating Requirements	The substantive requirements for temporary consolidation and accumulation of contaminated mining wastes in landfills are relevant and appropriate. Pursuant to 40 CFR §261.4 (b)(7) (Bevill Amendment), solid wastes from the extraction, beneficiation, and processing of ores and minerals are excluded from the RCRA Subtitle C requirements for managing hazardous wastes. The ROD Amendment is expected to incorporate an adaptive management approach, which will allow flexibility in the remedial design. EPA and the Trust must determine which (if any) of the substantive landfill requirements are to be adopted.	Relates to the design, construction, and maintenance of run-on and run-off control systems; the control of particulate matter; and permit specifications to ensure all requirements in 40 CFR 264.301 are satisfied.	
IDAPA 58.01.05.008 (40 CFR Part 264 Subpart N: 264.303 a(2)(b)	Idaho Rules and Standards for Hazardous Waste: Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities: Landfills: Monitoring and Inspection	The substantive requirements for temporary consolidation and accumulation of contaminated mining wastes in landfills are relevant and appropriate. Pursuant to 40 CFR §261.4 (b)(7) (Bevill Amendment), solid wastes from the extraction, beneficiation, and processing of ores and minerals are excluded from the RCRA Subtitle C requirements for managing hazardous wastes. The ROD Amendment is expected to incorporate an adaptive management approach, which will allow flexibility in the remedial design. EPA and the Trust must determine which (if any) of the substantive landfill requirements are to be adopted.	Relates to the monitoring and inspection of soil covers and run-on/run-off systems.	
IDAPA 58.01.05.008 (40 CFR Part 264 Subpart N: 264.309)	Idaho Rules and Standards for Hazardous Waste: Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities: Landfills: Surveying and Record-Keeping	The substantive requirements for mapping are relevant and appropriate for the WCA. Pursuant to 40 CFR §261.4 (b)(7) (Bevill Amendment), solid wastes from the extraction, beneficiation, and processing of ores and minerals are excluded from the RCRA Subtitle C requirements for managing hazardous wastes.	Relates to maintaining and updating a map of the landfill and documenting the types and locations of wastes placed in the landfill.	
IDAPA 58.01.05.008 (40 CFR Part 264 Subpart N: 264.310)	Idaho Rules and Standards for Hazardous Waste: Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities: Landfills: Closure and Post-Closure Care	The substantive requirements for cover at the final closure and post-closure requirements following closure are relevant and appropriate for the WCA. Pursuant to 40 CFR §261.4 (b)(7) (Bevill Amendment), solid wastes from the extraction, beneficiation, and processing of ores and minerals are excluded from the RCRA Subtitle C requirements for managing hazardous wastes.	Relates to cover requirements at final closure of the repository and post-closure requirements following final closure including maintenance and monitoring.	

Citation	Summary of Requirements	Evaluation	Regulatory Description	Design Basis Document
IDAPA 58.01.05.008 (40 CFR Part 264 Subpart G: 264.110)	Idaho Rules and Standards for Hazardous Waste: Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities: Closure and Post-Closure: Applicability	The substantive requirements for cover at the final closure and post-closure requirements following closure are relevant and appropriate for the WCA. Pursuant to 40 CFR §261.4 (b)(7) (Bevill Amendment), solid wastes from the extraction, beneficiation, and processing of ores and minerals are excluded from the RCRA Subtitle C requirements for managing hazardous wastes.	Establishes criteria for applicability of closure and post-closure	
IDAPA 58.01.05.008 (40 CFR Part 264 Subpart G: 264.111)	Idaho Rules and Standards for Hazardous Waste: Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities: Closure and Post-Closure: Closure Performance Standard	The substantive requirements for cover at the final closure and post-closure requirements following closure are relevant and appropriate for the WCA. Pursuant to 40 CFR §261.4 (b)(7) (Bevill Amendment), solid wastes from the extraction, beneficiation, and processing of ores and minerals are excluded from the RCRA Subtitle C requirements for managing hazardous wastes.	The owner or operator must close the facility in a manner that minimizes the need for further maintenance; and controls, minimizes or eliminates, to the extent necessary to protect human health and the environment, post-closure escape of hazardous waste, hazardous constituents, leachate, contaminated run-off, or hazardous waste decomposition products to the ground or surface waters or to the atmosphere; and complies with the closure requirements of this subpart.	
IDAPA 58.01.05.008 (40 CFR Part 264 Subpart G: 264.112)	Idaho Rules and Standards for Hazardous Waste: Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities: Closure and Post-Closure: Closure Plan; Amendment of Plan	The substantive requirements for cover at the final closure and post-closure requirements following closure are relevant and appropriate for the WCA. Pursuant to 40 CFR §261.4 (b)(7) (Bevill Amendment), solid wastes from the extraction, beneficiation, and processing of ores and minerals are excluded from the RCRA Subtitle C requirements for managing hazardous wastes.	Relates to the closure plan and amendment to closure plans.	
IDAPA 58.01.05.008 (40 CFR Part 264 Subpart G: 264.114)	Idaho Rules and Standards for Hazardous Waste: Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities: Closure and Post-Closure: Disposal or decontamination of equipment, structures, and soil	The substantive requirements for cover at the final closure and post-closure requirements following closure are relevant and appropriate for the WCA. Pursuant to 40 CFR §261.4 (b)(7) (Bevill Amendment), solid wastes from the extraction, beneficiation, and processing of ores and minerals are excluded from the RCRA Subtitle C requirements for managing hazardous wastes.	Relates to the disposal or decontamination of contaminated equipment, structures, and soil during partial closure and final closure.	
IDAPA 58.01.05.008 (40 CFR Part 264 Subpart G: 264.115 and 264.116)	Idaho Rules and Standards for Hazardous Waste: Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities: Closure and Post-Closure: Certification of Closure and Survey Plat, respectively	The substantive requirements for cover at the final closure and post-closure requirements following closure are relevant and appropriate for the WCA. Pursuant to 40 CFR §261.4 (b)(7) (Bevill Amendment), solid wastes from the extraction, beneficiation, and processing of ores and minerals are excluded from the RCRA Subtitle C requirements for managing hazardous wastes.	Relates to the certification of final closure and the final survey.	
IDAPA 58.01.05.008 (40 CFR Part 264 Subpart G: 264.117)	Idaho Rules and Standards for Hazardous Waste: Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities: Closure and Post-Closure: Post-Closure Care and Use of Property	The substantive requirements for cover at the final closure and post-closure requirements following closure are relevant and appropriate for the WCA. Pursuant to 40 CFR §261.4 (b)(7) (Bevill Amendment), solid wastes from the extraction, beneficiation, and processing of ores and minerals are excluded from the RCRA Subtitle C requirements for managing hazardous wastes.	Relates to post-closure care that must take place after completion of closure (including maintenance, monitoring, and reporting). The post-closure use of the property should not disturb the integrity of the final cover, liner(s), or any other components of the containment system, or the function of the facility's monitoring systems.	
IDAPA 58.01.05.008 (40 CFR Part 264 Subpart G: 264.118)	Idaho Rules and Standards for Hazardous Waste: Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities: Closure and Post-Closure: Post-Closure Plan; Amendment of Plan	The substantive requirements for cover at the final closure and post-closure requirements following closure are relevant and appropriate for the WCA. Pursuant to 40 CFR §261.4 (b)(7) (Bevill Amendment), solid wastes from the extraction, beneficiation, and processing of ores and minerals are excluded from the RCRA Subtitle C requirements for managing hazardous wastes.	Relates to the development of a written post-closure plan for monitoring, maintenance, and integrity of the cap/cover system, and the function of the monitoring equipment.	
IDAPA 58.01.05.008 (40 CFR Part 264 Subpart G: 264.119)	Idaho Rules and Standards for Hazardous Waste: Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities: Closure and Post-Closure: Post-Closure Notices	The substantive requirements for cover at the final closure and post-closure requirements following closure are relevant and appropriate for the WCA. Pursuant to 40 CFR §261.4 (b)(7) (Bevill Amendment), solid wastes from the extraction, beneficiation, and processing of ores and minerals are excluded from the RCRA Subtitle C requirements for managing hazardous wastes.	Submit a record of the type, location, and quantity of hazardous wastes disposed of within each cell or other disposal unit of the facility. Record, in accordance with State law, a notation on the deed to the facility property—or on some other instrument which is normally examined during title search—that will in perpetuity notify any potential purchaser of the property that the land has been used to manage hazardous wastes and its use is restricted.	
IDAPA 58.01.05.009 (40 CFR Part 265 Subpart B: 265.13)	Idaho Rules and Standards for Hazardous Waste: Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities: General Facility Standards: General Waste Analysis	The substantive requirements for waste analysis are relevant and appropriate. Pursuant to 40 CFR §261.4 (b)(7) (Bevill Amendment), solid wastes from the extraction, beneficiation, and processing of ores and minerals are excluded from the RCRA Subtitle C requirements for managing hazardous wastes. EPA and the Trust must determine if the waste material being place in the WCA requires characterization.	Before an owner or operator treats, stores, or disposes of any hazardous wastes, or nonhazardous wastes if applicable under §265.113(d), he must obtain a detailed chemical and physical analysis of a representative sample of the wastes. At a minimum, the analysis must contain all the information which must be known to treat, store, or dispose of the waste in accordance with this part and part 268 of this chapter. The analysis must be repeated as necessary to ensure that it is accurate and up to date.	
IDAPA 58.01.05.009 (40 CFR Part 265 Subpart G: 265.110(a) and (b)(1))	Idaho Rules and Standards for Hazardous Waste: Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities: Closure and Post Closure: Applicability	The substantive requirements for cover at the final closure and post-closure requirements following closure are relevant and appropriate for the WCA. Pursuant to 40 CFR §261.4 (b)(7) (Bevill Amendment), solid wastes from the extraction, beneficiation, and processing of ores and minerals are excluded from the RCRA Subtitle C requirements for managing hazardous wastes.	Sections 265.111 through 265.115 (which concern closure) apply to the owners and operators of all hazardous waste management facilities; and Sections 265.116 through 265.120 (which concern post-closure care) apply to the owners and operators of all hazardous waste disposal facilities; waste piles and surface impoundments; tank systems; and containment buildings.	
IDAPA 58.01.05.009 (40 CFR Part 265 Subpart G: 265.111)	Idaho Rules and Standards for Hazardous Waste: Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities: Closure and Post Closure: Closure Performance Standard	The substantive requirements for cover at the final closure and post-closure requirements following closure are relevant and appropriate for the WCA. Pursuant to 40 CFR §261.4 (b)(7) (Bevill Amendment), solid wastes from the extraction, beneficiation, and processing of ores and minerals are excluded from the RCRA Subtitle C requirements for managing hazardous wastes.	The owner or operator must close the facility in a manner that minimizes the need for further maintenance; controls, minimizes, or eliminates, to the extent necessary to protect human health and the environment, post-closure escape of hazardous waste, hazardous constituents, leachate, contaminated run-off, or hazardous waste decomposition products to the ground or surface waters or to the atmosphere; and complies with the closure requirements of this subpart.	
IDAPA 58.01.05.009 (40 CFR Part 265 Subpart G: 265.112)	Idaho Rules and Standards for Hazardous Waste: Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities: Closure and Post Closure: Closure Plan; Amendment of Plan	The substantive requirements for cover at the final closure and post-closure requirements following closure are relevant and appropriate for the WCA. Pursuant to 40 CFR §261.4 (b)(7) (Bevill Amendment), solid wastes from the extraction, beneficiation, and processing of ores and minerals are excluded from the RCRA Subtitle C requirements for managing hazardous wastes.	The owner or operator must have a written closure plan that identifies the steps necessary to perform partial and/or final closure of the facility at any point during its active life. The plan should include a description of how closure performance standards such as ground water monitoring, leachate collection, and run-on/run-off control will be met. The plan should be amended if changes in operations or the facility design affect the closure plan, there is a change in the expected year of closure, or during closure activities unexpected events require modification of the closure plan.	
IDAPA 58.01.05.009 (40 CFR Part 265 Subpart G: 265.114)	Idaho Rules and Standards for Hazardous Waste: Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities: Closure and Post-Closure: Disposal or Decontamination of Equipment, Structures and Soils	The substantive requirements for cover at the final closure and post-closure requirements following closure are relevant and appropriate for the WCA. Pursuant to 40 CFR §261.4 (b)(7) (Bevill Amendment), solid wastes from the extraction, beneficiation, and processing of ores and minerals are excluded from the RCRA Subtitle C requirements for managing hazardous wastes.	During the partial and final closure periods, all contaminated equipment, structures, and soil must be properly disposed or decontaminated.	

