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GEI Consultants

Geotechnical
Environmental and
Water Resources
Engineering

FINAL
Coal Ash Impoundment - Specific Site Assessment Report
PacifiCorp Energy
Jim Bridger Power Station

Submitted to:
Lockheed-Martin Corporation
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Submitted by:
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September 2009
Project 091330

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1.0 Introduction

1.1 Purpose

This report presents the results of a specific site assessment of the dam safety of Flue Gas Desulphurization (FGD) Pond 1 embankment dam FGD Pond 2 embankment dam at the PacifiCorp Energy Jim Bridger Power Station in Point of Rocks, Wyoming. The specific site assessment was conducted on June 9 and 10, 2009.

These impoundments were assessed because their failure may result in significant economic loss, environmental damage, disruption of lifeline facilities or loss of life (significant or high hazard according to U.S. Environmental Protection Agency (EPA) classification). The specific site assessment was performed with reference to Federal Emergency Management Agency (FEMA) guidelines for dam safety, which includes other federal agency guidelines and regulations (such as U.S. Army Corps of Engineers and U.S. Bureau of Reclamation) for specific issues, and defaults to state requirements where not specifically addressed by federal guidance or if the state requirements were more stringent.

1.2 Scope of Work

The scope of work between GEI and Lockheed-Martin Corporation for the specific site assessment is summarized in the following tasks:

1. Acquire and review existing reports and drawings relating to the safety of the project provided by the United States Environmental Protection Agency (EPA) and Owners.

2. Conduct detailed physical inspections of the project facilities. While on-site, fill out Field Assessment Check Lists provided by EPA for each management unit being assessed.

3. Review and evaluate stability analyses of the project's coal combustion waste impoundment structures.

4. Review the appropriateness of the inflow design flood (IDF), and adequacy of ability to store IDF, provision for any spillways, including considering the hazard potential in light of conditions observed during the inspections or to the downstream channel.

5. Review existing performance monitoring programs and recommend additional monitoring.

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6. Review existing geologic assessments for the projects.

7. Submit draft and final reports.

1.3 Authorization

GEI Consultants, Inc., performed the coal combustion waste impoundment assessment for the EPA as a subcontractor to Lockheed Martin who is a contractor to the EPA. This work was authorized by Lockheed-Martin under P.O. No.: 7100052068; EAC #0-381 between Lockheed-Martin and GEI Consultants, Inc. (GEI), dated June 5, 2009.

1.4 Project Personnel

The scope of work for this task order was completed by the following personnel from GEI:

Stephen G. Brown, P.E.	Project Manager/Task Leader
Amber L. Misgen	Staff Geotechnical Engineer
Daniel L. Johnson, P.E.	Technical Reviewer

The Program Manager for the EPA was Stephen Hoffman. The Program Manager for Lockheed-Martin Corporation was Dennis Miller.

1.5 Limitation of Liability

This report summarizes the assessment of dam safety of the FGD Pond 1 and FGD Pond 2 coal combustion waste impoundments at the PacifiCorp Energy Jim Bridger Power Station, Point of Rocks, Wyoming. The purpose of each assessment is to determine the structural integrity of the impoundments and provide summaries and recommendations based the available information and on engineering judgment. GEI used a professional standard of practice to review, analyze, and apply pertinent data. No warrantees, express or implied, are provided by GEI. Reuse of this report for any other purpose, in part or in whole, is at the sole risk of the user.

1.6 Prior Inspections

FGD Pond 1 and FGD Pond 2 embankment dams are inspected every 5 years by the Wyoming State Engineer’s Office (SEO). The SEO last inspected the FGD Pond 1 and FGD Pond 2 dams in June of 2004. The SEO was on site to inspect all Jim Bridger Power Station Impoundments concurrently with the assessment on June 9, 2009. SEO provided copies of the Wyoming Dam Inspection Reports for FGD Pond 1, FGD Pond 2, and the Evaporation

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Pond for the 2009 and 2004 inspections. The last reported inspection of FGD Pond 1 and FGD Pond 2 by PacifiCorp personnel was February 2009; the last inspection by outside consulting engineers was performed in March 2009.

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2.0 Description of Project Facilities

2.1 General

Jim Bridger Power Station is a coal-fired power plant consisting of 4 units that generate about 2,110 megawatts (MW). The Jim Bridger Power Station is located 25 miles East of Rock Springs in Point of Rocks, Sweetwater County, Wyoming, see Figure 1. The power plant is located approximately 4 miles north of the Point of Rocks I-80 exit 130. FGD Pond 1 and FGD Pond 2 are located to the northwest of the power plant. PacifiCorp Energy (PacifiCorp) and Idaho Power Inc. own the power plant, which is operated by PacifiCorp. The first unit went online in 1974. FGD Pond 1 first went into service in 1979 and was expanded in 1989. FGD Pond 2 first went into service in 1990 and was expanded in 2002-2003.

2.2 Impoundment Dams and Reservoirs

FGD Pond 1 and FGD Pond 2 embankments are classified by the SEO Dam Safety Bureau as Significant Hazard potential structures because of their height and storage capacity and economic risk to property. The hazard classification is further discussed in Sections 6 and 10. Both impoundments are located in Sections 25, 26, 35, and 36 Township 21 North Range 101 West.

2.2.1 FGD Pond 1

The maximum height of FGD Pond 1 is 32.5 feet at the main dam (Dike A). The main dam has a cross-valley configuration and the saddle dike (Dike B) is configured as a perimeter dike. FGD Pond 1 has a storage capacity of about 1,340 acre-feet and its surface area is approximately 93 acres. FGD Pond 1 is currently in process of closure as the storage capacity of the impoundment has been reached. An interim cover has been constructed using 74 acre-feet of bottom ash to control fugitive dust during the permit closure process.

The FGD Pond 1 main dam crest is 22 feet wide and both upstream and downstream slopes have an approximate 3H:1V slope. The maximum height of the main dam is 32.5 feet. There is a 12 foot wide berm along the downstream toe. The embankment is zoned with a shale and silty clay core, silty sand shells, and a processed sand chimney and blanket drain. A clay pond liner extends 10 feet under the upstream embankment shell.

The maximum height of Dike B is 11 feet. The FGD Pond 1 Dike B is a homogenous silty sand or siltstone/sandstone embankment with a 12 foot wide crest and having upstream and downstream slopes at an approximate 3H:1V slope. The upstream side of the upstream slope

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has a 9 foot wide shale or silty clay low permeability zone, except at one section where the dike embankment is above the planned maximum water surface El. 6,697.

The FGD Pond 1 does not have a spillway. A drop inlet decant structure with a 36-inch diameter concrete encased corrugated metal pipe (CMP) outlet conveys fluid from FGD Pond 1 to FGD Pond 2. Dewatering wells have been installed to dewater FGD Pond 1. Water collected by the wells is pumped to the decant inlet structure where it flows by gravity into FGD Pond 2.

2.2.2 FGD Pond 2

The maximum height of FGD Pond 2 is 42 feet, which includes a 28 foot raise that was constructed in 2002-2003. The dam is configured as a long U-shaped perimeter dike. FGD Pond 2 has a storage capacity of about 11,534 acre-feet and its surface area is approximately 392 acres. As of March 13, 2009, 2,958 acre-feet of FGD solids and water is stored in FGD Pond 2. Plant operations maintain a maximum of 2 feet of free liquid above the FGD solids. The level of free liquid varies seasonally depending on evaporation rate and precipitation.

FGD Pond 2 dam crest is 18 feet wide and both upstream and downstream slopes have an approximate 3H:1V slope. The dam is made up of silty sand shell material, and lean to fat clay core material. Four different types of foundation preparation were specified in the design drawings based on conditions encountered in the field. As-built drawings provided do not reflect the foundation-embankment geometries constructed in the field.

A cement-bentonite seepage cutoff wall is provided along the centerline of the dam and extends 15 to 20 feet below the key trench. Where upstream shell of the embankment is founded on pond solids a heavy duty woven geotextile was placed on top of the pond solids before placing the embankment raise.

A pump back system with a series of well points is used to control underground seepage and mitigate surface water contamination along the northeastern boundary of FGD Pond 2. Collected water is returned to FGD Pond 2. FGD Pond 2 has a bird hazing system to protect local and migratory birds.

FGD Pond 2 does not have a liner, spillway, or outlet structure. FGD Pond 2 inlet structure is the former outlet structure of FGD Pond 1.

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Table 2.1: Impoundment Dam Parameters Summary

Parameter	Value		
Dam	FGD Pond 1 (Dike A)	FGD Pond 1 (Dike B)	FGD Pond 2
Height (ft)	32.5	11	42
Length (ft)	Approx. 2,200	1,800	Approx. 9,780
Crest Width (ft)	22	12	18
Crest Elevation (ft)	6,702.5	6,701.5	6,702
Side Slopes (H:1V)	3:1	3:1	3:1
Current Ash/Pool El. (ft)	6,702.5	6,701.5	6,674
Storage Capacity (ac-ft)	1,340		11,534
Surface Area (acres)	93		392

2.3 Vicinity Map

The Jim Bridger Power Station is located 25 miles East of Rock Springs in Point of Rocks, Sweetwater County, Wyoming, see Figure 1. The power plant is located approximately 4 miles north of the Point of Rocks I-80 exit 130. FGD Pond 1 and FGD Pond 2 are located just northwest of the power plant. The site is in a semi-arid high plains region characterized by cactus, sagebrush, and sparse grasses.

2.4 Standard Operational Procedures

The facility is manned full-time (24 hours a day and 7 days a week) and personnel perform daily inspections of ash pond facilities. There have been no known spills or unpermitted releases for either FGD Pond 1 or FGD Pond 2 in the past 10 years. FGD Pond 1 is currently in the closure process and is not receiving coal combustion waste materials. A closure Corrective Action Plan has been submitted to the Wyoming Department of Environmental Quality. The planned impoundment closure includes a bottom ash cover, dewatering of impounded materials, a soil cover, and an evapo-transpiration cover to keep water from infiltrating to the waste materials.

Water is pumped approximately 41 miles from the Green River and stored on site for plant blowdown water. The plant relies on two nearby mines, Bridger Coal mine and Black Butte Mine, to supply coal for its operations.

Typically 90 percent of the generated fly ash is sold commercially as Class F pozzolanic fly ash for use in concrete. Waste bottom ash is dewatered and disposed of in an industrial landfill located to the north of FGD Pond 2. Water-borne coal combustion waste that consists primarily of flue gas desulphurization solids is pumped from the plant via two above-ground pipes around FGD Pond 1 to the FGD Pond 1 concrete outlet structure, which

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now functions solely as the inlet structure for FGD Pond 2. No water-borne coal combustion waste is placed in FGD Pond 1.

The site receives an average of approximately 7 inches of rain annually and the pan evaporation rate is 30 to 36 inches annually.

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3.0 Summary of Construction History and Operation

The Jim Bridger Power Station went online in 1972. The surge pond, which stores river water pumped from the Green River for the cooling towers, was built in the early 1970s and was raised in the 1990s. FGD Pond 1 was put into service in 1979 and was raised in 1989. Dike B was raised 3 feet to El. 6,701.5, and Dike A was filled to achieve a level crest at El. 6,702.5. FGD Pond 2 was originally an evaporation pond. Construction of the FGD Pond 2 expansion was completed in 2003 and involved a 28-foot raise of the existing dikes. The expansion increased the storage capacity of the pond to serve the plant for approximately 40 years. PacifiCorp considers the life of FGD Pond 2 as nominally 30 years.

Foundation preparation for the FGD Pond 1 dam included a minimum 1 foot removal of existing soil and excavation of a key trench to a varied depth along the crest alignment. The presence of any coal combustion waste materials within the dam footprint is not indicated on the design drawings. Specific foundation conditions were not shown on the documents reviewed, except at the drain along the geologic contact between the Almond and Lewis Formations. This detail shows the embankment founded directly on shale or sandstone material. Evidence of prior releases, failures or patchwork construction were not observed during the site visit or disclosed by plant personnel during the site visit. Construction reports were not available for review.