Citation	Summary of Requirements	Evaluation	Regulatory Description	Design Basis Document
IDAPA 58.01.05.009 (40 CFR Part 265 Subpart G: 265.115 and 265.116)	Idaho Rules and Standards for Hazardous Waste: Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities: Closure and Post-Closure: Certification of Closure and Survey Plat	The substantive requirements for cover at the final closure and post-closure requirements following closure are relevant and appropriate for the WCA. Pursuant to 40 CFR §261.4 (b)(7) (Bevill Amendment), solid wastes from the extraction, beneficiation, and processing of ores and minerals are excluded from the RCRA Subtitle C requirements for managing hazardous wastes.	Requires that a certification of closure be prepared that states the hazardous waste management unit or facility, as applicable, has been closed in accordance with the specifications in the approved closure plan. In addition, an owner or operator must submit to the local zoning authority, or the authority with jurisdiction over local land use, and to the Regional Administrator, a survey plat indicating the location and dimensions of landfill cells or other hazardous waste disposal units with respect to permanently surveyed benchmarks.	
IDAPA 58.01.05.009 (40 CFR Part 265 Subpart G: 265.117)	Idaho Rules and Standards for Hazardous Waste: Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities: Closure and Post-Closure: Post-Closure Care and Use of Property	The substantive requirements for cover at the final closure and post-closure requirements following closure are relevant and appropriate for the WCA. Pursuant to 40 CFR §261.4 (b)(7) (Bevill Amendment), solid wastes from the extraction, beneficiation, and processing of ores and minerals are excluded from the RCRA Subtitle C requirements for managing hazardous wastes.	Relates to post-closure care that must take place after completion of closure (including maintenance, monitoring, and reporting). The post-closure use of the property should not disturb the integrity of the final cover, liner(s), or any other components of the containment system, or the function of the facility's monitoring systems.	
IDAPA 58.01.05.009 (40 CFR Part 265 Subpart G: 265.118)	Idaho Rules and Standards for Hazardous Waste: Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities: Closure and Post-Closure: Post-Closure Plan; Amendment of Plan	The substantive requirements for cover at the final closure and post-closure requirements following closure are relevant and appropriate for the WCA. Pursuant to 40 CFR §261.4 (b)(7) (Bevill Amendment), solid wastes from the extraction, beneficiation, and processing of ores and minerals are excluded from the RCRA Subtitle C requirements for managing hazardous wastes.	Relates to the post-closure plan for monitoring, maintenance, and integrity of the cap/cover system, and the function of the monitoring equipment. The plan should be amended if changes in operations or the facility design affect the post-closure plan or events which occur during the active life of the facility, including partial and final closures, affect the post-closure plan.	
IDAPA 58.01.05.009 (40 CFR Part 265 Subpart G: 265.119)	Idaho Rules and Standards for Hazardous Waste: Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities: Closure and Post-Closure: Post-Closure Notices	The substantive requirements for cover at the final closure and post-closure requirements following closure are relevant and appropriate for the WCA. Pursuant to 40 CFR §261.4 (b)(7) (Bevill Amendment), solid wastes from the extraction, beneficiation, and processing of ores and minerals are excluded from the RCRA Subtitle C requirements for managing hazardous wastes.	Submit a record of the type, location, and quantity of hazardous wastes disposed of within each cell or other disposal unit of the facility. Record, in accordance with State law, a notation on the deed to the facility property—or on some other instrument which is normally examined during title search—that will in perpetuity notify any potential purchaser of the property that the land has been used to manage hazardous wastes and its use is restricted.	
IDAPA 58.01.05.009 (40 CFR Part 265 Subpart N: 265.300)	Idaho Rules and Standards for Hazardous Waste: Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities: Landfills: Applicability	The substantive requirements for temporary consolidation and accumulation of contaminated mining wastes in landfills are relevant and appropriate. Pursuant to 40 CFR §261.4 (b)(7) (Bevill Amendment), solid wastes from the extraction, beneficiation, and processing of ores and minerals are excluded from the RCRA Subtitle C requirements for managing hazardous wastes. The ROD Amendment is expected to incorporate an adaptive management approach, which will allow flexibility in the remedial design. EPA and the Trust must determine which (if any) of the substantive landfill requirements are to be adopted.	The regulations in this subpart apply to owners and operators of facilities that dispose of hazardous waste in landfills. A waste pile used as a disposal facility is a landfill and is governed by this subpart.	
IDAPA 58.01.05.009 (40 CFR Part 265 Subpart N: 265.301 d(2)(ii); f - i)	Idaho Rules and Standards for Hazardous Waste: Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities: Landfills: Design and Operating Requirements	The substantive requirements for temporary consolidation and accumulation of contaminated mining wastes in landfills are relevant and appropriate. Pursuant to 40 CFR §261.4 (b)(7) (Bevill Amendment), solid wastes from the extraction, beneficiation, and processing of ores and minerals are excluded from the RCRA Subtitle C requirements for managing hazardous wastes. The ROD Amendment is expected to incorporate an adaptive management approach, which will allow flexibility in the remedial design. EPA and the Trust must determine which (if any) of the substantive landfill requirements are to be adopted.	Relates to an exemption of a liner system for monofills that are located, designed, and operated so as to assure that there will be no migration of any hazardous constituent into ground water or surface water at any future time. Also, relates to the design, construction, operation, and maintenance of run-on control and run-off management systems that are capable of preventing flow onto the active portion of the landfill during peak discharge from at least a 25-year storm and the water volume resulting from a 24-hour, 25-year storm. Requires the cleaning and maintenance of collection and holding facilities (e.g., tanks or basins) associated with run-on and run-off control systems. Also requires the owner or operator of a landfill containing hazardous waste to cover or otherwise manage the landfill so that wind dispersal of the hazardous waste is controlled.	
IDAPA 58.01.05.009 (40 CFR Part 265 Subpart N: 265.309)	Idaho Rules and Standards for Hazardous Waste: Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities: Landfills: Surveying and Record Keeping	The substantive requirements for mapping are relevant and appropriate for the WCA. Pursuant to 40 CFR §261.4 (b)(7) (Bevill Amendment), solid wastes from the extraction, beneficiation, and processing of ores and minerals are excluded from the RCRA Subtitle C requirements for managing hazardous wastes. .	Requires the owner or operator of a landfill to maintain the following items in the operating record: the exact location and dimensions, including depth, of each cell with respect to permanently surveyed benchmarks on a map; and the contents of each cell and the approximate location of each hazardous waste type within each cell.	
IDAPA 58.01.05.009 (40 CFR Part 265 Subpart N: 265.310)	Idaho Rules and Standards for Hazardous Waste: Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities: Landfills: Closure and Post-Closure Care	The substantive requirements for cover at the final closure and post-closure requirements following closure are relevant and appropriate for the WCA. Pursuant to 40 CFR §261.4 (b)(7) (Bevill Amendment), solid wastes from the extraction, beneficiation, and processing of ores and minerals are excluded from the RCRA Subtitle C requirements for managing hazardous wastes. The ROD Amendment is expected to incorporate an adaptive management approach, which will allow flexibility in the remedial design. EPA and the Trust must determine which (if any) of the substantive landfill requirements are to be adopted.	Requires that at final closure of the landfill or closure of a cell the owner or operator must cover the landfill or cell with a final cover designed and constructed to: minimize migration of liquids through the landfill in the long-term, function with minimum maintenance, promote drainage and minimize erosion of the cover, accommodate settling so the cover's integrity is maintained, and have a permeability less than or equal to the permeability of any bottom liner system or natural subsoils present. After final closure, the owner or operator must maintain the integrity and effectiveness of the final cover, maintain and monitor the groundwater monitoring system, and prevent run-on and run-off from eroding or damaging the final cover.	
IDAPA 58.01.05.011 (40 CFR Part 268.45(a))	Idaho Rules and Standards for Hazardous Waste: Land Disposal Restrictions: Treatment Standards for Hazardous Debris: Treatment Standards	The substantive requirements for temporary consolidation and accumulation of contaminated mining wastes in landfills are relevant and appropriate. Pursuant to 40 CFR §261.4 (b)(7) (Bevill Amendment), solid wastes from the extraction, beneficiation, and processing of ores and minerals are excluded from the RCRA Subtitle C requirements for managing hazardous wastes. The ROD Amendment is expected to incorporate an adaptive management approach, which will allow flexibility in the remedial design. EPA and the Trust must determine which (if any) of the substantive treatment standards are to be adopted.	Hazardous debris must be treated prior to land disposal unless USEPA determines under 40 CFR 261.3(f)(2) that the debris is no longer contaminated with hazardous waste or the debris is treated to the waste-specific treatment standard provided for the waste contaminating the debris.	

Citation	Summary of Requirements	Evaluation	Regulatory Description	Design Basis Document
IDAPA 58.01.05.011 (40 CFR Part 268.45(a)(1), (3), and (4))	Idaho Rules and Standards for Hazardous Waste: Land Disposal Restrictions: Treatment Standards for Hazardous Debris: Treatment Standards: General, Mixtures of Debris Types, and Mixtures of Contaminant Types	The substantive requirements for temporary consolidation and accumulation of contaminated mining wastes in landfills are relevant and appropriate. Pursuant to 40 CFR §261.4 (b)(7) (Bevill Amendment), solid wastes from the extraction, beneficiation, and processing of ores and minerals are excluded from the RCRA Subtitle C requirements for managing hazardous wastes. The ROD Amendment is expected to incorporate an adaptive management approach, which will allow flexibility in the remedial design. EPA and the Trust must determine which (if any) of the substantive treatment standards are to be adopted.	Hazardous debris must be treated for each "contaminant subject to treatment" defined by 40 CFR Part 268.45(b) using the technology or technologies identified. The treatment standards must be achieved for each type of debris contained in a mixture of debris types. Debris contaminated with two or more contaminants subject to treatment must be treated for each contaminant using one or more treatment technologies.	
IDAPA 58.01.05.011 (40 CFR Part 268.45(b)(1) and (2))	Idaho Rules and Standards for Hazardous Waste: Land Disposal Restrictions: Treatment Standards for Hazardous Debris: Contaminants Subject to Treatment: Toxicity Characteristic Debris and Debris Contaminated with Listed Waste	The substantive requirements for temporary consolidation and accumulation of contaminated mining wastes in landfills are relevant and appropriate. Pursuant to 40 CFR §261.4 (b)(7) (Bevill Amendment), solid wastes from the extraction, beneficiation, and processing of ores and minerals are excluded from the RCRA Subtitle C requirements for managing hazardous wastes. The ROD Amendment is expected to incorporate an adaptive management approach, which will allow flexibility in the remedial design. EPA and the Trust must determine which (if any) of the substantive treatment standards are to be adopted.	The contaminants subject to treatment for debris that exhibits the toxicity characteristic identified in 40 CFR Part 261.24 are those extraction procedure constituents for which the debris exhibits the toxicity characteristic. The contaminants subject to treatment for debris that is contaminated with a prohibited listed hazardous waste are those constituents or wastes for which treatment standards are established for the waste.	
IDAPA 58.01.05.011 (40 CFR Part 268.45(c))	Idaho Rules and Standards for Hazardous Waste: Land Disposal Restrictions: Treatment Standards for Hazardous Debris: Conditioned Exclusion of Treated Debris	The substantive requirements for temporary consolidation and accumulation of contaminated mining wastes in landfills are relevant and appropriate. Pursuant to 40 CFR §261.4 (b)(7) (Bevill Amendment), solid wastes from the extraction, beneficiation, and processing of ores and minerals are excluded from the RCRA Subtitle C requirements for managing hazardous wastes. The ROD Amendment is expected to incorporate an adaptive management approach, which will allow flexibility in the remedial design. EPA and the Trust must determine which (if any) of the substantive treatment standards are to be adopted.	Hazardous debris that has been treated using one of the specified extraction or destruction technologies and that does not exhibit a characteristic of hazardous waste identified under 40 CFR Part 261 after treatment is not a hazardous waste and need not be managed in a subtitle C facility.	
Idaho Classification and Protection of Wildlife (Idaho Statute 36-201 and IDAPA 13.01.06)	**The Idaho Department of Fish and Game classifies wildlife as game, protected non-game, endangered, threatened, and species of special concern. None of the protected non-game species of special concern, threatened, or endangered species may be taken or possessed.**	**The substantive requirements that are more stringent than federal requirements are relevant and appropriate to remedial actions undertaken in areas that provide habitat for threatened, endangered, or protected non-game species of special concern.**		
Idaho Statute 36-201	Fish and Game, Chapter 2, Classification and Definitions; Fish and Game Commission Authorized to Classify Wildlife	The Idaho Fish and Game Statutes are relevant and appropriate to the WCA.	With the exception of predatory animals, the Idaho fish and game commission is authorized to define by classification or reclassification all wildlife in the state of Idaho to include game animals; game birds; game fish; fur-bearing animals; migratory birds; threatened or endangered wildlife; protected nongame species; and unprotected wildlife. Predatory wildlife include coyote; jackrabbit; skunk; weasel; starling; and raccoon. Notwithstanding the classification assigned to wolves, all methods of take including, but not limited to, all methods utilized by the United States fish and wildlife service and the United States department of agriculture wildlife services, shall be authorized for the management of wolves in accordance with existing laws or approved management plans.	
IDAPA 13.01.06	Idaho Fish and Game Commission; Rules Governing Classification and Protection of Wildlife.	The Idaho Fish and Game Statutes are relevant and appropriate to the WCA.	Establishes rules concerning the taking of wildlife species and the classification of all wildlife in the state of Idaho to include big game animals; upland game animals; game birds; game fish; furbearing animals; threatened or endangered species; protected nongame species; predatory wildlife; unprotected wildlife; and protection of wildlife.	
Idaho Preservation of Historical Sites (Idaho Statute 67-4601 et seq.) and Idaho State Historical Society (Idaho Statute 67-4101 et seq.)	**Covers historical sites and districts within the State of Idaho and the excavation of archaeological resources. The Idaho State historical Society is a state agency. It publishes the National Register of Historic Places for Idaho.**	**The substantive requirement that are more stringent than federal requirements are applicable to historical sites and districts within the Upper Basin where remedial action is undertaken.**		
Idaho Statute 67-4601	Preservation of Historic Sites	The preservation of historic sites is applicable site-wide.	Authorizes public policy (in the public interest of Idaho) to engage in a comprehensive program of historic preservation, undertaken at all levels of the government of Idaho and its political subdivisions, to promote the use and conservation of such property for the education, inspiration, pleasure and enrichment of the citizens of this state. Authorizes the local governing bodies of this state to engage in a comprehensive program of historic preservation.	
Idaho Statute 67-4101	Idaho State Historical Society, Statutes and Decisions Relating to the Idaho State Historical Society	The preservation of historic sites is applicable site-wide.	Established that the Idaho State Historical Society is an educational institution active in the fields of primary, secondary, higher, and adult education. Organized as a government corporation, the Society operates under policies for discharging research, publication, preservation, and teaching responsibilities in the history of Idaho and the Pacific Northwest. The Society functions as the state department of history, interpreting Idaho's heritage, providing for protection to historic and archaeological sites in Idaho, approval by the Society before historical markers may be erected on highways. providing for county support for historical societies and museums, providing for excavation of archaeological sites on public lands in Idaho, providing for local preservation commissions. requiring public notice and comment relating to historic site designation, and creating the Idaho archaeological survey.	

Table 13-3

Action-Specific ARARs and TBCs for Ecological Receptors in the Upper Basin Record of Decision (ROD) Amendment, Upper Basin of the Cour d'Alene River, Waste Consolidation Area (WCA)

Citation	Summary of Requirement	Evaluation	Regulatory Discussion	Design Basis Document
Federal				
RCRA: Subtitle C- Hazardous Waste Characteristics (40 CRF 261.20)	**Generators of solid waste must determine whether the waste is hazardous. A solid waste is hazardous if it exhibits the toxicity characteristic (based on extraction procedure Method 1311)**	**Applicable to characterization of unknown waste that may be encountered during remediation (e.g., buried drums.)**		

Citation	Summary of Requirements	Evaluation	Regulatory Description	Design Basis Document
40 CFR 261.20	A solid waste which is not excluded as a hazardous waste is a hazardous waste if it exhibits a characteristics of identified in 40 CFR 261.20	The characterization requirements are applicable for unknown solid wastes that may be encountered during remediation and placement in the WCA.	CFR 261.4 (b)(7) states that that solid waste from the extraction, beneficiation, and processing of ores and minerals (including coal, phosphate rock, and overburden from the mining of uranium ore), except as provided by §266.112 for facilities that burn or process hazardous waste are not hazardous wastes. For purposes of §261.4(b)(7) beneficiation of ores and minerals is restricted to the following activities; crushing; grinding; washing; dissolution; crystallization; filtration; sorting; sizing; drying; sintering; pelletizing; briquetting; calcining to remove water and/or carbon dioxide; roasting, autoclaving, and/or chlorination in preparation for leaching (except where the roasting (and/or autoclaving and/or chlorination)/leaching sequence produces a final or intermediate product that does not undergo further beneficiation or processing); gravity concentration; magnetic separation; electrostatic separation; flotation; ion exchange; solvent extraction; electrowinning; precipitation; amalgamation; and heap, dump, vat, tank, and in situ leaching.	
RCRA: Subtitle C- Hazardous Remediation Waste Management Requirements (HWIR-Media)(40 CFR 264.554)	**The use of staging piles can facilitate short-term storage of remediation wastes so that sufficient volumes can be accumulated for shipment to an offsite treatment facility or for efficient onsite treatment. The regulations contain performance standards for these piles.**	**The substantive requirements for 40 CFR 264.554 are applicable to remedial actions that involve the accumulation of hazardous waste prior to shipment offsite and are relevant and appropriate to remedial actions that involve the temporary consolidation and accumulation of contaminated mining waste prior to transport to a repository located within the Upper Basin.**		
40 CFR 264.554	Staging piles.	The substantive requirements for temporary consolidation and accumulation of contaminated mining wastes in staging piles are relevant and appropriate. Pursuant to 40 CFR §261.4 (b)(7) (Bevill Amendment), solid wastes from the extraction, beneficiation, and processing of ores and minerals are excluded from the RCRA Subtitle C requirements for managing hazardous wastes. The ROD Amendment is expected to incorporate an adaptive management approach, which will allow flexibility in the remedial design. EPA and the Trust must determine which (if any) of the substantive staging pile requirements are to be adopted.	Establishes the substantive requirements for defining a staging pile, locations, control, designation by the Director (for hazardous waste and remediation waste subject to land disposal restrictions) through a permit, standards and design criteria, certification, performance standards to prevent or minimize releases of hazardous constituents, operation time frames, prohibitions/conditions for staging piles of ignitable or reactive remediation waste, and prohibitions for staging incompatible wastes closure of staging pile.	
RCRA Subtitle C- Hazardous Waste Treatment and Storage (40 CFR 264 Subparts L and N)	**Requirements for storing or treating hazardous wastes in landfills and waste piles. Subpart F addresses groundwater monitoring at hazardous waste treatment, storage, and disposal facilities (TSDFs). Closure requirements for hazardous waste repositories are covered under Subpart G. Hazardous waste landfills must meet minimum design standards under Subpart N.**	**The substantive requirements related to the design, construction and operation and maintenance are relevant and appropriate to remedial actions that include or result in the storage and/or disposal of hazardous substances in landfills or waste piles. These regulations are applicable if the subject remedial actions involve the storage and/or disposal of hazardous wastes in landfills, or waste piles.**		
40 CFR Part 264 Subpart L	Subpart L - Waste Piles	The substantive requirements for temporary consolidation and accumulation of contaminated mining wastes in waste piles are relevant and appropriate. Pursuant to 40 CFR §261.4 (b)(7) (Bevill Amendment), solid wastes from the extraction, beneficiation, and processing of ores and minerals are excluded from the RCRA Subtitle C requirements for managing hazardous wastes. The ROD Amendment is expected to incorporate an adaptive management approach, which will allow flexibility in the remedial design. EPA and the Trust must determine which (if any) of the substantive waste pile requirements are to be adopted.	Establishes applicability to waste piles that store or treat hazardous waste and does not apply to owners or operators of waste piles that are closed with wastes left in place. Such waste piles are subject to regulation under subpart N. Subpart L establishes requirements for waste pile lining, leachate collection and removal, exemptions for alternate design and operating practices and location characteristics that will prevent the migration of any hazardous constituents into the ground water or surface water at any future time, top liner designed and constructed, sumps and liquid removal methods, run-on controls, run-off management system, collection and holding facilities associated with run-on and run-off control systems, control of wind dispersal inspection, notification, corrective action, reporting, prohibitions for ignitable or reactive waste and compatibility, closure and post-closure care.	
40 CFR Part 264 Subpart N	Subpart N - Landfills	The substantive requirements for temporary consolidation and accumulation of contaminated mining wastes in landfills are relevant and appropriate. Pursuant to 40 CFR §261.4 (b)(7) (Bevill Amendment), solid wastes from the extraction, beneficiation, and processing of ores and minerals are excluded from the RCRA Subtitle C requirements for managing hazardous wastes. The ROD Amendment is expected to incorporate an adaptive management approach, which will allow flexibility in the remedial design. EPA and the Trust must determine which (if any) of the substantive landfill requirements are to be adopted.	Establishes applicability to landfills that dispose of hazardous waste. Subpart N establishes design and operating requirements for liners, leachate collection and removal, exceptions, leachate collectio and removal system, leak detection system sumps, run-off management system, run-on and run-off control systems, control wind dispersal, monitoring and inspection, approved response action plan, notification, surveying and recordkeeping, closure and post-closure care, maintenance and monitoring , maintain and monitor the groundwater monitoring system, prevent run-on and run-off, prohibitions for hazardous waste containing free liquids, special requirements for containers, and conditions for reactive wastes.	
IDAPA 58.01.05.008 (40 CFR Part 264 Subpart N: 264.301b)	Idaho Rules and Standards for Hazardous Waste: Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities: Landfills: Design and Operating Requirements	The substantive requirements for temporary consolidation and accumulation of contaminated mining wastes in landfills are relevant and appropriate. Pursuant to 40 CFR §261.4 (b)(7) (Bevill Amendment), solid wastes from the extraction, beneficiation, and processing of ores and minerals are excluded from the RCRA Subtitle C requirements for managing hazardous wastes. The ROD Amendment is expected to incorporate an adaptive management approach, which will allow flexibility in the remedial design. EPA and the Trust must determine which (if any) of the substantive landfill requirements (i.e liner systems) are to be adopted.	Relates to an exemption of a liner system for landfills if owner/operator can demonstrate to the Regional Administrator that alternative design and operating practices, together with location characteristics, will prevent the migration of hazardous constituents into the groundwater or surface water at any future time.	
IDAPA 58.01.05.008 (40 CFR Part 264 Subpart N: 264.301d)	Idaho Rules and Standards for Hazardous Waste: Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities: Landfills: Design and Operating Requirements	The substantive requirements for temporary consolidation and accumulation of contaminated mining wastes in landfills are relevant and appropriate. Pursuant to 40 CFR §261.4 (b)(7) (Bevill Amendment), solid wastes from the extraction, beneficiation, and processing of ores and minerals are excluded from the RCRA Subtitle C requirements for managing hazardous wastes. The ROD Amendment is expected to incorporate an adaptive management approach, which will allow flexibility in the remedial design. EPA and the Trust must determine which (if any) of the substantive landfill requirements (i.e liner systems) are to be adopted.	Relates to an exemption of a liner system for landfills if owner/operator can demonstrate to the Regional Administrator that alternative design and operating practices, together with location characteristics, will prevent the migration of hazardous constituents into the groundwater or surface water at any future time and will allow the detection of leaks of hazardous constituents through the top liner at least as effectively.	