The 2003 expansion of FGD Pond 2 raised the existing dikes by 28 feet. The raise was completed using onsite borrow materials except for imported granular drain material. The resulting dike is approximately 9,700 feet long and varies from 10 feet to 40 feet in height. A cement-bentonite cutoff wall was excavated from the key trench for the length of the dam and has a minimum depth of 15 feet and width of 2 feet.

FGD Pond 1 has been filled to capacity and is currently out-of-service awaiting closure. The current liquid elevation in FGD Pond 2 is El. 6,674, with a current freeboard of 28 feet. At the end of its service life, the highest water elevation in FGD Pond 2 will be El. 6,699 with an operating freeboard of 3 feet.

Effluent is conveyed to FGD Pond 1 via two 12-inch overland pipes. The current outlet structure in FGD Pond 1 will continue to be used to convey effluent to FGD Pond 2 until FGD Pond 1 has been closed.

A diversion channel has been constructed at the western end of FGD Ponds 1 and 2 to divert surface water up to the 100 year flood event around the impoundments.

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The foundation conditions at FGD Pond 2 vary over the length of the dike. Subgrade preparation requirements for FGD Pond 2 are documented as part of the 2003 dike raise drawings. Foundation preparation requirements for FGD Pond 2 included stripping topsoil to a minimum depth of 6 inches and excavating a key trench along the length of the dam alignment to a depth of about 2 feet. Special foundation preparation was required between Station 11+00 and 25+00 where the new dam was constructed over parts of the old evaporation pond berms and sediments. In these areas, the soft soils and sediments were excavated from beneath the footprint of the new dam, except for localized areas where the sediment was stabilized using a layer of granular soil and geotextile beneath the upstream shell of the dam. Evidence of prior releases, failures or patchwork construction were not observed during the site visit or disclosed by plant personnel during the site visit. Construction reports were not available for review.

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4.0 Geologic and Seismic Considerations

The site is situated along the northeastern flank of the Rock Springs Uplift. This north-south trending structural anticline formed during the Laramide Orogeny. The sedimentary beds dip northeasterly at approximately 5 degrees. Formations found at the site include the upper Cretaceous Fox Hills, Lewis, and Almond Formations. These formations are made up of sandstone, siltstone, shale, clay, and coal beds.

Geologic maps of the site show the Almond Sandstone outcropping along the southern boundary of FGD Pond 1. The Lewis/Almond contact outcrops at the western end of FGD 1 and underlies the western quarter of the pond.

Surface stream flow is mostly ephemeral during the spring and early summer months. Potash Wash is located north of FGD 2. Potash Wash flows east towards Deadmans Wash which joins with Bitter Creek. Bitter Creek is a tributary to Green River. Deadmans Wash flows from northwest to southeast at a distance of approximately 1,200 feet east of the impoundments.

Embankment stability studies at the site have used a peak ground acceleration of 0.10g for 95 percent probability of ground motion not being exceeded in a 50-year period. According to the United States Geological Survey National Seismic Hazard Mapping Project the peak ground motion for this site is on the order of 0.05g for a similar return period. The previous stability models for design of FGD Pond 2 used an acceptably conservative seismic coefficient of 0.10g for the pseudo-static stability analysis.

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5.0 Instrumentation

FGD Pond 1 and FGD Pond 2 do not have any embankment monitoring instrumentation. FGD Pond 1 has a downstream gravel trench to collect seepage through the left abutment and a sump pump to return the seepage to the impoundment. FGD Pond 2 has a series of well points and a pump station to collect seepage from the north side of the Pond and return it to FGD Pond 2.

At the time of our site visit, the FGD Pond 1 sump was nearly full of water, but the pump-back system had been disconnected. Site personnel advised this water is from the Evaporation Pond and is not seepage from FGD Pond 1 based on the color of the water.

The as-built drawings for FGD Pond 2 indicate that plans for installing settlement monuments and up to 8 piezometers were not implemented from the original design.

There are 56 wells installed on site for groundwater quality observation and an associated program of groundwater sampling and monitoring. Twelve of the wells are monitored quarterly. Thirty-two of the wells are monitored semiannually. These wells are not associated with monitoring the performance of the embankments or the seepage collection system.

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6.0 Field Assessment

6.1 General

Field observations of the FGD Pond 1 and FGD Pond 2 Impoundments were made on June 9, 2009, by Stephen G. Brown, P.E. and Amber L. Misgen, of GEI. The field assessment was attended by Joe Byron of the United States Environmental Protection Agency, Jeff Tucker of PacifiCorp Energy, and Michael Meyer, P.E. and Paul Falhsing, P.E. of PacifiCorp Energy Jim Bridger Power Station. The State of Wyoming was represented by Larry Stockdale, P.E. Safety of Dams Engineer and Louis Harmon, P.E., P.G., Water and Wastewater Program Manager. The Wyoming agency personnel conducted a separate inspection of the facilities and departed the site at the completion of their inspection.

The weather during the field assessment was generally overcast, windy, and a high temperature of 61 degrees. The site had received rain during the several days prior to the site visit and, as a result, ponded water was present at several locations.

A copy of the field checklists are provided in Appendix B and photographs are provided in Appendix C. Sections 6.2 and 6.3 describe observations made during the inspection relative to key project features. Section 6.4 presents specific observations.

6.2 FGD Pond 1

FGD Pond 1 is formed by the main dam (Dike A) at the south and a saddle dike, (Dike B) at the northeast. FGD Pond 1 is currently full and has an interim covering consisting of bottom ash. This impoundment is in the process of being closed. Wells have been installed to dewater the permanently stored material prior to construction of the permanent cover. The crest, abutments, and downstream slope were assessed during the June 9, 2009 inspection. The June 2009 will be the last SEO inspection of this impoundment according to the state inspectors.

6.2.1 Dam Crest

The dam crest appears to be in good condition. We saw no obvious signs of settlement or displacement, see photos 1 and 5.

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6.2.2 Upstream Slope

The upstream slope of the dam was not observed because it is covered with settled FGD solids and a temporary bottom ash cover. See photo 1, 2, 5, and 6.

6.2.3 Downstream Slope

The downstream slope of the dam, which consists of processed sand used for the dam shells, does not have additional erosion protection. Ponded water was observed near the downstream toe in a low area of an access road. This water was considered to be ponded rainwater from recent thunderstorms.

Seepage from the left abutment FGD Pond 1 is collected in a gravel-filled trench drain that is located approximately 300 feet downstream. Seepage collected by the trench drain flow to a sump and is then pumped to FGD Pond 1. The sump has been disconnected and is no longer in use since FGD Pond 1 has been filled and the dewatering system installed. The seepage from FGD Pond 1 is reported to be greatly reduced since the liquid levels in FGD Pond 1 have been lowered by the dewatering well system.

The downstream slope and toe berm of FGD Pond 1 are covered with thick mature sagebrush, grasses, and bushes. This vegetation should be removed to enable visual inspection of the dam and prevent roots from penetrating the dam. See photos 3 and 4. Except for the excessive vegetation, the downstream slope was observed to be in generally good condition. We recognize that FGD Pond 1 is not in service, has been dewatered, and is in the process of formal closure. According to PacifiCorp, the closure plan includes establishment of native vegetation including grasses, forbs, and sagebrush, on the final soil cover. While such vegetation with intrusive root systems is not acceptable on dam embankments, PacifiCorp may choose to incorporate the existing, or similar, vegetation into the final soil cover assuming FGD Pond 1 remains dewatered and closure cover construction occurs in the near future.

6.2.4 Outlet Works

The concrete decant inlet structure in FGD Pond 1 currently receives pumped effluent from the plant and effluent dewatered from the FGD Pond 1 well points. This structure currently serves as the inlet to FGD Pond 2 and no coal combustion waste is placed in FGD Pond 1.

The structure is missing the west and north safety railing. Surface soil and rock appears to be sloughing into the structure from the north. A few cobble sized rocks are present atop a metal screening and dead tumbleweed is present in the structure. The concrete appears to be in good condition considering the age of the outlet (See Photo 25).

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6.2.5 Emergency Spillway

There is no emergency spillway associated with FGD Pond 1.

6.2.6 Internal Drains or Toe Drains

FGD Pond 1 Dike A has a processed sand blanket and chimney drain on the downstream side of the core. There is no collection sump for seepage through the blanket drain. No seepage was observed at the downstream toe of the embankment.

Design drawings for FGD Pond 1 Dike B show that a pit-run gravel and sand toe drain was part of the design but was not part of the contract associated with the 1979 as-built drawings and was apparently not constructed.

6.3 FGD Pond 2

FGD Pond 2 is formed by a dam along the east and north, small saddle dikes on its northern and southern boundaries. A cement–bentonite cutoff wall is provided to reduce foundation seepage along the dam centerline and extends 15 to 20 feet below the key trench. Field observations of FGD Pond 2 included the dam crest, upstream face, and downstream face.

6.3.1 Dam Crest

The dam crest was generally level and in good condition with exception of a rutted area along the crest between FGD Pond 1 and Pond 2 that is attributed to vehicle activity on a wet area caused by snow melt. We saw no obvious signs of settlement or displacement. See photos 9, 12, 22, 30, and 36.

6.3.2 Upstream Slope

There was no visual evidence of slumps or bulges on the slope that would be indicative of stability issues. There are several of areas that are experiencing erosion. Near Station 46+00 in the groin, there are erosion rills that run from the crest to the water surface. Near Stations 73+00 and 84+00 where a pipe penetrates the dam near the crest there is erosion from mid-slope to the water surface. The pipes exit the upstream slope below the crest and they lay directly on the embankment. The pipes frequently freeze causing plant operations staff to cut openings into the pipes, see photos 15 to 20. These intentional openings allow fluid to spill out of the pipes and erode the embankment. Near Station 3+00 the ground shows significant erosion in a ramp constructed on natural ground, see photos 33 and 34. The erosion issues present on the upstream slope are repairable and at this time to not pose a dam safety issue.

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The upstream face of the dam does not have slope protection, see photo 35, and there is localized wave cutting erosion of the eastern embankment (Stations 10+00 to Station 40+00) that appears to extend about one foot above the reservoir water surface. This wave erosion could be alleviated with the addition of riprap armament or other slope protection, however, the 2001 Design Report considered the anticipated loss of embankment due to wave erosion to have negligible influence on the performance of the embankment because the eroded compacted fill of the embankment would be replaced by settled FGD solids. This assumption was justified in the 2001 Design Report because the planned 1.5-foot, or less, height of ponded water on top of the FGD solids would cause the wave heights to be small and the associated erosion to be small and the limited embankment erosion loss would be balanced by the planned annual infilling of about a foot of solids. Assuming the ponded water depth was 1.5 feet during the assessment, the observed erosion height of one foot above the water surface would result in a loss of about 7.5 foot horizontal distance of compacted fill from the embankment. Strength and permeability properties of the FGD solids were not developed in the 2001 design information. However, GEI expects that the FGD solids that replace the embankment fill would have lower strength properties compared to the original compacted embankment. The 2001 Design Report recommends addressing isolated areas of erosion by discharging effluent at multiple points to allow for immediate infilling of the affected areas. PacifiCorp has indicated that they do not plan to discharge at multiple points because it is not feasible. GEI considers the embankment that is lost to erosion and backfilled by FGD solids to be a sacrificial zone that does not contribute to the stability and seepage performance of the constructed dike. GEI considers the discharge of FGD solids at various locations to address localized areas of erosion to be feasible as one possible component of addressing erosion issues at FGD Pond 2.

Except for localized slope erosion and the wave erosion, the upstream slope was observed to be in good condition.

6.3.3 Downstream Slope and Toe

The downstream slope of the dam does not have additional erosion protection. It is currently grass covered. Near Station 59+00 a 24-inch-diameter CMP culvert was observed at the downstream toe that penetrates beneath the toe of the downstream slope, see photo 40. From the subsequent review of design documents, it appears that this culvert was associated with former saddle Dike III. Based on the drawings, the culvert extends from the downstream toe of Dike III a distance of approximately 225 feet to the north. The culvert should be removed or properly abandoned by grouting full and the affected embankment repaired as necessary. Prior to removing/abandoning the culvert the length and condition of the culvert should be confirmed.