Citation	Summary of Requirements	Evaluation	Regulatory Description	Design Basis Document
IDAPA 58.01.05.008 (40 CFR Part 264 Subpart N: 264.301g - k)	Idaho Rules and Standards for Hazardous Waste: Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities: Landfills: Design and Operating Requirements	The substantive requirements for temporary consolidation and accumulation of contaminated mining wastes in landfills are relevant and appropriate. Pursuant to 40 CFR §261.4 (b)(7) (Bevill Amendment), solid wastes from the extraction, beneficiation, and processing of ores and minerals are excluded from the RCRA Subtitle C requirements for managing hazardous wastes. The ROD Amendment is expected to incorporate an adaptive management approach, which will allow flexibility in the remedial design. EPA and the Trust must determine which (if any) of the substantive landfill requirements are to be adopted.	Relates to the design, construction, and maintenance of run-on and run-off control systems; the control of particulate matter; and permit specifications to ensure all requirements in 40 CFR 264.301 are satisfied.	
IDAPA 58.01.05.008 (40 CFR Part 264 Subpart N: 264.303a(2), b)	Idaho Rules and Standards for Hazardous Waste: Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities: Landfills: Monitoring and Inspection	The substantive requirements for temporary consolidation and accumulation of contaminated mining wastes in landfills are relevant and appropriate. Pursuant to 40 CFR §261.4 (b)(7) (Bevill Amendment), solid wastes from the extraction, beneficiation, and processing of ores and minerals are excluded from the RCRA Subtitle C requirements for managing hazardous wastes. The ROD Amendment is expected to incorporate an adaptive management approach, which will allow flexibility in the remedial design. EPA and the Trust must determine which (if any) of the substantive landfill requirements (i.e monitorin and inspection of soil cover and run-on/run-off systems) are to be adopted.	Relates to the monitoring and inspection of soil covers and run-on/run-off systems.	
IDAPA 58.01.05.008 (40 CFR Part 264 Subpart N: 264.309)	Idaho Rules and Standards for Hazardous Waste: Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities: Landfills: Surveying and Record-Keeping	The substantive requirements for mapping are relevant and appropriate. Pursuant to 40 CFR §261.4 (b)(7) (Bevill Amendment), solid wastes from the extraction, beneficiation, and processing of ores and minerals are excluded from the RCRA Subtitle C requirements for managing hazardous wastes.	Relates to maintaining and updating a map of the landfill and documenting the types and locations of wastes placed in the landfill.	
IDAPA 58.01.05.008 (40 CFR Part 264 Subpart N: 264.310)	Idaho Rules and Standards for Hazardous Waste: Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities: Landfills: Closure and Post-Closure Care	The substantive requirements for cover at the final closure and post-closure requirements following closure are relevant and appropriate. Pursuant to 40 CFR §261.4 (b)(7) (Bevill Amendment), solid wastes from the extraction, beneficiation, and processing of ores and minerals are excluded from the RCRA Subtitle C requirements for managing hazardous wastes. The ROD Amendment is expected to incorporate an adaptive management approach, which will allow flexibility in the remedial design. EPA and the Trust must determine which (if any) of the substantive landfill requirements (i.e. maintenance and monitoring) are to be adopted.	Relates to cover requirements at final closure of the repository and post-closure requirements following final closure including maintenance and monitoring.	
RCRA Subtitle D-RCRA Criteria for Classification of Solid Waste Disposal Facilities and Practices (42 USC 6901 et seq.: 40 CFR 257)	**Certain criteria are required to be met by solid waste disposal facilities and practices, such as not restricting the base flow of the floodplain, not taking threatened or endangered species, and not causing a discharge to navigable waters.**	**The substantive requirements are relevant and appropriate to remedial actions that involve the consolidation of mine wastes in repositories or beneath protective barriers.**		
40 CFR Part 257 Subpart A Section 257.1 (c)	Classification of Solid Waste Disposal Facilities and Practices: Scope and Purpose	The solid waste disposal facilities and practices requirements are relevant and appropriate for the WCA.	The criteria apply to all solid waste disposal facilities and practices with the exceptions identified in Section 257.1 (c).	
40 CFR Part 257 Subpart A Section 257.3-1	Classification of Solid Waste Disposal Facilities and Practices: Criteria for Classification o Solid Waste Disposal Facilities and Practices: Floodplains	The solid waste disposal facilities and practices requirements for floodplains are relevant and appropriate for the WCA. The WCA will be located in a high mountain valley away from floodplains.	Facilities or practices in floodplains shall not restrict the flow of the base flood, reduce the temporary water storage capacity of the floodplain, or result in washout of solid waste, so as to pose a hazard to human life, wildlife, or land or water resources.	
40 CFR Part 257 Subpart A Section 257.3-2	Classification of Solid Waste Disposal Facilities and Practices: Criteria for Classification o Solid Waste Disposal Facilities and Practices: Endangered Species	The solid waste disposal facilities and practices requirements for endangered species are relevant and appropriate for the WCA. U.S. Fish and Wildlife Service (Service) did not identify any endangered or threatened species to be considered for the project.	Facilities or practices shall not cause or contribute to the taking of any endangered or threatened species of plants, fish, or wildlife. The facility or practice shall not result in the destruction or adverse modification of the critical habitat of endangered or threatened species.	
40 CFR Part 257 Subpart A Section 257.3-3	Classification of Solid Waste Disposal Facilities and Practices: Criteria for Classification o Solid Waste Disposal Facilities and Practices: Surface Water	The solid waste disposal facilities and practices requirements for surface water are relevan and appropriate for the WCA.	For purposes of section 4004(a) of the Act, a facility shall not cause a discharge of pollutants or dredged material or fill material into waters of the United States that is in violation of the requirements of the National Pollutant Discharge Elimination System (NPDES) under section 402 of the Clean Water Act, as amended. A facility or practice shall not cause non-point source pollution of waters of the United States that violates applicable legal requirements implementing an area-wide or Statewide water quality management plan that has been approved by the Administrator under section 208 of the Clean Water Act, as amended.	
40 CFR Part 257 Subpart A Section 257.3-4	Classification of Solid Waste Disposal Facilities and Practices: Criteria for Classification o Solid Waste Disposal Facilities and Practices: Groundwater	The solid waste disposal facilities and practices requirements for groundwater are relevant and appropriate. The ROD Amendment is expected to incorporate an adaptive management approach, which will allow flexibility in the remedial design. EPA and the Trust must determine which (if any) of the substantive landfill requirements (i.e. infiltratio to the ground) are to be adopted.	A facility or practice shall not contaminate an underground drinking water source beyond the solid waste boundary or beyond an alternative boundary.	
40 CFR Part 257 Subpart A Section 257.3-5	Classification of Solid Waste Disposal Facilities and Practices: Criteria for Classification o Solid Waste Disposal Facilities and Practices: Application to Land Used for the Production of Food-Chain Crops	The solid waste disposal facilities and practices requirements for food chain crops are relevant and appropriate. The WCA will not be located within the prescribed distance for the production of food-chain crops.	A facility or practice concerning application of solid waste to within one meter (three feet) of the surface of land used for the production of food-chain crops shall not exist or occur, unless in compliance with all requirements of certain paragraphs.	
40 CFR Part 257 Subpart A Section 257.3-6(a)	Classification of Solid Waste Disposal Facilities and Practices: Criteria for Classification o Solid Waste Disposal Facilities and Practices: Disease: Disease Vectors	The solid waste disposal facilities and practices requirements for disease vector control are relevant and appropriate. EPA and the Trust must determine which (if any) of the substantive cover requirements are to be adopted.	The facility or practice shall not exist or occur unless the on-site population of disease vectors is minimized through the periodic application of cover material or other techniques as appropriate so as to protect public health.	

Citation	Summary of Requirements	Evaluation	Regulatory Description	Design Basis Document
40 CFR Part 257 Subpart A Section 257.3-7	Classification of Solid Waste Disposal Facilities and Practices: Criteria for Classification o Solid Waste Disposal Facilities and Practices: Air	The solid waste disposal facilities and practices requirements for air and SIP areas are relevant and appropriate for the WCA.	The facility or practice shall not engage in open burning of residential, commercial, institutional, or industrial solid waste. This requirement does not apply to infrequent burning of agricultural wastes in the field, silvicultural wastes for forest management purposes, land-clearing debris, diseased trees, debris from emergency clean-up operations, and ordnance. For purposes of section 4004(a) of the Act, the facility shall not violate applicable requirements developed under a State Implementation Plan (SIP) approved or promulgated by the Administrator pursuant to section 110 of the Clean Air Act, as amended.	
40 CFR Part 257 Subpart A Section 257.3-8(d)	Classification of Solid Waste Disposal Facilities and Practices: Criteria for Classification o Solid Waste Disposal Facilities and Practices: Safety: Access	The solid waste disposal facilities and practices requirements for site safety and access are relevant and appropriate for the WCA.	Access. A facility or practice shall not allow uncontrolled public access so as to expose the public to potential health and safety hazards at the disposal site.	
RCRA Subtitle D-Disposal of Nonhazardous Solid Waste (42 USC 6901 et seq.: 40 CFR Part 285	**Provides criteria for cover material, run-on/run-off control systems, access control, and liquid restrictions.**	**The substantive requirements are relevant and appropriate to remedial actions that involve the consolidation of mine wastes in repositories or beneath protective barriers.**		
40 CFR Part 258 Subpart C, Section 258.21 (a and b)	Criteria for Municipal Solid Waste Landfills: Subpart C: Operating Criteria: Cover Material Requirements.	The solid waste disposal facilities and practices requirements for cover material are relevant and appropriate for the Scathe WCA is not defined as a municipal solid waste landfill (MSWL). EPA and the Trust must determine which (if any) of the substantive cover requirements are to be adopted.	Cover material must cover disposed solid waste with six inches of earthen material at the end of each operating day, or at more frequent intervals if necessary, to control disease vectors, fires, odors, blowing litter, and scavenging. Alternative materials of an alternative thickness (other than at least six inches of earthen material) may be approved by the Director of an approved State if the owner or operator	
40 CFR Part 258 Subpart C, Section 258.25	Criteria for Municipal Solid Waste Landfills: Subpart C: Operating Criteria: Access Requirements	The MSWL requirements for controlling access, vehicular traffic, and illegal dumping are relevant and appropriate for the WCA. The WCA is not defined as a municipal solid waste landfill (MSWL).	Municipal solid waste landfill unit must control public access and prevent unauthorized vehicular traffic and illegal dumping of wastes by using artificial barriers, natural barriers, or both, as appropriate to protect human health and the environment.	
40 CFR Part 258 Subpart C, Section 258.26 (a and b)	Criteria for Municipal Solid Waste Landfills: Subpart C: Operating Criteria: Run-on/Run off Control	The MSWL requirements for run-on/run-off control are relevant and appropriate for the WCA. The WCA is not defined as a municipal solid waste landfill (MSWL).	Municipal solid waste landfill must design, construct, and maintain a run-on control system to prevent flow onto the active portion of the landfill during the peak discharge from a 25-year storm; a run-off control system from the active portion of the landfill to collect and control at least the water volume resulting from a 24-hour, 25-year storm. The run-off from the active portion of the landfill unit must be handled in accordance surface water requirements	
40 CFR Part 258 Subpart C, Section 258.28 a	Criteria for Municipal Solid Waste Landfills: Subpart C: Operating Criteria: Liquid Restrictions	The MSWL requirements for placing liquid waste are relevant and appropriate for the WCA. The WCA is not defined as a municipal solid waste landfill (MSWL).	Bulk or noncontainerized liquid waste may not be placed in municipal solid waste landfill units unless the waste is household waste other than septic waste; or the waste is leachate or gas condensate derived from the MSWL unit and the MSWL unit, whether it is a new or existing MSWL, or lateral expansion, is designed with a composite liner and leachate collection system.	
Best Management Practices for Soil Treatment Technologies (OSWER, 1997)	**Provides technologies for controlling cross-media transfer of contaminants during materials handling activities.**	**TBC during excavation of contaminated soil.**		
US EPA, OSWER, EPA530-R-97-007 May 1997 Best Management Practices (BMPs) for Soil Treatment Technologies: Suggested Operational Guidelines to Prevent Cross-media Transfer of Contaminants During Clean-up Activities	BMP for containment technologies	The BMP for containment technologies are TBC for the WCA.	Generally accepted best management practices (BMPs) to minimize cross-media transfer of contaminants during remedial actions or corrective measure implementations when using containmen technologies to manage soils or solid media. BMPs are meant only to provide guidance and general recommendations on the operational practices of selected technologies.	
Clean Water Act/Water Pollution Control Act (33 USC 1251), Effluent Limitations (Sections 301-302), Water Quality Standards (Sections 303), Federal Water Quality Criteria (Section 304), National Performance Standards (Section 306), National Pollutant Discharge Elimination System (Section 402)	**These regulations govern water quality, including water discharged as part of a remedial process. Section 401-Water Quality Certification requires that EPA receive a water quality certification from a state that a given project requiring a federal permit that may result in a discharge to navigable water will comply with the state's water quality standards. Section 402. The NPDES program establishes a comprehensive framework for addressing processing water and stormwater discharges under the program. requires that point-source discharges not cause the exceedence of surface water quality standards outside the mixing zone. Specifies requirements under 40 CFR 122.26 for point-source discharge of stormwater form construction sites to surface water and provides for Best management Practices such as erosion control for removal and management of sediment to prevent run-on and runoff.**	**The substantive requirements are applicable as they apply to the operation of and discharges from remedial activities that involve the collection, treatment, and discharge of groundwater, surface water, stormwater, or other wastewaters.**		
33 U.S.C. Section §1251 et seq.; Clean Water Act (CWA)	Clean Water Act, Basics of the Regulatory Process Compliance Enforcement	The Clean Water Act requirements are applicable for the WCA.	CWA establishes the basic structure for regulating discharges of pollutants into the waters of the United States and regulating quality standards for surface waters. EPA has implemented pollution control programs such as setting wastewater standards for industry and contaminants in surface waters. CWA made it unlawful to discharge any pollutant from a point source into navigable waters, unless a permit was obtained. EPA's National Pollutant Discharge Elimination System (NPDES) permit program controls discharges.	
Effluent Limitations (Sections 301-302),	Section 301; Effluent Limitations and Section 302; Water Quality Related Effluent Limitations	The Clean Water Act requirements are applicable for the WCA.	Establishes effluent limitations (including alternative effluent control strategies) for point source which can reasonably be expected to contribute to the attainment or maintenance of such water quality	
Water Quality Standards (Sections 303)	Section 303; Water Quality Standards and Implementation Plans	The Clean Water Act requirements are applicable for the WCA.	Establishes procedures to ensure that any water quality standard applicable to interstate waters shall remain in effect unless the Administrator determined that such standard is not consistent with the applicable requirements of the FWPCA.	
Federal Water Quality Criteria (Section 304)	Section 304; Information and Guidelines	The Clean Water Act requirements are applicable for the WCA.	Requires EPA to develop and publish, criteria for water quality accurately reflecting the latest scientific knowledge.	

Citation	Summary of Requirements	Evaluation	Regulatory Description	Design Basis Document
National Performance Standards (Section 306)	Section 306; National Standards of Performance	The Clean Water Act requirements are applicable for the WCA.	Establishes standard of performance to control of the discharge of pollutants which reflects the greatest degree of effluent reduction which EPA determines to be achievable through application of the best available demonstrated control technology, processes, operating methods, or other alternatives, including, where practicable, a standard permitting no discharge of pollutants.	
National Pollutant Discharge Elimination System (Section 402)	Section 402; The National Pollutant Discharge Elimination System	The Clean Water Act requirements are applicable for the WCA.	The NPDES permit program regulates point source discharges of pollutants into waters of the United States by setting specific discharge limits for point sources discharging pollutants into waters of the United States and establishes effluent limitations on pollutants of concern; pollutant monitoring frequencies; reporting requirements; schedules of compliance; operating conditions; best managemen practices; and administrative requirements.	
40 CFR 122.26 for Point Source Discharge	Storm Water Discharges	The Clean Water Act requirements are applicable for the WCA.	Establishes permitting processes and discharge regulations for storm water. Specific requirements under 40 CFR 122.26 for point source discharges of storm water to surface water and provisions for BMPs to prevent sediment run-on and run-off.	
Clean Air Act (42 USC 7401 et seq.)	**Requires minimization of the harmful effects to air quality from excavation, construction, and other removal activities.**	**The substantive requirements of these regulations are relevant and appropriate to remedial actions that may involve the generation of fugitive dust (e.g., removal, transport, and consolidation of contaminated soil, waste rock, or sediments.**		
42 USC 7401 et seq; 40 CFR Part 50	National Ambient Air Quality Standards (NAAQS)	The National Ambient Air Quality Standards (NAAQS) are relevant and appropriate for the consolidation of contaminated soil, waste rock, or sediment in the WCA.	Establishes particulate and chemical standards for emissions that must be met during the removal, transport, and consolidation of soils, waste rock, and sediments. NAAQS's have been established for lead, particulate matter, PM_{10}, and $PM_{2.5}$.	
40 CFR Part 50	National Primary and Secondary Ambient Air Quality Standards (NAAQS)	The National Primary and Secondary Ambient Air Quality Standards (NAAQS) are relevant and appropriate for the consolidation of contaminated soil, waste rock, or sediment in the WCA.	Establishes requirements for the control of fugitive dust, including control of fine and course particulates and lead.	
Federal Clean Air Act (42 U.S.C. 7401 et seq)	Airborne Contaminants and Fugitive Dust	The Airborne Contaminant Fugitive Dust requirements are relevant and appropriate for the consolidation of contaminated soil, waste rock, or sediment in the WCA.	Provide guidance to minimize the harmful effects of fugitive dust and airborne contaminants from removal, transport, and consolidation of contaminated soil, waste rock, and sediment.	
Surface mining Control and Reclamation Act of 1977 (SMCRA) (30 USC 1201 et seq., 30 CFR 816)	**Requires the protection of human health and the environment form the adverse effects of current and past surface coal mining operations. Some of the potentially relevant and appropriate requirements for the removal of contaminated surface soil include: Stabilization of all exposed surface areas to effectively control erosion and air pollution attendant to erosion (30 CFR 816.95) AND Use of best technology currently available to (1) minimize disturbances to and adverse impacts on fish, wildlife and related environmental values and to achieve enhancement of such if possible, (2) conduct no activity that may jeopardize the continued existence of endangered species or that is likely to destroy or adversely modify their critical habitat: and (3) avoid disturbances to, enhance where practicable, or restore or replace wetlands, riparian vegetation, and habitats for fish and wildlife (30 CFR 816.97)**	**The substantive requirements are relevant and appropriate to the remediation of mines sites.**		
30 CFR 816: Section 816.95 (a and b)	Permanent Program Performance Standards: Surface Mining Activities: Stabilization of Surface Areas	The Permanent Program Performance Standards are relevant and appropriate to the construction and operation of the WCA.	Sets forth that all exposed surface areas shall be protected and stabilized to effectively control erosion and air pollution attendant to erosion. Rills and gullies, which form in areas that have been regraded and topsoiled and which either (1) disrupt the approved post mining land use or the reestablishment of the vegetative cover, or (2) cause or contribute to a violation of water quality standards for receiving streams shall be filled, regraded, or otherwise stabilized; topsoil shall be replaced; and the areas shall be reseeded or replanted.	
30 CFR 816: Section 816.97 (a through i)	Permanent Program Performance Standards: Surface Mining Activities: Protection of fish, wildlife, and related environmental values	The Permanent Program Performance Standards are relevant and appropriate to the construction and operation of the WCA.	Establishes protection of fish, wildlife, and related environmental values, to the extent possible, using the best technology currently available to minimize disturbances and adverse impacts on fish, wildlif and related environmental values and shall achieve enhancement of such resources where practicable. Considerations must be applied to endangered and threatened species and bald and golden eagles not to conduct activities to jeopardize the continued existence and not to unlawful take bald or golden eagle nest or any of its eggs. Best technology currently available shall be applied to electric power lines and other transmission facilities design and construct to minimize electrocution hazards, locate and operate haul and access roads so as to avoid or minimize impacts on important fish and wildlife species, design fences, overland conveyors, and other potential barriers to permit passage for large mammals, except where the regulatory authority determines that such requirements are unnecessary; and fence, cover, or use other appropriate methods to exclude wildlife from ponds which contain hazardous concentrations of toxic-forming materials. The operator conducting surface mining activities shall avoid disturbances to, enhance where practicable, restore, or replace, wetlands, and riparian vegetation along rivers and streams and bordering ponds and lakes. Surface mining activities shall avoid disturbances to, enhance where practicable, or restore, habitats of unusually high value fo fish and wildlife. Plant species to be used on reclaimed areas shall be selected on the basis of the proven criteria.	
National Emissions Standards for Asbestos (40 CFR Sections 61.145, 61.149 and 61.150) (CORRECTED CITATIONS)	**Any asbestos-containing materials encountered in mill demolition must be removed and disposed of in accordance with these regulations.**	**The substantive requirements are relevant and appropriate to remedial actions that involve the removal of asbestos-containing material.**		