The downstream slope and toe was observed to be in generally good condition.

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6.3.4 Emergency Spillway

There is no emergency spillway for FGD Pond 2.

6.3.5 Outlet Works

There is no outlet works for FGD Pond 2.

6.3.6 Internal Drains or Toe Drains

Seepage was being collected and pumped back into Pond 2 from the toe drain located between Station 80+00 and 91+75.

6.4 Field Assessment Observations

6.4.1 Settlement

No evidence of significant settlement of FGD Pond 1 and FGD Pond 2 embankments was observed.

6.4.2 Movement

No evidence was observed to indicate differential movement of the FGD Pond 1 and FGD Pond 2 dams or the FGD Pond 1 concrete decant inlet structure.

6.4.3 Erosion

Erosion observed on FGD Pond 2 is generally minor, its source is apparent, and easily could be repaired. The more significant erosion feature discussed above should be repaired and the cause of the erosion addressed to prevent.

6.4.4 Seepage

No evidence of significant seepage through FGD Pond 1 or FGD Pond 2 dam embankments. Seepage through both embankments has been mitigated with pump back systems. At FGD Pond 1 a collector trench and sump had been used in the past. Seepage at FGD Pond 1 is expected to continue to decline as the pond is dewatered and the sump pump is not in service any longer. Seepage and/or groundwater, was observed in the sump as it is continuing to flow and be collected by the trench drain. At FGD Pond 2, well points collect seepage and then the effluent is pumped back into FGD Pond 2.

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6.4.5 Cracking

No cracks were observed in the upstream or downstream slopes or the crests of the dams.

6.4.6 Deterioration

No significant deterioration of FGD Pond 1 and FGD Pond 2 dams and structures was observed.

6.4.7 Geologic Conditions

The geology of FGD Pond 1 and FGD Pond 2 project features is consistent with descriptions in the available reports. There have been no studies or events (landslide, earthquake, etc.) that would result in changes to the description of local geologic conditions.

6.4.8 Foundation Deterioration

No signs of foundation deterioration were observed for the FGD Pond 1 and FGD Pond 2 dams.

6.4.9 Condition of Spillway and Outlet Works

There is no spillway at FGD Pond 1 or FGD Pond 2. FGD Pond 1 outlet structure was observed to be in acceptable condition. The decant structure trashrack should be cleaned of debris and safety railings should be replaced, see photo 25. There is no outlet at FGD Pond 2 and water is only removed by evaporation.

6.4.10 Reservoir Rim Stability

No reservoir rim stability issues were observed.

6.4.11 Uplift Pressures on Structures, Foundations, and Abutments

There are no significant structures associated with the two impoundments. No evidence of uplift pressure issues was observed.

6.4.12 Other Significant Conditions

No other conditions were observed that would affect the safety of the project structures.

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7.0 Structural Stability

7.1 Visual Observations

The inspection team saw no visible signs of instability associated with the FGD Pond 1 and FGD Pond 2 dams during the June 9, 2009, site assessment.

7.2 Field Investigations

A Geotechnical Analysis Report for the FGD Pond 2 expansion was prepared by Maxim Technologies Inc. in 2001. Subsurface investigations performed at the site consisted of:

- In 2001, Maxim drilled 24 soil borings to depths ranging from approximately 20 to 66 feet below grade. Standard Penetration Tests (SPT) data was recorded in the field. Laboratory tests consisted of gradation, Atterberg Limits, moisture content, dry density, direct shear, swell/consolidation, moisture-density relationship, specific gravity, and resistivity and pH. Temporary casings were installed in select borings to allow ground water level monitoring. Field permeability tests were performed in the bedrock.
- The 2001 Maxim report references previous laboratory testing completed by Bechtel in 1973. This design document was not reviewed.

The stability analyses performed for the FGD Pond 1 construction and raise were not received for this review. While FGD Pond 1 Dike A and B have shown no signs of stability issues over the years, an analysis of FGD Pond 1 Dikes A and B would be advisable to address the loading conditions for the planned closure.

FGD Pond 1 Dike B poses little risk to property or life as a failure would release materials into FGD Pond 2, which contains similar materials. As FGD Pond 2 fills with solids, it will act as a toe berm to increase the stability of Dike B.

The design report for FGD Pond 1 Dikes A and B was not available for review for this assessment. As-built drawings for Dikes A and B were provided but did not provide any documentation of the stability analyses completed for design.

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7.3 Discussion of Stability Analysis

7.3.1 FGD Pond 1

No stability analyses were provided to GEI from the design of FGD Pond 1. GEI completed a representative static-steady seepage analysis for the maximum section of Dike A using material properties developed for the FGD Pond 2 analyses.

7.3.2 FGD Pond 2

The 2001 study was completed to evaluate the stability of the proposed FGD Pond 2 embankment expansion by evaluating five cross section locations. Using STABL version 6, developed by Purdue University, stability under steady seepage conditions and end of construction conditions were evaluated using the Modified Bishop Method. For the seismic case, an equivalent acceleration of 0.1g was applied as a pseudostatic coefficient to the embankment. It was noted that a ground acceleration of 0.05g is appropriate for the region.

The material properties used in the stability modeling were based on laboratory testing of site-specific materials and engineering judgment. The modeled sections were based on the design geometry. The five sections evaluate stability at the most critical sections of the embankment. Areas where pond solids or other weak foundation conditions were stabilized by a layer of granular fill and geotextiles were not included in the stability models, which implies the design considered the strength of the stabilized material to be equal to or higher than the surrounding dam and foundation materials. Similarly, the stability analyses did not include the cutoff wall, which implies the design considered the strength of the cement-bentonite cutoff wall to be equal to or higher than the strength of the surrounding foundation materials.

Old dike materials that underlie some parts of the embankment were not modeled in the pertinent stability cross-sections. The old dike materials were primarily removed where key trench was excavated and remain in some locations beneath the dam shells. The original dikes and the new dam embankment were constructed of onsite borrow materials and this similarity in materials may explain why different embankment material properties were not assigned.

The phreatic surface used in the models was based on seepage output from the SEEP2D software developed by the United States Army Engineer Waterways Experiment Station. Input and output data was visualized using GMS, a graphical user interface program developed by Brigham Young University. Hydraulic conductivity values were based on field tests, laboratory tests, and engineering judgment. Seepage analyses were completed for a full

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reservoir of water El. 6,699, which neglects the benefits of a longer seepage path as the impoundment fills with solids.

7.4 Factors of Safety

7.4.1 FGD Pond 1

No stability analyses were provided to GEI from the design of FGD Pond 1. GEI completed a representative static-steady seepage analysis for the maximum section of Dike A and using material properties developed for the FGD Pond 2 analyses. The phreatic surface was estimated based on engineering judgment. Upstream slope protection material was ignored and the core was modeled as a single material type. The resulting factor of safety exceeds the minimum FERC requirement of 1.5. GEI performed a sensitivity analysis of modeling the impoundment at the high water elevation of 6,694 and at the crest elevation of 6,702.5. Factors of safety exceeded the minimum FERC requirements in all cases modeled (see Appendix E.1).

7.4.2 FGD Pond 2

We reviewed the computed factors of safety for the embankment design contained in the 2001 Design Report (Maxim, 2001), which indicates the factors of safety for static steady-seepage, earthquake (pseudostatic), and end of construction loading conditions meet or exceed the required minimum factors of safety as defined by the FERC and the SEO Dam Safety Bureau. The criteria are minimum factors of safety of 1.5 for steady-state seepage, 1.0 for pseudostatic seismic stability, and 1.1 for end of construction.

However, GEI was unable to reproduce the factors of safety reported in the 2001 Design Report (see Appendix E.2). The check analyses at one location and cross-section of the embankment by GEI resulted in factors of safety lower than those reported in the 2001 Design Report for end of construction and steady seepage analysis. The *steady seepage with a cutoff wall* analysis at Section 8+00 resulted in a factor of safety of 1.33, which is lower than the 1.5 factor of safety reported in 2001 for this section and lower than the minimum required FERC factor of safety of 1.5.

GEI performed several stability analyses in an attempt to replicate the stability results presented in the 2001 Design Report. These included varying the phreatic surface downstream of the core and specifying the coordinates of the failure surfaces reported in the 2001 Design Report. The resulting factors of safety were lower than presented in the Design Report for the range of conditions analyzed. In order to meet FERC factor of safety guidelines for this analysis, it was necessary to model the steady seepage with a cutoff wall

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analysis at Section 8+00 with a phreatic surface having zero excess head in the downstream shell, which would not be a conservative design assumption. To provide comparable analyses to those in the 2001 Design Report, GEI did not neglect the sacrificial erosion zone in the embankment model. Inclusion of the sacrificial erosion zone in stability analysis of embankment is expected to result in further reductions in the calculated factor of safety due to a net steepening of the upstream slope for pond operations based on the pond life cycle analysis.

GEI's review analyses were completed with GeoStudio 2007 v. 7.14 stability module SLOPE/W, by GEO-SLOPE International, Ltd. As indicated in Table 7.1, the minimum calculated factor of safety resulting from GEI's review of the static – steady seepage analyses is less than required.

Table 7.1: Stability Factors of Safety for FGD Pond 2 and Guidance Values

Loading Condition	Min. Calculated FOS (2001 Report)	Min. Calculated FOS (GEI Review)	Min. Required FOS
Full Reservoir – Static-Steady Seepage	1.5	1.33 (at Station 8+00)	1.5
Full Reservoir – SS with pseudostatic earthquake (0.1g)	1.1	1.18	1.0
End Of Construction	1.4	1.23	1.1

Based on our field observations, the FGD Pond 2 embankment appears to be performing adequately in terms of stability and seepage. However, the FGD Pond 2 is in the early stages of filling and it would be prudent to re-evaluate the static stability and seepage stability in the near term to address the questions regarding the design analyses and characterize the embankment geometry consistent with the sacrificial zone, or to include material properties of FGD solids if they are to be considered part of the embankment, Pond management operations should be monitored to follow the life cycle operations analysis and to maintain measured embankment erosion within the embankment geometry used to establish the stability of the facility.

7.5 Seismic Stability - Liquefaction Potential

The liquefaction potential was not analyzed for the expansion of FGD Pond 2. Liquefiable soils were not encountered during the soil investigation performed for FGD Pond 2 and are also not expected to be present in FGD Pond 1.

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7.6 Summary of Results

7.6.1 FGD Pond 2

The stability analyses that have been performed for FGD Pond 2 appear to have been performed for the most critical sections of the embankment.

The structural stability of four of the five embankment sections evaluated for FGD Pond 2 meets or exceeds the minimum required factors of safety in accordance with FERC guidelines. Check analyses completed by GEI show the factor of safety for steady seepage conditions is 1.33 at FGD Pond 2 Station 8+00, which is below the FERC minimum required criteria of 1.5. A factor of safety of 1.33 is substantially below the required factor of safety, however it does not indicate impending instability. The check analyses performed by GEI resulted in lower calculated factors of safety for steady seepage and end of construction conditions than reported in the 2001 Design Report. It is concerning that the design stability analyses are not reproducible.

The 2001 design stability and seepage analyses are not fully representative of the as-constructed conditions. Importantly, the sacrificial zone of the embankment that is lost to wave erosion and the resulting steepened upstream slope is not represented in the cross-sections analyzed for stability or seepage. The cement-bentonite slurry wall is not included in the stability cross-sections, however the strength of the cement-bentonite wall is expected to be equal or higher than the surrounding materials. At several locations, the FGD Pond 2 dam embankment is constructed on top of old dike materials or pond solids. The strength properties of these underlying materials is not discussed or accounted for in the 2001 Design Report, except that these materials may have been considered to have equivalent properties to the engineered fill of the new embankment and did not need to be distinguished in the analysis, which may not be a conservative approach.

A filter compatibility evaluation was not included in the 2001 Design Report for the granular stabilization material beneath the upstream and downstream shells of the dam. The filter compatibility for the toe drain should also be reviewed.

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8.0 Spillway Adequacy

8.1 Floods of Record

Floods of record have not been evaluated for the ponds at the Jim Bridger facility.

8.2 Inflow Design Floods

Inflow design flood information was included in the FGD Pond 2 Design Report and consisted of back-to-back 100 year events over the basin plus a 100-year event occurring on the pond area. This inflow design flood was approved by the Wyoming SEO and resulted in a 1 foot flood surcharge on the pond area. The inflow design flood for a Significant Hazard Dam would generally be one-half the Probable Maximum Flood (PMF) based on FERC guidelines and federal dam practice.

8.2.1 Determination of the PMF

The PMF was not evaluated in the design of FGD Ponds 1 and 2. For the purpose of this review, a preliminary estimate of the Probable Maximum Precipitation (PMP) hydrology of the basin is discussed below.

A 24-hour, 10 square mile PMP is estimated to be 18 inches and the ½ PMP would be 9 inches or 0.75 feet.

FGD Pond 1 would receive 9 inches falling directly on its surface plus water from an estimated additional 123 acres of contributing basin area. FGD Pond 1 has an upstream diversion ditch that is sized for the 100 year, but is considered to convey ¼ of the 100 year before the ditch fails for this analysis. The resulting inflow to the pond is 0.35 feet of surcharge in the pond. The total for the Probable Maximum Flood (PMF) is 1.1 feet of surcharge on the pond. FGD Pond 1 has limited freeboard as it is nearly full of ash. Based on the interim cover grading plan, which indicates that Dike B is one foot lower than the Main Dam, a majority of this flood would run-off towards Dike B. The existing decant outlet structure located at Dike B is considered to have limited capacity during such a large, rare flood to convey the inflow flood to FGD Pond 2. The remaining flood flows would likely overtop Dike B and flow into FGD Pond 2.

Similarly, FGD Pond 2 would receive 9 inches falling directly on its surface plus runoff from an estimated 1,148 acres of total contributing basin area, which includes the pond area. FGD Pond 2 has an upstream diversion ditch that is sized for the 100 year, but is considered to convey ¼ of the 100 year before the ditch fails for this analysis. Adjusting the volume by deducting the flood

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captured by the diversion ditch before the ditch fails results in an inflow flood of an estimated 798 acre-feet into a 392 acre pond, which results in a 2 foot surcharge on the pond.

Additionally, there is a potential to add 0.25 feet for runoff from FGD Pond 1, as discussed above, for a total of 2.25 foot surcharge on FGD Pond 2. FGD Pond 2 was designed for 3 feet of freeboard and can store the ½ PMF.

8.2.2 Freeboard Adequacy

The freeboard at FGD Pond 1 is not adequate because the freeboard has been nearly eliminated by filling the pond to just below the dam crest with solids. Large, rare, storm inflow floods to FGD Pond 1 are expected to runoff over Dike B and into FGD Pond 2 with a potential to erode and damage Dike B.

The available freeboard at FGD Pond 2 is adequate based on the design inflow flood and for the ½ PMF.

8.2.3 Dam Break Analysis

Dam break analyses have not been performed for the either FGD Pond 1 or 2 embankments. FGD Ponds 1 and 2 are currently classified as Significant Hazard and we concur with this rating as a minimum. FGD Pond 1 is out-of-service, full of ash that is in a dewatered state from pumping, and the pond will be undergoing closure following an approved closure plan. Therefore, a dam break analysis is not considered necessary for FGD Pond 1.

A dam break analysis for FGD Pond 2 would be based on the assumption that the impoundment is filled to capacity with materials that behave as a liquid. Breach flows would cross a county road that is located within a few hundred feet downstream of the dam. The drainageway is a broad, dry wash and flood flows would need to travel for about 7 miles to reach the I-80 embankment, which crosses the drainage. A visual inspection of the drainage way at the I-80 embankment indicates a potential for a breach flood, if substantial flows are not otherwise attenuated upstream in the drainageway, to overtop Interstate 80. At the location where the main drainage meets I-80, the drainage is restricted, the I-80 embankment and the railroad embankment terminate the drainage with a potentially small storage capacity, and the available culverts appear undersized for the anticipated flow. If the results of a dam break analysis indicate that I-80 would be overtopped, then there would be an associated high potential for loss of life. We recommend dam break analyses and inundation mapping be performed for FGD Pond 2.

8.2.4 Spillway Rating Curves

There are no spillways associated with either FGD Pond 1 or FGD Pond 2.

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9.0 Adequacy of Maintenance and Methods of Operation

9.1 Procedures

Currently there is no formal Operation & Maintenance Manual in use at the Jim Bridger Plant. Engineering staff is currently considering formalizing the standard operational procedures to inspect, maintain, report, and operate the system. Several of the plant engineers and operating personnel have been with the facility for many years. The power plant is manned 24 hours a day, seven days a week. There is a daily equipment check performed by plant personnel.

9.2 Maintenance of Impoundments

Maintenance of the two impoundments is performed by Jim Bridger Plant staff under the guidance of PacifiCorp managers and engineers.

9.3 Surveillance

The impoundments are patrolled by plant personnel. Plant personnel are available at the power plant and on 24-hour call for any emergencies that may arise. There are no automatic alarm systems at the impoundments.

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10.0 Emergency Action Plan

An Emergency Action Plan (EAP) and inundation mapping has not been developed for the Significant Hazard dams at this site and is not required as part of the dam safety program in Wyoming.

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11.0 Conclusions

11.1 Assessment of Dams

11.1.1 Field Assessment

The FGD Pond 1 and FGD Pond 2 embankments were generally found to be in satisfactory condition.

11.1.2 Stability Analysis (Adequacy of Factors of Safety)

The check stability analyses completed by GEI for FGD Pond 2 embankment expansion meet the minimum required factors of safety criteria according to SEO and the FERC guidance, except the steady seepage analysis at Station 8+00 yields a factor of safety of 1.33, which is lower than required. These analyses generally include use of appropriate material properties and loading conditions, however, the modeled geometry does not account for the loss of upstream embankment due to wave erosion and potential weaker materials underlying parts of the dam shells that were not explicitly addressed in the models. While GEIs review analysis factor of safety for FGD Pond 2 at Station 8+00 is substantially below the required minimum, it does not indicate impending instability of the dam. Our field observations indicate the embankment was performing satisfactorily at the time of the assessment.

The check analyses performed by GEI for steady seepage and end of construction loading conditions resulted in lower factors of safety than the 2001 design analyses. While some variance in stability model results can be expected, the difference between the results or our check analyses and those reported in the 2001 design is significant. The factors of safety reported in the 2001 Design Report were not reproducible based on the information provided in Appendix D of the report.

11.1.3 Embankment Settlement at Station 54+00

The addendum to the design report (Maxim, 2002) discusses a concern for soils that exhibit collapse potential in the foundation near Station 54+00. It was advised in the addendum appendix that this area should be observed at least once every three months for the first year and once every year thereafter for cracking and/or settlement. While no obvious signs of settlement or cracking were observed in this area during our site visit, the monitoring advised by the addendum is sound and should be a documented part of operations. Particular attention to monitoring this area should be made as the embankment and foundation become saturated.

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11.1.4 Spillway Adequacy and Outlet Works

Neither FGD Pond 1 nor FGD Pond 2 has emergency spillways. FGD Pond 1 is nearly full of solids and has little freeboard. Therefore, large floods would be assumed to runoff from FGD Pond 1 and, based on the crest elevation of Dike B being one foot lower than the main dam crest, this runoff would flow primarily into FGD Pond 2. Runoff from Pond 1 should be managed to avoid erosion damage to Dike B.

FGD Pond 2 was designed to have 3 feet of operating freeboard, which is sufficient to store the ½ PMF for Pond 2 as well as runoff for the ½ PMF from Pond 1. The available storage in FGD Pond 2 exceeds the requirement to safely store the ½ PMF in accordance with general federal engineering practice for Significant Hazard dams. A preliminary estimate of the PMP was made for purposes of this report.

FGD Pond 1 decant outlet structure functions adequately as the inlet for FGD Pond 2. The inlet receives pumped effluent from the plant and the water from FGD Pond 1 dewatering well points.

11.2 Adequacy of Maintenance and Surveillance

FGD Pond 1 and Pond 2 have acceptable maintenance and surveillance programs, except for instrumentation and vegetation and the need to verify a culvert identified during the assessment. Instrumentation is lacking for both FGD Pond 1 and FGD Pond 2. The excessive vegetation on FGD Pond 1 main dam should be controlled until it is officially closed because its status as an impoundment necessitates basic maintenance, including control of vegetation. While such vegetation with intrusive root systems is not acceptable on dam embankments, PacifiCorp may choose to incorporate the existing, or similar, vegetation into the final soil cover in accordance with the closure plan assuming FGD Pond 1 remains dewatered and closure cover construction occurs in the near future. Evaluate the purpose and extent of the CMP culvert identified at the downstream toe of FGD Pond 2 near Station 59+00, and, if it serves no useful purpose or penetrates beneath the dam, either abandon by grouting full or remove the CMP. Implement a formalized inspection and documentaion process for the Significant Hazard class impoundments.

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12.0 Recommendations

12.1 Corrective Measures for the Structures

12.1.1 FGD Pond 1

1. During the interim period until the final cover is installed and closure is completed, it is important to be able to route flood flows across FGD Pond 1 such that unacceptable erosion damage to Dike B does not occur. Measures could include maintaining adequate capacity for flood storage or providing erosion protection for Dike B.

12.1.2 FGD Pond 2

1. The calculated factor of safety at Station 8+00 of 1.33 for static steady-seepage is below the state and federal guidance of 1.5. Re-evaluate this loading condition at Station 8+00 and, if the issue cannot be resolved by analysis, implement measures to improve the stability to achieve a factor of safety of 1.5. Also, the 2001 stability results could not be reproduced in check analyses and did not address the anticipated loss of embankment due to the planned erosion of the upstream slope. Revisit and revise the 2001 stability analysis as necessary to complete the documentation of the design.

2. Protect the embankment crest from developing soft spots that result in vehicle ruts by restricting vehicle traffic or upgrading the crest surface in problem areas.

3. Consistent with the 2002 Addendum to the Design Report, settlement monitoring near Station 54+00 should be performed and documented as part of operations. This monitoring should include documentation of observed embankment conditions at, and around, Station 54+00, and a surveyed crest settlement monument.

4. Abandon the CMP at Station 59+00 in-place by grouting full or remove the CMP if it is found to serve no useful purpose or if it penetrates beneath the dam.

12.1.3 FGD Pond 1 Outlet Structure – FGD Pond 2 Inlet Structure

1. Repair the north and west safety railing, stabilize surrounding soils, and clear debris from the structure.

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12.2 Corrective Measures Required for Maintenance and Surveillance Procedures

1. Address the excessive sage brush vegetation on FGD Pond 1 main dam.

2. Monitor and repair the minor surface erosion present at various locations on the upstream face of FGD Pond 2.

3. Perform studies to demonstrate that FGD solids are equal to, or stronger than, the compacted embankment or discount the contribution of infilling with FGD solids to replace eroded dam embankment. Monitor wave erosion and take measures to address excessive erosion such that the upstream slope geometry remains within an acceptable sacrificial zone as identified based on revised slope stability and seepage analysis for the dam.

4. Document inspections using a checklist for consistency.

12.3 Corrective Measures Required for the Methods of Operation of the Project Works

None.

12.4 Any New or Additional Monitoring Instruments, Periodic Observations, or Other Methods of Monitoring Project Works or Conditions That May Be Required

1. Install instrumentation to monitor the performance of the FGD Pond 2 dams and dikes and implement a program of regular readings and engineering evaluation of the data. Instrumentation and the associated monitoring program provide important information about the internal performance of a dam and its foundation. Instrumentation may be implemented as a modest program at key locations initially and supplemented in the future based on the monitoring results and visual inspections of the dam performance.

2. Continue monitoring seepage at the downstream toe of FGD Pond 2 northern embankment for any changes in seepage quantity and flow rate or evidence that the flow is carrying soil/ash particles from the embankment.