Citation	Summary of Requirements	Evaluation	Regulatory Description	Design Basis Document
40 CFR 61.145 (a through c), 40 CFR 61.149 (a through f) and 40 CFR 61.150 (a through e)	National Emission Standard for Asbestos, Subpart M, Standard for demolition and renovation, Standard for waste disposal for asbestos mills, and Standard for waste disposal for manufacturing, fabricating, demolition, renovation, and spraying operations.	There is no anticipated action that would incorporate ACM into the WCA. The NESHAPs for asbestos are relevant and appropriate.	Establishes rules for applicability, notification, emission control, waste disposal, use a wetting agent, suspension of wetting agents during cold ambient temperatures, recordkeeping, use an alternative emission control and waste treatment methods, marking of transport vehicles, waste shipment records, certification, and reporting to authority for ACM management. Asbestos is not anticipated to be encountered in waste streams to be consolidated at the WCA.	
State				
Idaho Solid Waste Management Rules and Standards (IDAPA 58.01.06)	**Requires all solid waste be managed to prevent human health hazards, public nuisances, or pollution of the environment. Elements relating to landfill cover, surface water management, and erosion control may be ARARs.**	**The substantive requirements that are more stringent than federal requirements are relevant and appropriate to remedial actions that include the removal, transport, consolidation, and/or disposal of contaminated mine wastes.**		
IDAPA 58.01.06.009.03 (a through d)	Idaho Solid Waste Management Rules: Solid Waste Management Facility Classification, Tier II Facility	The WAC meets the definition of a TIER II Landfill. EPA and the Trust must determine if the TIER II classification and associated obligations are relevant and appropriate for the WCA.	Establishes general siting, operational and closure requirements. Tier II facilities are not required to install ground water monitoring wells, leachate collection systems or liners. Facilities shall be classified as a Tier II facility if the Department determines the facility is not: (1) landfilling or disposing of CESQG hazardous waste; (2) landfilling or disposing of materials with a high human pathogenic potential; (3) managing solid was in a manner or volume that will form toxic leachate or gas; or (4) managing solid waste in a manner or volume that is likely to pose a substantial risk to human health or the environment. A Tier II facility is one that meets the four (4) above criteria and is a non municipal solid waste (NMSW) landfill which has a total disposal capacity greater than two thousand (2000) cubic yards.	
IDAPA 58.01.06.012.01 (a through d)	Idaho Solid Waste Management Rules: Applicable Requirements for Tier II Facilities: General Siting Requirements	The WAC meets the definition of a TIER II Landfill. EPA and the Trust must determine if the TIER II classification and associated obligations are relevant and appropriate for the WCA.	Establishes procedures to complying with floodplain, endangered or threatened species, surface water, and park, scenic, or natural use restrictions. Repository should 1) not be located within the 100-year floodplain if it will restrict the flow of the 100-year flood, reduce the temporary water storage capacity of the floodplain, or result in a washout of solid waste so as to pose a hazard to human health and the environment; 2) not cause or contribute to the taking of any threatened or endangered species or their critical habitat; 3) should not cause contamination of surface waters; and 4) should not be located closer than 1,000 feet from the boundary of any state or national park or land reserved or withdrawn for scenic or natural use.	
IDAPA 58.01.06.012.02 (a through j)	Idaho Solid Waste Management Rules: Applicable Requirements for Tier II Facilities: Siting Application	The WAC meets the definition of a TIER II Landfill. EPA and the Trust must determine if the TIER II classification and associated obligations are relevant and appropriate for the WCA.	Requires that a map be created which identifies highways, roads, and adjacent communities; property boundaries; total site acreage; off-site and on-site access roads; land use adjacent to the site and a description of all facilities on the site; all water courses within 1/4 mile from the site boundary; high tension power lines, fuel transmission lines, and proposed and existing utilities in the site vicinity; proposed or existing fencing; proposed or existing structures on site and within 500 feet of the site boundary; and direction of prevailing winds.	
IDAPA 58.01.06.012.03 (a through h, i, and l)	Idaho Solid Waste Management Rules: Applicable Requirements for Tier II Facilities: General Operating Requirements	The WAC meets the definition of a TIER II Landfill. EPA and the Trust must determine if the TIER II classification and associated obligations are relevant and appropriate for the WCA.	Identifies general operating requirements including prohibited activities (e.g., disposal of medical and radioactive wastes), signage, waste types, waste monitoring and measurement, communication devices, fire prevention and control, facility access, scavenging and salvaging, nuisance control, and storm water run-on/run-off controls. Regarding facility access: unauthorized vehicles and persons shall be prohibited access to the facility. A facility open to the public shall accept waste only when an attendant is on duty. The facility shall be fenced or otherwise blocked to access when an attendant is not on duty.	
IDAPA 58.01.06.012.04	Idaho Solid Waste Management Rules: Applicable Requirements for Tier II Facilities: Operating Plan	The WAC meets the definition of a TIER II Landfill. EPA and the Trust must determine if the TIER II classification and associated obligations are relevant and appropriate for the WCA.	Requires development of an operating plan that includes a description of the wastes to be accepted, methods for maintaining compliance with operating requirements, and methods for complying with any applicable facility specific requirements.	
IDAPA 58.01.06.012.05 (a through e)	Idaho Solid Waste Management Rules: Applicable Requirements for Tier II Facilities: Closure Requirement	The WAC meets the definition of a TIER II Landfill. EPA and the Trust must determine if the TIER II classification and associated obligations are relevant and appropriate for the WCA.	Identifies closure and post-closure care requirements such as public notice, closure of the facility within 6 months of the approval of the closure plan, clean site and access control, drainage and erosion control (control run-on/run-off from a 25-year, 24-hour storm event), and submittal of a notice that the facility has been closed in accordance with the closure plan.	
IDAPA 58.01.06.012.06 (a through l)	Idaho Solid Waste Management Rules: Applicable Requirements for Tier II Facilities: Closure Plan Application	The WAC meets the definition of a TIER II Landfill. EPA and the Trust must determine if the TIER II classification and associated obligations are relevant and appropriate for the WCA.	Requires the closure plan to include: legal description of the facility; map of the facility including facility boundaries, drainage patterns, location of fill areas, location of access control measures, all water courses, location of disposal trenches, description of waste disposed, and proposed final contours of the facility; date of last receipt of waste; description of public access control; estimate of total cubic yards or tons of waste disposed; total acreage of facility; total acreage containing waste; closure equipment and procedures to be used; texture, depth and permeability of final cover; placement, design, and management of run-on/run-off controls; types of vegetation and planting procedures for establishing vegetative cover; and other closure information necessary to protect human health and the environment.	

Citation	Summary of Requirements	Evaluation	Regulatory Description	Design Basis Document
IDAPA 58.01.06.012.11 (a through l)	Idaho Solid Waste Management Rules: Applicable Requirements for Tier II Facilities: Tier II Non Municipal Solid Waste Landfill (NMSWLF)	The WAC meets the definition of a TIER II Landfill. EPA and the Trust must determine if the TIER II classification and associated obligations are relevant and appropriate for the WCA.	Identifies additional requirements such as siting requirements as follows: the facility shall not be constructed in a wetland, the facility shall not cause contamination to a drinking water source or to groundwater, and the facility should not be located closer than 100 feet to a property line. A design application should include a facility map illustrating surface water and erosion control systems; location of fill areas and trenches; location of borrow areas; design elevation grade or final cover; soil and water table test boring holes, wells or excavations; proposed receiving, processing, and storage areas; proposed trench layout and development; and contour lines at 5-foot intervals within the operating area and 10-foot intervals to the facility boundary. Also includes operating requirements such as compaction and placement of waste; provisions for storage of waste; application of a 6-inch soil cover layer on exposed waste; placement of an interim cover layer of 12-inches of compacted soil between lifts; and preservation of existing vegetation. Closure requirements include a final cover including an 18-inch compacted soil layer with in-place permeability design to minimize infiltration, and a 6-inch layer that minimizes erosion and sustains plant growth; facility stabilization and slope stability (final grade: minimum of 2% grade and 33% slope on the final surface after settlement; and drainage control. Other items include a deed notation and post-closure care plan.	
Mill and Mill Waste Remedial Guidelines and Best Management Practices (Coeur d'Alene Basin Restoration Project)	**Design and implementation of selected response actions should consider a number of factors and techniques for protecting water quality, fish and wildlife habitat while minimizing the potential for human exposure.**	**TBC**		
WAITING FOR BMP DOCUMENT				
Best Management Practices and Guidelines for Mine Tailings Repositories	**Provides guidelines for location, design, construction, and management of mine waste repositories.**	**TBC**		
Coeur d'Alene Restoration Project: Guidelines for Mine Tailings Repositories	Goals and Guidelines	The goals and guidelines for the design and construction of the WCA are TBC.	The goal is to develop non-regulatory, Coeur d'Alene Basin guidelines for mine waste repositories to guide development and management of long-term repository sites within the basin. Guidelines are needed for use by all project sponsors for location and design of repository sites to prevent human health hazards, and ground and surface water contamination. Guidelines are organized into four categories: Location, Design, Construction, and Management.	
Coeur d'Alene Restoration Project: Guidelines for Mine Tailings Repositories	Location Guidelines	The location guidelines for the design and construction of the WCA are TBC.	Some of the location guidelines are as follows: a proposed location should be relatively flat to accommodate maximum repository slope placement of 3:1; distance to a perennial or intermittent stream should be considered; site subsurface hydrology must be considered: depth to groundwater, soil, subsoil and bedrock permeability, land type stability; a repository should be located in an area of sub-basin already impacted by mining activities; and sites that are highly visible or easily accessible to recreationists or area residents may be considered if sufficient design or management controls can be economically applied to safe-guard the site and users.	
Coeur d'Alene Restoration Project: Guidelines for Mine Tailings Repositories	Design Guidelines	The design guidelines for the design and construction of the WCA are TBC.	Some of the design guidelines are as follows: provide for erosion control, including water diversion, proper grading, capping, riprap, etc.; reduce water infiltration as needed to prevent metal dissolution through suitable compaction of tailings, surface grading, and appropriate cap such as soil covering, vegetation, clay, or impermeable liner ore cap; minimize health threats and wildlife impacts by providing necessary fences or other barriers, as needed; and vegetate the repository surface with appropriate grasses, shrubs, or trees compatible with the general terrain. Repositories should blend with the surrounding landscape as much as possible.	
Coeur d'Alene Restoration Project: Guidelines for Mine Tailings Repositories	Construction Guidelines	The construction guidelines for the design and construction of the WCA are TBC.	The construction guidelines are as follows: determine construction methods required to achieve design in the most cost-effective, environmentally sound manner; plan construction details within a realistic work period that considers weather, precipitation, runoff periods, and local use patterns. Develop contracts that are flexible and can be adjusted for abnormal (good or bad) weather or water conditions; follow the appropriate worker safety plan to address worker contact/health issues; comply with applicable OSHA requirements; implement necessary erosion/sediment controls such as hay bales, silt screens, etc., to reduce short-term impacts; implement dust control measures as needed; and revegetate completed sections as soon as possible; do not allow unfinished projects to over-winter without effective vegetative or other erosion controls in place.	
Coeur d'Alene Restoration Project: Guidelines for Mine Tailings Repositories	Management Guidelines	The management guidelines for the design and construction of the WCA are TBC.	The management guidelines are as follows: a location map/sketch of the repository should be provided to the local Planning and Zoning office and Coeur d'Alene Basin Restoration Project (CBRP) Project Office. Provide adequate detail so ownership and location can be tracked into the future; determine agency or person responsible for future management; future use of the site should be managed compatible with the design of the facility. Secure assurance from site owner, manager, and county that future uses will be compatible with repository objectives; periodic inspections of the repository are needed to assure that necessary maintenance is conducted and site is functioning as designed; and necessary pre and post monitoring should be integrated into the CBRP monitoring plan, with specific monitoring responsibilities assigned and accepted by appropriate parties.	