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12.5 Acknowledgement of Assessment

I acknowledge that the management unit(s) referenced herein was personally inspected by me and was found to be in the following condition:

SATISFACTORY

FAIR

POOR

UNSATISFACTORY

DEFINITIONS FOR ASSESSMENT

SATISFACTORY
No existing or potential management unit safety deficiencies are recognized. Acceptable performance is expected under all applicable loading conditions (static, hydrologic, seismic) in accordance with the applicable criteria. Minor maintenance items may be required.

FAIR
Acceptable performance is expected under all required loading conditions (static, hydrologic, seismic) in accordance with the applicable safety regulatory criteria. Minor deficiencies may exist that require remedial action and/or secondary studies or investigations

POOR
A management unit safety deficiency is recognized for any required loading condition (static, hydrologic, seismic) in accordance with the applicable dam safety regulatory criteria. Remedial action is necessary. POOR also applies when further critical studies or investigations are needed to identify any potential dam safety deficiencies.

UNSATISFACTORY
Considered unsafe. A dam safety deficiency is recognized that requires immediate or emergency remedial action for problem resolution. Reservoir restrictions may be necessary.

COLORADO REGISTERED PROFESSIONAL ENGINEER
STEPHEN G. BROWN
26679
09-14-09

I acknowledge that the management unit referenced herein:

Has been assessed on June 9 and 10, 2009 (date)

Signature: ____________________

<u>List of Participants:</u>

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Amber L. Misgen	GEI Consultants, Inc.
Joe Byron	Environmental Protection Agency
Jeff Tucker	PacifiCorp Energy
Michael Meyer, P.E.	PacifiCorp Energy Jim Bridger Power Station
Paul Falhsing, P.E.	PacifiCorp Energy Jim Bridger Power Station
Larry Stockdale, P.E.	SEO Safety of Dams Engineer
Louis Harmon, P.E., P.G.	SEO Water and Wastewater Program Manager.

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13.0 References

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Figures

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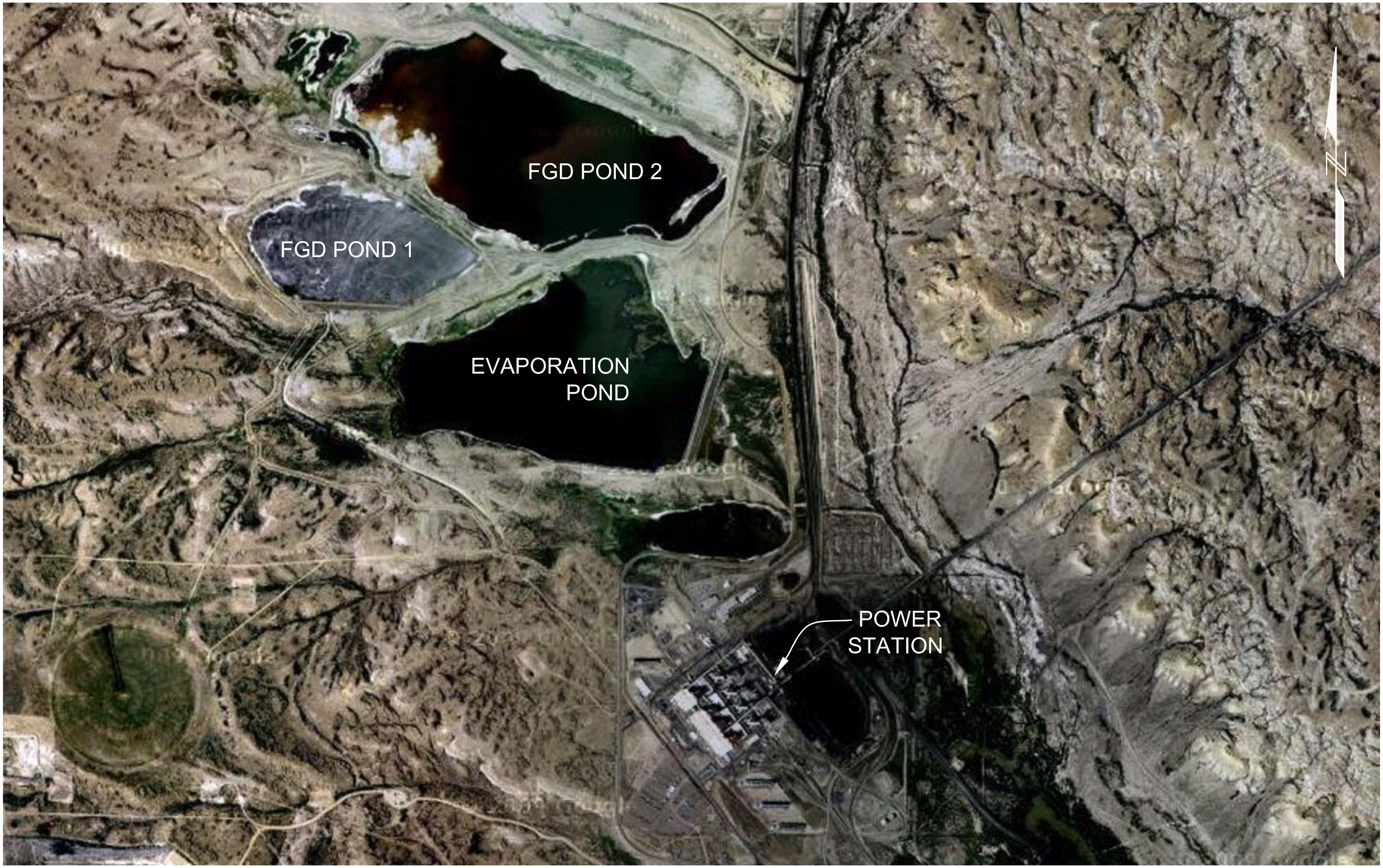
P:\091330 - Lockheed Martin Coal Ash Impoundments\JimBridger WY\Report Figures\ FIGURE 1 SITE VICINITY MAP.dwg Sep

Assessment of Dam Safety PacifiCorp Energy, Jim Bridger Power Station	GEI Consultants	SITE VICINITY MAP
Lockheed-Martin Corporation Edison, NJ	Project 091330	September 2009 Figure 1

P:\091330 - Lockheed Martin Coal Ash Impoundments\JimBridger WY\Report Figures\ FIGURE 2 SITE MAP.dwg Sep 2009



Assessment of Dam Safety PacifiCorp Energy, Jim Bridger Power Station	GEI Consultants	SITE MAP
Lockheed-Martin Corporation Edison, NJ	Project 091330	September 2009 Figure 2

Appendix A

Instrumentation Data – (No instrumentation data available)

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Appendix B

Inspection Checklist

June 9, 2009

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Coal Combustion Dam Inspection Checklist Form

US Environmental Protection Agency

Site Name: PACIFICORP, JIM BRIDGER	Date: June 9, 2009.
Unit Name: FGD # 1	Operator's Name: PACIFICORP
Unit I.D.: WYOMING # 9594R	Hazard Potential Classification: High (Significant) Low
Inspector's Name: STEPHEN G. BROWN, P.E., GEI CONSULTANTS, INC.	

Check the appropriate box below. Provide comments when appropriate. If not applicable or not available, record "N/A". Any unusual conditions or construction practices that should be noted in the comments section. For large diked embankments, separate checklists may be used for different embankment areas. If separate forms are used, identify approximate area that the form applies to in comments.

DAM CREST EL. 6702.5

	Yes	No		Yes	No
1. Frequency of Company's Dam Inspections?			18. Sloughing or bulging on slopes?		✓
2. Pool elevation (operator records)? 6699.5	✓		19. Major erosion or slope deterioration? minor/local		✓
3. Decant inlet elevation (operator records)? 6700	✓		20. Decant Pipes: * N/A		
4. Open channel spillway elevation (operator records)?	N/A		Is water entering inlet, but not exiting outlet?		
5. Lowest dam crest elevation (operator records)? 6702.5	✓		Is water exiting outlet, but not entering inlet?		
6. If instrumentation is present, are readings recorded (operator records)? No instruments	N/A		Is water exiting outlet flowing clear?		
7. Is the embankment currently under construction?		✓	21. Seepage (specify location, if seepage carries fines, and approximate seepage rate below):		
8. Foundation preparation (remove vegetation,stumps, topsoil in area where embankment fill will be placed)?	✓		From underdrain? Underdrain for leachate sampling.		✓ N/A
9. Trees growing on embankment? (If so, indicate largest diameter below)	✓		At isolated points on embankment slopes?		✓
10. Cracks or scarps on crest?		✓	At natural hillside in the embankment area?		✓
11. Is there significant settlement along the crest?		✓	Over widespread areas?		✓
12. Are decant trashracks clear and in place? NONE		✓	From downstream foundation area?		✓
13. Depressions or sinkholes in tailings surface or whirlpool in the pool area?		✓	"Boils" beneath stream or ponded water?		✓
14. Clogged spillways, groin or diversion ditches?		✓	Around the outside of the decant pipe?		✓
15. Are spillway or ditch linings deteriorated?		✓	22. Surface movements in valley bottom or on hillside?		✓
16. Are outlets of decant or underdrains blocked?		✓	23. Water against downstream toe?		✓
17. Cracks or scarps on slopes?		✓	24. Were Photos taken during the dam inspection?	✓	

Major adverse changes in these items could cause instability and should be reported for further evaluation. Adverse conditions noted in these items should normally be described (extent, location, volume, etc.) in the space below and on the back of this sheet.

Inspection Issue # Comments

2. Top of FGD solids is El. 6699.5 ±. Pond is full and FGD residuals are no longer disposed in pond.

3. Decant only used to discharge a large stormwater event. Currently, plant discharge is piped directly to discharge into decant structure. The decant structure is planned to be abandoned when FGD #1 is capped.

9. SUBSTANTIAL WOODY SAGE, TRUNK DIA. TO 4"

12. DECANT IS A DROP INLET BOX WITH STOPLOGS AND 30" ϕ STEEL OUTLET PIPE TO FGD #2.

EPA FORM -XXXX

* 20. FGD #1 IS PARTIALLY DEWATERED. THEREFORE ONLY PIPED PLANT DISCHARGE IS DISCHARGED TO DECANT STRUCTURE AND FLOWS INTO FGD #2

U. S. Environmental Protection Agency

Coal Combustion Waste (CCW) Impoundment Inspection

Impoundment NPDES Permit # ZERO DISCHARGE - NO PERMIT INSPECTOR STEPHEN G. BROWN GEI CONSULTANTS, INC.
Date June 9, 2009

Impoundment Name FGD #1
Impoundment Company PACIFICORP
EPA Region 8
State Agency (Field Office) Addresss WYOMING DAM SAFETY - STATE ENGINEER'S OFFICE 122 W 25th STREET CHEYENNE, WY 82002
Name of Impoundment FGD #1
(Report each impoundment on a separate form under the same Impoundment NPDES Permit number)

New ✓ Update ____

	Yes	No
Is impoundment currently under construction?		✓
Is water or ccw currently being pumped into the impoundment?		✓ INACTIVE

IMPOUNDMENT FUNCTION: STORES FLUE GAS EMMISSION CONTROL RESIDUALS WITH MINOR AMOUNTS OF FLY ASH & BOTTOM ASH.

Nearest Downstream Town : Name POINT OF ROCKS, WYOMING
Distance from the impoundment 8 MILES
Impoundment * N 396,246.43 E 485,860.73 PLANT COORD
Location: Longitude 108 Degrees 48 Minutes 26.8 Seconds
Latitude 41 Degrees 45 Minutes 13.7 Seconds
State WY County SWEETWATER

Does a state agency regulate this impoundment? YES ✓ NO ____

If So Which State Agency? WYOMING SAFETY OF DAMS

* CONV. FROM PLANT COORD TO WYOMING COORD. SEE BECHTEL DWG FGD POND EXPANSION 1 OF 2 1978

HAZARD POTENTIAL (In the event the impoundment should fail, the following would occur):

______ **LESS THAN LOW HAZARD POTENTIAL:** Failure or misoperation of the dam results in no probable loss of human life or economic or environmental losses.

______ **LOW HAZARD POTENTIAL:** Dams assigned the low hazard potential classification are those where failure or misoperation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the owner's property.