Citation	Summary of Requirements	Evaluation	Regulatory Description	Design Basis Document
Idaho Rules Governing Exploration and Surface Mining-Best Management Practices, Reclamation (IDAPA 20.03.02.060, .140,.160)	**Reclamation requirements include best management practices for the protection of water quality, non-point sediment control, clearing and grubbing operations, overburden and topsoil requirements to enhance revegetation of disturbed areas, and road construction requirements to minimize erosion. Additional best management practices are specified for backfilling and grading and revegetation activities.**	**The substantive requirements that are more stringent than federal requirements are relevant and appropriate to remedial actions that include clearing and grubbing operations.**		
IDAPA 20.03.02.001.05	Rules Governing Exploration, Surface Mining, and Closure of Cyanidation Facilities: Title and Scope: Applicability	The substantive requirements are relevant and appropriate. The Idaho surface mining operation and exploration activities as defined in IDAPA 20.03.02.010 will not be conducted at the WCA site.	These rules apply to all exploration, surface mining operations, and permanent closure of cyanidation facilities on all lands in the state, regardless of ownership.	
IDAPA 20.03.02.060 (01 through 08)	Rules Governing Exploration, Surface Mining, and Closure of Cyanidation Facilities: Exploration Operations and Required Reclamation	The substantive requirements are relevant and appropriate. The Idaho surface mining operation and exploration activities as defined in IDAPA 20.03.02.010 will not be conducted at the WCA site.	Requires reclamation activities that are conducted on exploration sites shall be performed in a good, workmanlike manner with all reasonable diligence, and as to a given exploration drill hole; notify the Department of any operator desiring to conduct exploration using motorized earth-moving equipment to locate minerals for immediate or ultimate sale; conduct exploration reclamation (less than two acres) by contouring the affected lands; plugging abandoned exploration drill holes; and reclaim adjoining land if water runoff from exploration causes siltation of surface waters in amounts more than normally results from runoff. For exploration reclamation involving more than two acres), abandoned exploration roads shall be cross-ditched as necessary to minimize erosion; level ridges of overburden to have a minimum width of ten (10) feet at the top' level peaks of overburden to have a minimum width of fifteen (15) feet at the top; prepare erosion control for overburden piles; top dress abandoned lands affected by exploration; and prepare water containment structures so as not to constitute a hazard to humans or animals.	
IDAPA 20.03.02.140.01	Rules Governing Exploration, Surface Mining, and Closure of Cyanidation Facilities: Best Management Practices and Reclamation for Surface Mining Operation and Permanent Closure of Cyanidation Facilities: Nonpoint Source Control	The substantive requirements are relevant and appropriate. The Idaho surface mining operation and exploration activities as defined in IDAPA 20.03.02.010 will not be conducted at the WCA site.	Operators shall utilize Best Management Practices (BMPs) designed to achieve state water quality standards and to protect existing beneficial uses of adjacent waters of the state, but shall not be required to do more than is necessary to preserve the condition of runoff from the affected land or the cyanidation facility prior to conducting any exploration, surface mining or cyanidation facility operations. State water quality standards, including protection of existing beneficial uses, shall be the standard that must be achieved by BMPs unless the operator can show, and the director determines, that a lesser standard existed in the area to be affected prior to the commencement of the subject surface mining or exploration operations.	
IDAPA 20.03.02.140.02	Rules Governing Exploration, Surface Mining, and Closure of Cyanidation Facilities: Best Management Practices and Reclamation for Surface Mining Operation and Permanent Closure of Cyanidation Facilities: Sediment Control	The substantive requirements are relevant and appropriate. The Idaho surface mining operation and exploration activities as defined in IDAPA 20.03.02.010 will not be conducted at the WCA site.	The operator shall take necessary steps at the close of each operating season to assure that sediment movement associated with surface runoff over the area is minimized in order to achieve water quality standards, or to preserve the condition of water runoff from the mined area prior to commencement of the subject surface mining or exploration operations; whichever is the lesser standard. Requirement identifies specific sediment control methods that may be used.	
IDAPA 20.03.02.140.03	Rules Governing Exploration, Surface Mining, and Closure of Cyanidation Facilities: Best Management Practices and Reclamation for Surface Mining Operation and Permanent Closure of Cyanidation Facilities: Clearing and Grubbing	The substantive requirements are relevant and appropriate. The Idaho surface mining operation and exploration activities as defined in IDAPA 20.03.02.010 will not be conducted at the WCA site.	Operators are cautioned to keep clearing and grubbing areas as small as possible as the operator shall be required to meet the applicable surface water quality standards.	
IDAPA 20.03.02.140.04 (d) and (e)	Rules Governing Exploration, Surface Mining, and Closure of Cyanidation Facilities: Best Management Practices and Reclamation for Surface Mining Operation and Permanent Closure of Cyanidation Facilities: Overburden/Topsoil: Topsoil Placement and Fill	The substantive requirements are relevant and appropriate. The Idaho surface mining operation and exploration activities as defined in IDAPA 20.03.02.010 will not be conducted at the WCA site.	Abandoned affected lands shall be covered with topsoil or other type of overburden that is conducive to plant growth, to the extent such materials are readily available, in order to achieve a stable uniform thickness. Excessive compaction of overburden and topsoil is to be avoided. Topsoil redistribution shall be timed so that seeding, or other protective measures, can be readily applied to prevent compaction and erosion. Backfill and fill materials should be compacted in a matter to ensure stability.	
IDAPA 20.03.02.140.05	Rules Governing Exploration, Surface Mining, and Closure of Cyanidation Facilities: Best Management Practices and Reclamation for Surface Mining Operation and Permanent Closure of Cyanidation Facilities: Roads	The substantive requirements are relevant and appropriate. The Idaho surface mining operation and exploration activities as defined in IDAPA 20.03.02.010 will not be conducted at the WCA site.	Roads shall be constructed to minimize erosion. All access and haul roads shall be adequately drained. Roads shall be maintained at periodic intervals as needed. Roads that will not be re-contoured to approximate original contours upon abandonment shall be cross-ditched and revegetated, as necessary, to control erosion.	
IDAPA 20.03.02.140.06	Rules Governing Exploration, Surface Mining, and Closure of Cyanidation Facilities: Best Management Practices and Reclamation for Surface Mining Operation and Permanent Closure of Cyanidation Facilities: Backfilling and Grading	The substantive requirements are relevant and appropriate. The Idaho surface mining operation and exploration activities as defined in IDAPA 20.03.02.010 will not be conducted at the WCA site.	An operator who conducts surface mining or cyanidation facility operations which disturb 2 acres or more shall reduce all waste piles and depressions to the lowest possible grade. Backfill and fill materials should be compacted in a manner to ensure mass and surface stability. After the disturbed area has been graded, slopes will be measured for consistency with the approved reclamation plan or the permanent closure plan.	
IDAPA 20.03.02.140.07	Rules Governing Exploration, Surface Mining, and Closure of Cyanidation Facilities: Best Management Practices and Reclamation for Surface Mining Operation and Permanent Closure of Cyanidation Facilities: Disposal of Waste in Areas Other Than Mine Excavation	The substantive requirements are relevant and appropriate. The Idaho surface mining operation and exploration activities as defined in IDAPA 20.03.02.010 will not be conducted at the WCA site.	Waste material not used to backfill mined areas shall be transported and placed in a manner designed to stabilize the waste piles and control erosion. Design features should include diversion and drainage of surface water flows, compaction and grading of waste materials, and revegetation activities.	
IDAPA 20.03.02.140.08	Rules Governing Exploration, Surface Mining, and Closure of Cyanidation Facilities: Best Management Practices and Reclamation for Surface Mining Operation and Permanent Closure of Cyanidation Facilities: Settling Ponds; Minimum Criteria: Sediment Storage Volume, Water Detention Time, and Emergency Spillway	The substantive requirements are relevant and appropriate. The Idaho surface mining operation and exploration activities as defined in IDAPA 20.03.02.010 will not be conducted at the WCA site.	Settling ponds should provide adequate sediment storage capacity to achieve compliance with applicable water quality standards and protect existing beneficial uses. Settling ponds should also provide adequate theoretical detention time for water inflow and runoff and shall be designed to withstand and release storm flows as required by the Dam Safety Act. The WCA is not a tailings impoundment.	
IDAPA 20.03.02.140.09	Rules Governing Exploration, Surface Mining, and Closure of Cyanidation Facilities: Best Management Practices and Reclamation for Surface Mining Operation and Permanent Closure of Cyanidation Facilities: Tailings Impoundments	The substantive requirements are relevant and appropriate. The Idaho surface mining operation and exploration activities as defined in IDAPA 20.03.02.010 will not be conducted at the WCA site.	All tailings, dams, or other types of tailings impoundments shall be designed, constructed, operated, and decommissioned so that upon their abandonment, the dam and impoundment area will not constitute a hazard to human or animal life. The WCA is not a tailings impoundment.	