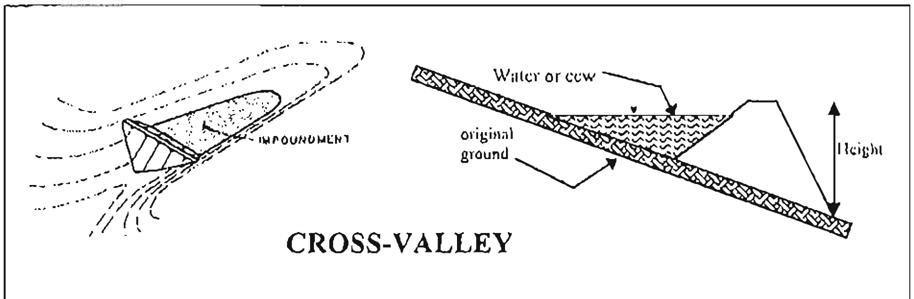
__✓__ **SIGNIFICANT HAZARD POTENTIAL:** Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure.

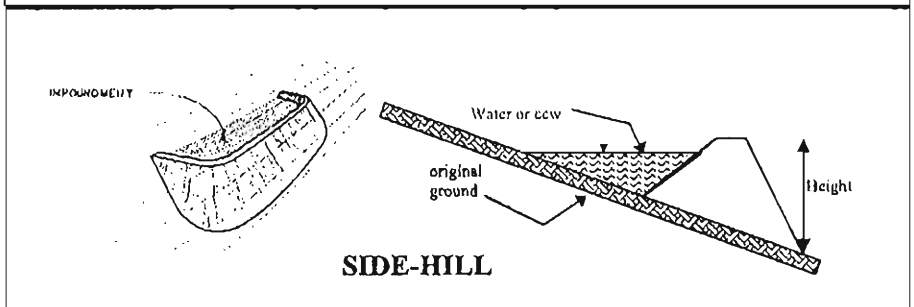
______ **HIGH HAZARD POTENTIAL:** Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

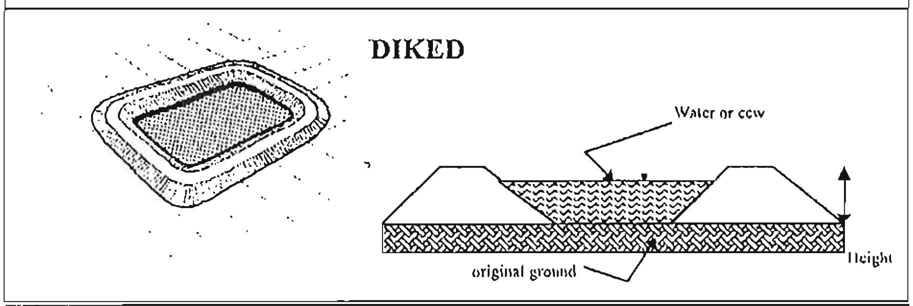
DESCRIBE REASONING FOR HAZARD RATING CHOSEN:

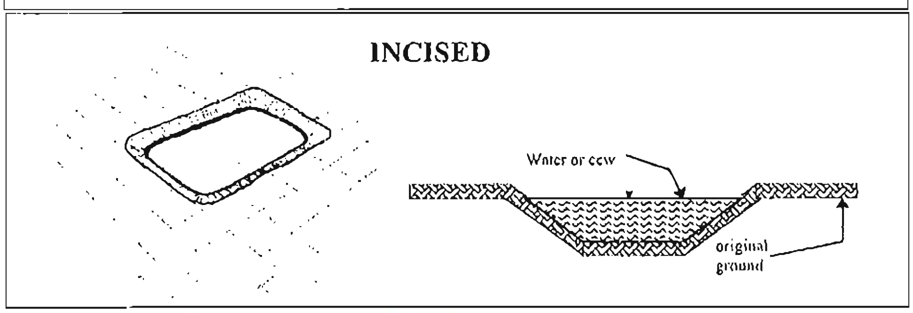
SIGNIFICANT HAZARD ASSIGNED BY WYOMING DAM SAFETY IS CONSISTENT WITH POTENTIAL FOR ENVIRONMENTAL/ECONOMIC DAMAGE IN EVENT OF FAILURE. POTENTIAL FOR RAISING CLASSIFICATION TO HIGH HAZARD WOULD NEED TO CONSIDER POTENTIAL FOR OUTFLOWS TO OVERTOP I-80. DISCHARGE CHANNEL NARROWS AT I-80 AND THE EXISTING CULVERTS MAY NOT BE ADEQUATE TO PASS THE FLOW. INUNDATION MAPPING WOULD BE NEEDED TO EVALUATE THIS CONCERN. NOTE THAT PLANNED CLOSURE CAPPING OF THIS INACTIVE POND AND DEWATERING PUMPING IS EXPECTED TO REDUCE FLOW MOBILITY OF THE FGD RESIDUALS IN THE IMPOUNDMENT.

CONFIGURATION:









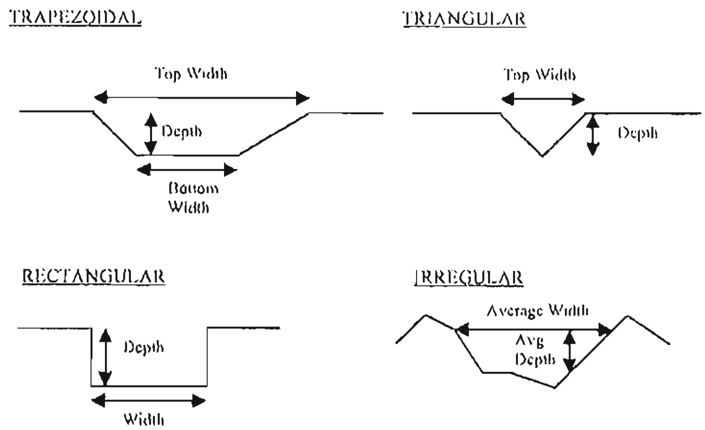
✓ Cross-Valley / DIKED COMBINATION
_____ Side-Hill
_____ Diked
_____ Incised (form completion optional)
_____ Combination Incised/Diked

Embankment Height 32.5 feet Embankment Material Processed shale core with SILTY SAND SHELLS.
Pool Area 93 acres Liner CLAY
Current Freeboard 3 feet Liner Permeability 1×10^{-5} cm/sec EST. FOR SILTY CLAY.

TYPE OF OUTLET (Mark all that apply)

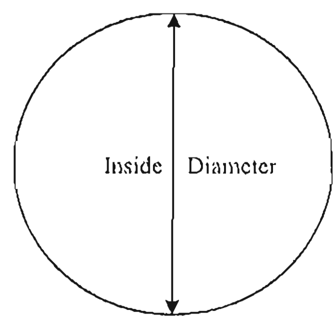
N/A **Open Channel Spillway**
_____ Trapezoidal
_____ Triangular
_____ Rectangular
_____ Irregular

_____ depth
_____ bottom (or average) width
_____ top width



_____ **Outlet**

30" inside diameter



Material
_____ corrugated metal
✓ welded steel
_____ concrete
_____ plastic (hdpe, pvc, etc.)
_____ other (specify) ________________

Is water flowing through the outlet? *YES ✓ NO _____

*FLOW IS PLANT DISCHARGE PIPE FLOW, NOT DECANT FROM FGD #1. FLOW CURRENTLY BYPASSES FGD #1.

_____ **No Outlet**

_____ **Other Type of Outlet** (specify) ________________

The Impoundment was Designed By BECHTEL CORP., 1978

Has there ever been a failure at this site? YES __________ NO __✓__

If So When? ______________________________

If So Please Describe : ______________________________

Has there ever been significant seepages at this site? YES ✓ NO ____

If So When? MID TO LATE 1990'S FIRST OCCURRENCE.

IF So Please Describe: SEEPAGE AT LEFT ABUTMENT OF FGD #1.
SEEPAGE THROUGH ABUTMENT FOUNDATION ROCK WAS CAPTURED BY INSTALLING A FRENCH DRAIN (GRAVEL-FILLED TRENCH WITH PERFORATED PIPE) AND PUMP BACK SUMP.
PUMP HAS NOT BEEN IN SERVICE FOR SEVERAL YEARS SINCE FGD RESIDUALS NO LONGER PLACED IN FGD #1. SUMP WAS OBSERVED TO HAVE WATER IN IT - WATER WAS CHARACTERIZED AS GROUNDWATER AND NOT ASSOC. WITH POND SOLIDS BY PACIFICORP PERSONNEL (DURING SITE VISIT).

Has there ever been any measures undertaken to monitor/lower Phreatic water table levels based on past seepages or breaches at this site? YES ✓ NO ____

If so, which method (e.g., piezometers, gw pumping,...)? pumping from wells.

If so Please Describe : As part of unit management and not directly related to a seepage event, the owner has installed wells into the impounded deposits to draw down the internal water level in the impoundment. Drawing down the water is done primarily to stabilize the deposits during construction of an earthen cover as part of closure plan under State of Wyoming.

Coal Combustion Dam Inspection Checklist Form

US Environmental Protection Agency

Site Name: PACIFICORP, JIM BRIDGER	Date: June 9, 2009
Unit Name: FGD #2	Operator's Name: PACIFICORP
Unit I.D.: WYOMING ID #11633R	Hazard Potential Classification: High (Significant) Low
Inspector's Name: STEPHEN G. BROWN, GEI CONSULTANTS, INC.	

Check the appropriate box below. Provide comments when appropriate. If not applicable or not available, record "N/A". Any unusual conditions or construction practices that should be noted in the comments section. For large diked embankments, separate checklists may be used for different embankment areas. If separate forms are used, identify approximate area that the form applies to in comments.

DAM CREST EL. 6702

	Yes	No		Yes	No
1. Frequency of Company's Dam Inspections?			18. Sloughing or bulging on slopes?		✓
2. Pool elevation (operator records)? El. 6674	✓		19. Major erosion or slope deterioration? MINOR, LOCAL		✓
3. Decant inlet elevation (operator records)? NONE	N/A		20. Decant Pipes: N/A		
4. Open channel spillway elevation (operator records)?	N/A		Is water entering inlet, but not exiting outlet?		
5. Lowest dam crest elevation (operator records)?			Is water exiting outlet, but not entering inlet?		
6. If instrumentation is present, are readings recorded (operator records)? YES, NOT READ ~~NONE~~		✓	Is water exiting outlet flowing clear?		
7. Is the embankment currently under construction?		✓	21. Seepage (specify location, if seepage carries fines, and approximate seepage rate below):		
8. Foundation preparation (remove vegetation, stumps, topsoil in area where embankment fill will be placed)?	✓		From underdrain?		N/A
9. Trees growing on embankment? (If so, indicate largest diameter below)		✓	At isolated points on embankment slopes?		✓
10. Cracks or scarps on crest?		✓	At natural hillside in the embankment area?		✓
11. Is there significant settlement along the crest?		✓	Over widespread areas?		✓
12. Are decant trashracks clear and in place?	N/A		From downstream foundation area?	✓	
13. Depressions or sinkholes in tailings surface or whirlpool in the pool area?		✓	"Boils" beneath stream or ponded water?		✓
14. Clogged spillways, groin or diversion ditches?		✓	Around the outside of the decant pipe?		N/A.
15. Are spillway or ditch linings deteriorated?	N/A		22. Surface movements in valley bottom or on hillside?		✓
16. Are outlets of decant or underdrains blocked?	N/A		23. Water against downstream toe?		✓
17. Cracks or scarps on slopes?		✓	24. Were Photos taken during the dam inspection?	✓	

Major adverse changes in these items could cause instability and should be reported for further evaluation. Adverse conditions noted in these items should normally be described (extent, location, volume, etc.) in the space below and on the back of this sheet.

Inspection Issue # — Comments

21. TOE DRAIN FOUNDATION SEEPAGE TYP 11,000 TO 18,000 gal per MONTH

20. No outlet or decant pipe; pumped inflow from plant develops. Less than 1 foot free water over FGD solids – this depth will decrease as pond fills with solids; permit requires 5' freeboard.

6. Observation wells installed at dam crest between Sta. 80+00 to 91+00 at location of seepage/toe drain. Study showed seepage is through foundation weathered shale so embankment instruments no longer read. No other instruments are provided on the embankment.

U. S. Environmental Protection Agency

Coal Combustion Waste (CCW) Impoundment Inspection

Impoundment NPDES Permit # NONE - ZERO DISCHARGE INSPECTOR STEPHEN G. BROWN
Date JUNE 9, 2009. GEI CONSULTANTS, INC.

Impoundment Name FGD #2
Impoundment Company PACIFICORP
EPA Region 8
State Agency (Field Office) Addresss WYOMING DAM SAFETY - STATE ENGINEER'S OFFICE
122 W 25th STREET
Name of Impoundment FGD #2 CHEYENNE, WY 82002
(Report each impoundment on a separate form under the same Impoundment NPDES Permit number)

New ✓ Update ____

	Yes	No
Is impoundment currently under construction?		✓
Is water or ccw currently being pumped into the impoundment?	✓	

IMPOUNDMENT FUNCTION: STORAGE OF FLUE GAS EMMISSION CONTROLS RESIDUALS.
COUNTY ROAD 15 LOCATED AT D/S TOE.

Nearest Downstream Town : Name POINT OF ROCKS, WYOMING
Distance from the impoundment 8 MILES
Impoundment * N 397140 E 489465
Location: Longitude 108 Degrees 47 Minutes 16.5 Seconds
Latitude 41 Degrees 45 Minutes 24.8 Seconds
State WY. County SWEETWATER

Does a state agency regulate this impoundment? YES ✓ NO ____

If So Which State Agency? WYOMING SAFETY OF DAMS

* PLANT COORD SYSTEM

HAZARD POTENTIAL (In the event the impoundment should fail, the following would occur):

______ **LESS THAN LOW HAZARD POTENTIAL:** Failure or misoperation of the dam results in no probable loss of human life or economic or environmental losses.

______ **LOW HAZARD POTENTIAL:** Dams assigned the low hazard potential classification are those where failure or misoperation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the owner's property.

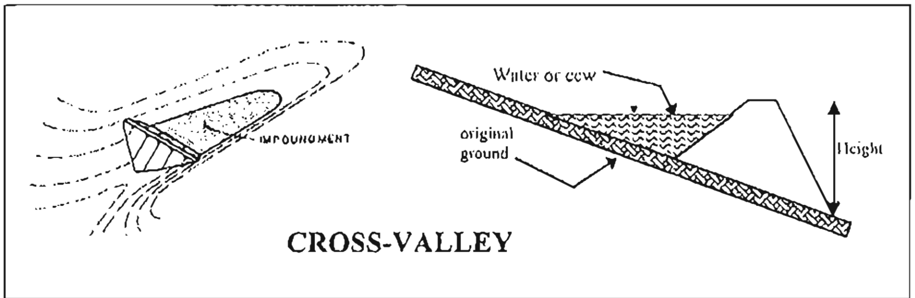
__✓__ **SIGNIFICANT HAZARD POTENTIAL:** Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure.

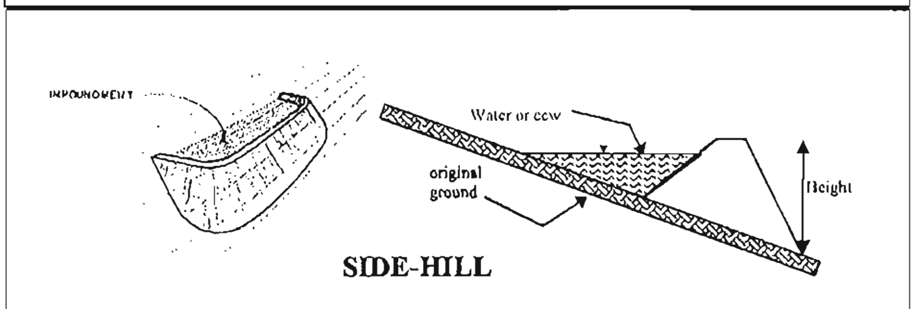
______ **HIGH HAZARD POTENTIAL:** Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

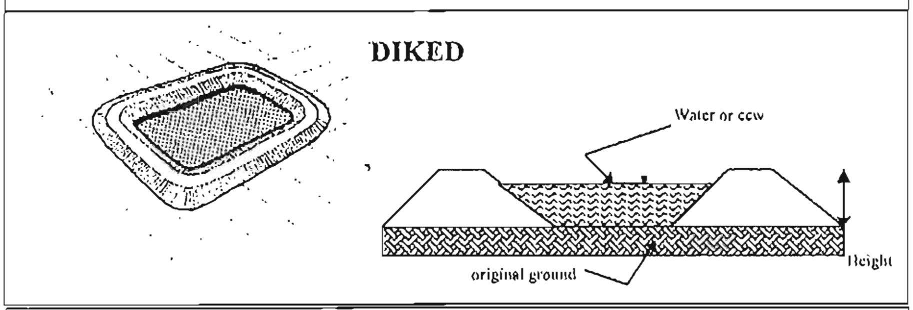
DESCRIBE REASONING FOR HAZARD RATING CHOSEN:

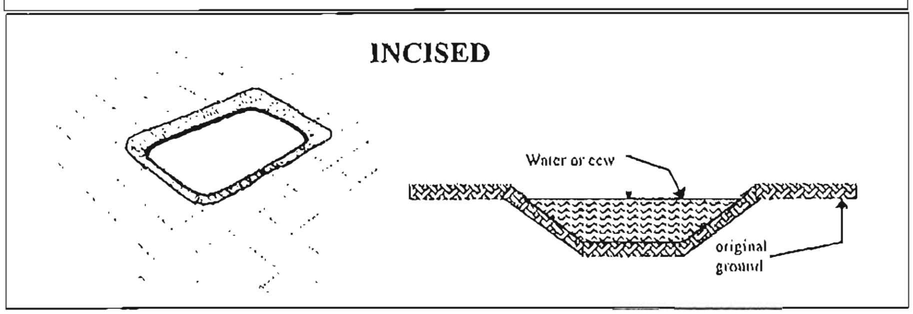
SIGNIFICANT HAZARD ASSIGNED BY WYOMING DAM SAFETY IS CONSISTENT WITH POTENTIAL FOR ENVIRONMENTAL/ECONOMIC DAMAGE IN EVENT OF FAILURE. POTENTIAL FOR RAISING CLASSIFICATION TO HIGH HAZARD WOULD NEED TO CONSIDER LOCATION OF COUNTY ROAD 15 LOCATED AT DOWNSTREAM TOE OF DAM AND POTENTIAL FOR FAILURE DISCHARGE TO OVERTOP INTERSTATE 80. OVERTOP OF I-80 MAY BE CREDIBLE BASED ON OBSERVED NARROWING OF DISCHARGE CHANNEL JUST UPSTREAM OF I-80, CONSTRUCTION OF RR EMBANKMENT THAT RESTRICTS FLOODWAY, AND POTENTIALLY UNDERSIZED CULVERTS UNDER RR AND I-80. INUNDATION MAPPING WOULD BE NEEDED TO EVALUATE THIS CONCERN.

CONFIGURATION:









_____ Cross-Valley
_____ Side-Hill
__✓__ Diked /CROSS VALLEY COMBINATION
_____ Incised (form completion optional)
_____ Combination Incised/Diked

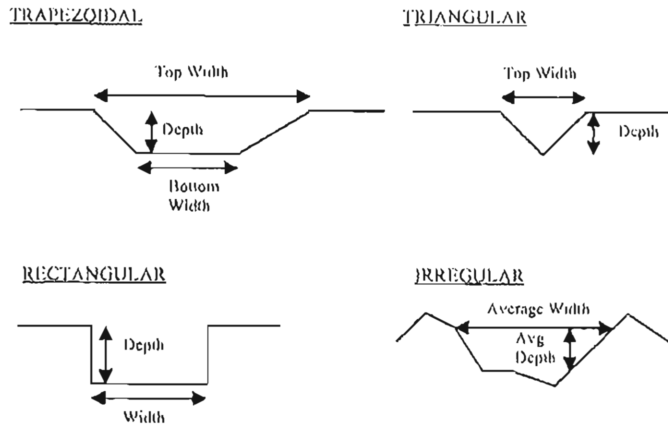
Design Rpt/Specs.
Processed shale (CL-CH)

Embankment Height ___42___ feet Embankment Material CLAY CORE + SILT SHELLS (SILTY SAND TO SANDY SILT)
Pool Area ___392___ acres Liner NONE
Current Freeboard ___28___ feet Liner Permeability N/A

TYPE OF OUTLET (Mark all that apply)

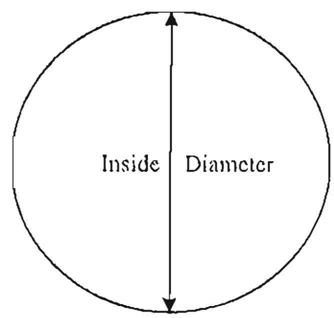
N/A **Open Channel Spillway**
_____ Trapezoidal
_____ Triangular
_____ Rectangular
_____ Irregular

_____ depth
_____ bottom (or average) width
_____ top width



_____ **Outlet**

_____ inside diameter



Material
_____ corrugated metal
_____ welded steel
_____ concrete
_____ plastic (hdpe, pvc, etc.)
_____ other (specify) ____________________

Is water flowing through the outlet? YES _______ NO _______

✓ **No Outlet**

_____ **Other Type of Outlet** (specify) ______________________________

The Impoundment was Designed By MAXIM TECHNOLOGIES, INC. 2002 (SIGNIFICANT EXPANSION)

Has there ever been a failure at this site? YES __________ NO ____✓______

If So When? ____________________________

If So Please Describe : ____

Has there ever been significant seepages at this site? YES ✓ NO ______

If So When? Approx [2007 (September)] → FIRST DOCUMENTATION. June 2007

IF So Please Describe: Approx. 4 years after pond placed in service and when pond water elevation reached sufficient elevation El. 6671-72.

Pond currently at El. 6674

Mitigation plan implemented to install toe drain with gravel drain and pipe to manhole at time of design based on predicted higher permeability foundation rock (weathered shale) in that area. Added pump to manhole after seepage became active.

Approx 11,000 to 18,000 gallons per month pumped back into FGD #2 pond.