Citation	Summary of Requirements	Evaluation	Regulatory Description	Design Basis Document
IDAPA 20.03.02.140.10	Rules Governing Exploration, Surface Mining, and Closure of Cyanidation Facilities: Best Management Practices and Reclamation for Surface Mining Operation and Permanent Closure of Cyanidation Facilities: Permanent Cessation and Time Limits for Planting	The substantive requirements are relevant and appropriate. The Idaho surface mining operation and exploration activities as defined in IDAPA 20.03.02.010 will not be conducted at the WCA site.	Seeding and planting of affected lands and/or a permanently closed cyanidation facility should be conducted during the first normal period for favorable planting conditions after final seedbed preparation.	
IDAPA 20.03.02.140.11	Rules Governing Exploration, Surface Mining, and Closure of Cyanidation Facilities: Best Management Practices and Reclamation for Surface Mining Operation and Permanent Closure of Cyanidation Facilities: Revegetation Activities	The substantive requirements are relevant and appropriate. The Idaho surface mining operation and exploration activities as defined in IDAPA 20.03.02.010 will not be conducted at the WCA site.	The operator shall select and establish plant species that can be expected to result in vegetation comparable to that growing on the affected lands or on a closed cyanidation facility prior to surface mining or cyanidation facility operations, respectively. For locations with an average annual precipitation of more than twenty-six (26) inches, the director, in approving a reclamation or permanent closure plan, may set a minimum standard for success of revegetation as follows: Vegetative cover of seventy percent (70%) for two (2) full growing seasons in areas planted to herbaceous species only; or fifty percent (50%) vegetative cover for two (2) full growing seasons and six hundred (600) woody plants per acre in areas planted to a mixture of herbaceous and woody species. Introduced species may be planted if they are known to be comparable to previous vegetation, or if known to be of equal or superior use for the approved post-mining use of the affected land, or, if necessary, to achieve a quick, temporary cover for soil stabilization purposes.	
IDAPA 20.03.02.140.12	Rules Governing Exploration, Surface Mining, and Closure of Cyanidation Facilities: Best Management Practices and Reclamation for Surface Mining Operation and Permanent Closure of Cyanidation Facilities: Petroleum-Based Products and Chemicals	The substantive requirements are relevant and appropriate. The Idaho surface mining operation and exploration activities as defined in IDAPA 20.03.02.010 will not be conducted at the WCA site.	All refuse, chemical and petroleum products and equipment should be stored and maintained in a designated location away from surface water and disposed of in such a manner as to prevent their entry into a waterway.	
IDAPA 20.03.02.160	Rules Governing Exploration, Surface Mining, and Closure of Cyanidation Facilities: Best Management Practices and Reclamation for Surface Mining Operation and Permanent Closure of Cyanidation Facilities: Enforcement and Failure to Comply	The substantive requirements are relevant and appropriate. The Idaho surface mining operation and exploration activities as defined in IDAPA 20.03.02.010 will not be conducted at the WCA site.	Establishes right of inspection, bond forfeiture, civil penalty, injunctive procedures, and appeal of final order.	
Idaho Mine Tailings Impoundment Structure Rules (IDAPA 37.03.05)	**Design elements of the regulation may be relevant and appropriate to construction of regional repositories. Construction, enlargement, and alteration of mine tailings impoundments must conform to specific design specifications, spillways or diversion structures, cutoff walls, filters, and embankment slopes.**	**The substantive requirements of these regulations that are more stringent than federal requirements are relevant and appropriate to remedial actions that involve the consolidation of mine wastes in repositories or beneath protective barriers.**		
IDAPA 37.03.05	Mines Tailings Impoundment Structures: Section 045.01(f), Mine Tailings Impoundment Structures Design Criteria Section and Section 045.04(c), Borrowed Fill Embankment	The substantive requirements are relevant and appropriate. Mine tailings impoundment structures will not be constructed at the WCA site.	Establishes a design that shall consider the need for drains and/or operational procedures to promote consolidation and insure that a low phreatic surface is maintained within the embankment. Drainage pipe shall not be used beneath embankments where excessive or differential settlement may cause failure of the pipes and subsequent piping of the tailings or embankment. When the quality of the mine tailings slurry is such that it will adversely affect the quality of the existing groundwater, the design should be coordinated with the Department and the Department of Environmental Quality to insure that all applicable permits are obtained. The material shall be compacted by means of a loaded sheepsfoot roller, vibratory roller, or other acceptable means, to the required density.	
Idaho Stream Channel Alterations Rules (IDAPA 37.03.07)	**Governs the alteration of stream channels in Idaho**	**The requirements that are more stringent than federal requirements are applicable to remedial actions that involve the alteration of stream channels.**		
IDAPA 37.03.07	Stream Channel Alteration Rules	The stream channel alterations rules are applicable if the WCA involves defined actions.	Establishes rules and minimum standards to specify procedures for processing and considering applications for stream channel alterations.	
Idaho Water Quality Standards and Wastewater Treatment Requirements (IDAPA 58.01.02.800)	**Restrictions are placed on the discharge of waste waters and on human activities that may adversely affect water quality in state waters. Under IDAPA 58.01.02.800, hazardous and deleterious materials must not be stored, disposed of, or accumulated adjacent to or in the immediate vicinity of state waters unless adequate measures and controls are provided to ensure that those materials will not enter state waters. Deleterious materials are defined as any non-toxic substances that may cause the tainting of edible species of fish, taste and odors in drinking water supplies, or the reduction of the usability of water without causing physical injury to water users or aquatic and terrestrial organisms. Non-point source activities conducted in a manner that demonstrates a knowledgeable and reasonable effort to minimize resulting adverse water quality impacts are not subject to conditions or legal actions (IDAPA 58.01.02.350.02.a**	**The substantive requirements that are more stringent than federal requirements and as they apply to the operation of and discharges from remedial activities that involve the collection, treatment, and discharge of groundwater and surface water are relevant and appropriate to remedial actions that result in the consolidation of mine waste containing hazardous substances in repositories or otherwise buried beneath protective barriers (e.g. capped).**		
IDAPA 58.01.02.800 (01 and 02)	Hazardous and Deleterious Material Storage	The Idaho Hazardous and Deleterious Material Storage rules are relevant and appropriate if the WCA stores, disposes, or accumulates hazardous or deleterious materials adjacent to or in the immediate vicinity of state waters.	Establishes rules that state hazardous and deleterious materials must not be stored, disposed of, or accumulated adjacent to or in the immediate vicinity of state waters unless adequate measures and controls are provided to insure that those materials will not enter state waters as a result of high water, precipitation runoff, wind, storage facility failure, accidents in operation, or unauthorized third party activities. Criteria to be evaluated and delineation of materials are defined.	
Idaho Non-Point Source Management Plan, Final (December 1999)	**Remedial activities should be consistent with the state's goal of restoration, maintenance, and protection of the beneficial uses of both surface water and groundwater. Long-term goals include design and implementation of Best Management Practices for surface water and groundwater.**	**TBC**		
Idaho's Nonpoint Source Management Program	Idaho's Nonpoint Source Management Program	The Idaho Nonpoint Source Management Program is TBC.	Idaho's nonpoint source management program goal is to prevent and eliminate water pollution from nonpoint sources of water pollution in all water bodies in the state by focusing predominantly on implementing water quality activities prescribed in water body improvement plans known as Total Maximum Daily Loads (TMDLs). Activities are designed to protect and restore beneficial uses (such as swimming and fishing) and to prevent significant threats from present and future activities from degrading water quality.	

Citation	Summary of Requirements	Evaluation	Regulatory Description	Design Basis Document
Idaho Air Pollution Control Rules (IDAPA 58.01.01)	**Requires that remedial activities be designed to take all reasonable precautions to prevent particulate matter from becoming airborne, including the use of water or chemicals as dust suppressants, the covering of trucks, and the prompt removal and handling of excavated materials.**	**The substantive requirement that are more stringent that federal requirements are applicable to remedial actions that may involve the generation of fugitive dust (e.g., removal, transport, and consolidation of contaminated soil, waste rock, or sediments).**		
IDAPA 58.01.01.210.16	Demonstration of Preconstruction Compliance with Toxic Standards: Environmental Remediation Source	The Idaho Demonstration of Preconstruction Compliance with Toxic Standards are applicable for consolidation of contaminated soil, waste rock, or sediments at the WCA.	For remediation sources subject to or regulated by the RCRA (42 U.S.C. Sections 6901-6992k) and the "Idaho Rules and Standards for Hazardous Waste," (IDAPA 58.01.05.000 et seq.) or the Comprehensive Environmental Response, Compensation and Liability Act (42 U.S.C. 6901-6992k) or a consent order, if the estimated ambient concentration at the point of impact is greater than the acceptable ambient impacts listed in Sections 585 and 586, Best Available Control Technology shall be applied and operated until the estimated uncontrolled emissions from the remediation source are below the acceptable ambient concentration.	
IDAPA 58.01.01.650	Rules for Control of Fugitive Dust	The Idaho Rules for Control of Fugitive Dust are applicable for consolidation of contaminated soil, waste rock, or sediments at the WCA.	The purpose of Sections 650 is to require that all reasonable precautions be taken to prevent the generation of fugitive dust.	
IDAPA 58.01.01.651 (01 through 06)	General Rules	The Idaho General Rules for controlling particulate matter are applicable for consolidation of contaminated soil, waste rock, or sediments at the WCA.	Establishes rules requiring that all reasonable precautions shall be taken to prevent particulate matter from becoming airborne. In determining what is reasonable, consideration will be given to factors such as the proximity of dust-emitting operations to human habitations and/or activities, the proximity to mandatory Class I Federal Areas and atmospheric conditions which might affect the movement of particulate matter. Some of the reasonable precautions may include, but are not limited to, the following: use of water or chemicals, application of dust suppressants, use of control equipment, covering of trucks, paving, and prompt removal of materials.	
IDAPA 58.01.01.808. (01 and 02)	Fugitive Dust Control	The Control of Fugitive Dust are applicable for consolidation of contaminated soil, waste rock, or sediments at the WCA.	Establishes that no person shall cause, allow or permit a plant to operate that is not equipped with an efficient fugitive dust control system. The system shall be operated and maintained in such a manner as to satisfactorily control the emission of particulate material from any point other than the stack outlet. For property dust controls, the owner or operator of the plant shall maintain fugitive dust control of the plant premises and plant owned, leased or controlled access roads by paving, oil treatment or other suitable measures. Good operating practices, including water spraying or other suitable measures, shall be employed to prevent dust generation and atmospheric entrainment during operations such as stockpiling, screen changing and general maintenance.	
Idaho Land Remediation (IDAPA 58.01.18.027)	**Institutional controls may be used in instances where residual concentrations of chemicals exceed risk-based health standards, or when they are required to ensure the continued protection of human health and the environment of the integrity of the cleanup action.**	**The substantive requirements that are more stringent than federal requirements are applicable to remedial actions that do not result in a cleanup that is protective of un-restricted use of the property and are not otherwise covered by the Institutional Controls Program.**		
IDAPA 58.01.18.027.01 (a)	Idaho Land Remediation Rules: Institutional Controls: Purpose	The Idaho land remediation rules are applicable to persons who enter voluntary remediation agreements with the State. The rules are relevant and appropriate for managing wastes where metal level concentrations remain above regulatory levels after remediation.	Institutional controls may be proposed by the applicant or the Department as an element of the voluntary remediation work plan.	
IDAPA 58.01.18.027.03 (a and b)	Idaho Land Remediation Rules: Institutional Controls: Institutional Controls	The Idaho land remediation rules are applicable to persons who enter voluntary remediation agreements with the State. The rules are relevant and appropriate for managing wastes where metal level concentrations remain above regulatory levels after remediation.	Institutional controls may include physical measures such as fences and signs, to limit activities that may interfere with the cleanup action or result in exposure to hazardous substances at the site. Institutional controls may also include legal and administrative controls, such as zoning restrictions, restrictive covenants, or equitable servitudes used to ensure such measures are maintained.	
IDAPA 58.01.18.027.05 (a and b)	Idaho Land Remediation Rules: Institutional Controls: Legal Use Restriction Requirements	The Idaho land remediation rules are applicable to persons who enter voluntary remediation agreements with the State. The rules are relevant and appropriate for managing wastes where metal level concentrations remain above regulatory levels after remediation.	The legal use restriction requirements should prohibit activities on site that may interfere with a cleanup action, operation and maintenance, monitoring, or other measures necessary to assure the integrity of the cleanup action and continued protection of human health and the environment and prohibit activities that may result in the release of a hazardous substance contained as part of the remediation.	
Idaho Water Law (Title 42 of the 2011 Idaho State Statute)	**Evaluation of whether: withdrawal of water is for a beneficial use; the new use will damage existing water rights; water supply is sufficient for the purpose of the new use; the application was made in good faith and is not speculative; the applicant has sufficient resource to complete the project; the use does not conflict with local public interests; and the project is consistent with the conservation of water in Idaho.**	**The substantive requirements that are more stringent than federal requirements are applicable to remedial actions that include the collection of contaminated water that is conveyed to a downstream location for treatment.**		
PENDING				

Appendix K

Draft Specifications

Draft
Preliminary (30 Percent) Base Technical Specification Package

Successor Coeur d'Alene Custodial and Work Trust

December 2012

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