Has there ever been any measures undertaken to monitor/lower Phreatic water table levels based on past seepages or breaches at this site? YES ________ NO ✓

If so, which method (e.g., piezometers, gw pumping,...)? ____________________

If so Please Describe : ____________________

Appendix C

Inspection Photographs

June 9, 2009

US EPA ARCHIVE DOCUMENT

Assessment of Dam Safety PacifiCorp Energy, Jim Bridger Power Station	GEI Consultants	Photo Location Map	
Lockheed-Martin Corporation Edison, NJ	Project 091330	September 2009	Figure C-1

FGD Pond 1

Photo 1: Crest and downstream toe of Saddle Dike (Dike B); Looking to the right (east)

Photo 2: FGD Pond 1, Crest and downstream face of the main dam (Dike A); looking from Left abutment toward the west

US EPA ARCHIVE DOCUMENT


Photo 3: FGD Pond 1, Downstream toe of the main dam; Looking to the left (east)


Photo 4: FGD Pond 1, Downstream face on toe berm of main dam; Looking to the right (west)

US EPA ARCHIVE DOCUMENT

Photo 5: FGD Pond 1, Crest of the main dam; Standing near right abutment and looking to the left (east)

Photo 6: FGD Pond 1, Crest – View of right abutment and downstream groin of main dam; Looking to the left (east)

US EPA ARCHIVE DOCUMENT

FGD Pond 2

Photo 7: FGD Pond 2, Upstream face at turn in embankment near Station 45+00, note erosion rills; Looking North upslope to crest

Photo 8: FGD Pond 2, Upstream face near Station 45+00 Looking right (south)

US EPA ARCHIVE DOCUMENT

Photo 9: FGD Pond 2, Crest near Station 45+00 Looking right (southwest)

Photo 10: FGD Pond 2, Downstream face near Station 45+00 Looking right (southwest)

US EPA ARCHIVE DOCUMENT


Photo 11: FGD Pond 2, Downstream face near Station 47+00 Looking left (west)


Photo 12: FGD Pond 2, Crest near Station 47+00 Looking left (west)

US EPA ARCHIVE DOCUMENT

US EPA ARCHIVE DOCUMENT

Photo 13: FGD Pond 2, Upstream face near Station 57+00 Looking left (west)

Photo 14: FGD Pond 2, Upstream Face Erosion rills approx. 3 inches deep (typical) Looking north upslope

Photo 15: FGD Pond 2, Upstream Face HDPE pipe penetration approx. 5 feet below crest near Station 73+00 Looking north upslope

Photo 16: FGD Pond 2, Upstream Erosion face Looking North upslope near Station 73+00

US EPA ARCHIVE DOCUMENT

Photo 17: FGD Pond 2, Upstream face showing pipe and erosion Looking South downslope near Station 73+00

Photo 18: FGD Pond 2, Upstream face Pipe causing erosion from Crest pipe from Sump Drain Pump Back Near Station 84+00

US EPA ARCHIVE DOCUMENT

US EPA ARCHIVE DOCUMENT

Photo 19: FGD Pond 2, Upstream Face Erosion and Pipe from Sump Drain Pump Back Near Station 84+00

Photo 20: FGD Pond 2, Upstream Face Erosion and Pipe from Sump Drain Pump Back Near Station 84+00

Photo 21: FGD Pond 2, Upstream face near Station 88+00 Looking left (west)

Photo 22: FGD Pond 2, Crest near Station 93+00 Left Abutment Looking West

US EPA ARCHIVE DOCUMENT

US EPA ARCHIVE DOCUMENT

Photo 23: FGD Pond 2, Downstream toe near Station 93+00 Left Abutment Looking right (east)

Photo 24: FGD Pond 2, Looking downstream (east) from western extent of reservoir encroachment

Photo 25: Looking South at outfall from FGD Pond 1. Large pipes are directly from plant, smaller pipes are from FGD Pond 1 dewatering wells

Photo 26: FGD Pond 2, Looking North closer look at inlet.

US EPA ARCHIVE DOCUMENT

US EPA ARCHIVE DOCUMENT

Photo 27: FGD Pond 2, Looking southwest from FGD Pond 2 to FGD Pond 1 along buried inlet pipe

Photo 28: FGD Pond 2, Looking left (southeast) at Erosion rill off crest down the upstream face. Metal pipe is abandoned and runs parallel to crest.

US EPA ARCHIVE DOCUMENT

Photo 29: Looking right (west) Ruts in Crest of saddle dike between FGD Pond 1 (left) and FGD Pond 2 (right).

Photo 30: FGD Pond 2, Crest near Station 4+00 Evaporation Pond on right Looking left (east)

Photo 31: FGD Pond 2, Downstream toe near Station 4+00 Evaporation pond (right) Looking left (east)

Photo 32: FGD Pond 2, Upstream toe near Station 4+00 Looking left (east)

US EPA ARCHIVE DOCUMENT

US EPA ARCHIVE DOCUMENT

Photo 33: FGD Pond 2, Erosion of Upstream face Near Station 4+00

Photo 34: FGD Pond 2, Significant erosion of upstream face near station 4+00 Looking Southeast

US EPA ARCHIVE DOCUMENT

Photo 35: FGD Pond 2, Upstream toe near Station 17+00 Wave cutting of toe Looking left (northeast)

Photo 36: FGD Pond 2, Crest near Station 17+00 Looking left (north)

US EPA ARCHIVE DOCUMENT

Photo 37: FGD Pond 2, Downstream toe near Station Looking left (north) near Station 30+00

Photo 38: FGD Pond 2, Downstream face near Station 30+00 Looking left (north)

US EPA ARCHIVE DOCUMENT

Photo 39: FGD Pond 2, Downstream toe near Station 30+00 Looking right (south)

Photo 40: FGD Pond 2, Dry pipe penetrating beyond downstream toe. Old culvert associated with Dike III.

Appendix D

Reply to Request for Information Under Section 104(e)

US EPA ARCHIVE DOCUMENT

Jim Bridger Plant
P.O. Box 158
Point of Rocks, WY 82942

PACIFICORP ENERGY
A PACIFICORP COMPANY

March 30, 2009

Mr. Richard Kinch
US Environmental Protection Agency
Two Potomac Yard
2733 S. Crystal Dr.
5th Floor; N-5783
Arlington, VA 22202-2733

Via Overnight Delivery

Re: Jim Bridger Power Station: Request for Information Under Section 104(e) of the Comprehensive Environmental Response, Compensation and Liability Act, 42 U.S.C. 9604(e) dated March 9, 2009 and received on March 16, 2009

Dear Mr. Kinch,

This letter and the enclosed materials constitute the response of the Jim Bridger Power Station to the above Request for Information. Specifically, this letter and the enclosed materials provide the Jim Bridger Power Station's response "to each request for information set forth in the Enclosure [A], including all documents responsive to such request."

Although PacifiCorp, as operator of the Jim Bridger Power Station, intends to cooperate fully in responding to the Request for Information, this response is made subject to the, objections and other exceptions as noted herein.

Moreover, PacifiCorp affirmatively asserts that the ten business day response deadline contained in the Request for Information is unrealistically short and does not reasonably reflect the type and volume of responsive information which EPA has requested, particularly when considering that PacifiCorp is required to provide similar responses at three other facilities at the same time. Therefore, PacifiCorp objects to this deadline and reserves the right to supplement this response after the 10 business day deadline with any materials that it was unable to gather and submit by the requested deadline.

Please be aware that PacifiCorp has included in this response those "surface impoundments or similar diked or bermed management unit(s)" at the Jim Bridger Power Station which appear to be covered by the Request for Information. These "surface impoundments or similar diked or bermed management units" are described in more detail below. PacifiCorp has not included in this response; however, stormwater and wastewater retention basins which are neither managed nor operated as coal combustion waste impoundments even though they may contain storm or waste water which has been in incidental contact with coal ash or coal combustion products. Please advise us to the extent EPA interprets its Request for Information to include these stormwater and wastewater retention basins.

I certify that the information contained in this response to EPA's request for information and the accompanying documents is true, accurate and complete. As to the identified portions of this response for which I cannot personally verify their accuracy, I certify under penalty of law that this response and all attachments were prepared in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge, true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and imprisonment for knowing violations.

If you have any questions regarding this response, please direct them to Mr. Brett Shakespear at 801-220-2575 or at brett.shakespear@pacificorp.com. Legal inquires should be made to Mr. Michael Jenkins at 801-220-2233 or at michael.jenkins@pacificorp.com.

Sincerely,

Bob Arambel
Managing Director
Jim Bridger Power Station

cc: Brett Shakespear, Michael Jenkins

Response To Enclosure A For FGD Pond #1

The term "FGD Pond #1" as used in this response means a single pond with no discharge which received flue gas desulphurization solution from the plant scrubbers. This pond is no longer receiving any material and has been dewatered. The pond is currently being closed. EPA's Enclosure A requests are reproduced below in italics and separated within request numbers for ease of response. The responses below are offered without waiving any of the objections noted herein and in the cover letter.

Jim Bridger Power Station Response to Request No. 1

"Relative to the National Inventory of Dams criteria for High, Significant, Low, or Less-than-Low, please provide the potential hazard rating for each management unit"

The rating for FGD Pond #1 is Significant.

"Indicate who established the rating"

Wyoming State Engineer.

"What the basis of the rating is"

As per the Wyoming State Engineer's Office, in the event of a dam failure, substantial property damage could be expected, but loss of life, although possible, is not expected.

"What federal or state agency regulates the unit(s)"

Wyoming State Engineer.

"If the unit(s) does not have a rating, please note that fact"

NA

Jim Bridger Power Station Response to Request No. 2

"What year was each management unit commissioned and expanded?"

FGD Pond #1 was placed in service in 1979.

FGD Pond #1 was expanded in 1989.

FGD Pond #1 no longer functions as an active disposal pond and a closure Corrective Action Plan has been submitted to the Wyoming Department of Environmental Quality.

Jim Bridger Power Station Response to Request No. 3

"What materials are temporarily or permanently contained in the unit? Use the following categories to respond to this question: (1) fly ash; (2) bottom ash: (3) boiler slag; (4) flue gas emission control residuals; (5) other. If the management unit contains more than one type of material, please identify all that apply. Also, if you identify "other," please specify the other types of materials that are temporarily or permanently contained in the unit(s)."

The following categories of material have been placed in FGD Pond #1: fly ash (small amounts collected in the scrubbers after the electrostatic precipitators); bottom ash (6 inch cap on pond surface to control fugitive dust); and flue gas emission control residuals.

Jim Bridger Power Station Response to Request No. 4

"Was the management unit(s) designed by a Professional Engineer?"

Yes

"Is or was the construction of the waste management unit(s) under the supervision of a Professional Engineer?"

PacifiCorp has been unable to locate documentation to make this assessment.

"Is inspection and monitoring of the safety of the waste management unit(s) under the supervision of a Professional Engineer?"

The Wyoming State Engineer's Office periodically inspects and monitors FGD Pond #1.

Jim Bridger Power Station Response to Request No. 5

"When did the company last assess or evaluate the safety (i.e., structural integrity) of the management unit(s)?"

FGD Pond #1 was last internally inspected on February 14, 2009. An external inspection was performed on March 4 and 5, 2009.

"Briefly describe the credentials of those conducting the structural integrity assessments/evaluations."

The internal inspection of FGD Pond #1 was completed, by PacifiCorp employee Roger L. Raeburn, whose title is Engineering Manager, Dam Safety and who is licensed as a Professional Engineer in the state of Oregon. The external inspection was completed by Cornforth Consultants, Inc., a geotechnical firm staffed with professional engineers and certified engineering geologists.

"Identify actions taken or planned by facility personnel as a result of these assessments or evaluations."

The recent inspections will be evaluated as they are received, and actions, if any, will be based on the results.

"If corrective actions were taken, briefly describe the credentials of those performing the corrective actions, whether they were company employees or contractors."

See response above.

"If the company plans an assessment or evaluation in the future, when is it expected to occur?"

The need for further assessments or evaluations and their frequencies will be based on the results of the recently completed inspections.

Jim Bridger Power Station Response to Request No. 6

"When did a State or a Federal regulatory official last inspect or evaluate the safety (structural integrity) of the management unit(s)?"

FGD Pond #1 was last inspected by the Wyoming State Engineer's Office on June 21, 2004.

"If you are aware of a planned state or federal inspection or evaluation in the future, when is it expected to occur?"

The Wyoming State Engineer's Office typically inspects this type of facility on a five year interval. While no notice has been received, an inspection is anticipated in 2009.

"Please identify the Federal or State regulatory agency or department which conducted or is planning the inspection or evaluation."

See response above.

"Please provide a copy of the most recent official inspection report or evaluation"

See attachment.

Jim Bridger Power Station Response to Request No. 7

"Have assessments or evaluations, or inspections conducted by State or Federal regulatory officials conducted within the past year uncovered a safety issue(s) with the management unit(s)?"

No

"If so, describe the actions that have been or are being taken to deal with the issue or issues"

NA

"Please provide any documentation that you have for these actions."

NA

Jim Bridger Power Station Response to Request No. 8

"What is the surface area (acres) and total storage capacity of each of the management units?"

The FGD Pond #1 surface area is 93 acres.

The FGD Pond #1 storage capacity is 1340 acre-feet.

"What is the volume of material currently stored in each of the management unit(s)?"

The volume of material in FGD Pond #1 is 1340 acre-feet.

Additionally, 74 acre feet of bottom ash was placed on top of the flue gas emissions control residuals to control fugitive dust during permit closure of management unit.

"Please provide the date that the volume measurement(s) was taken."

Exact measurements were not taken. The storage volume is based on FGD Pond #1 at full operational depth. The bottom ash placement volumes were calculated on January 8, 2009.

"Please provide the maximum height of the management unit(s). The basis for determining maximum height is explained later in this Enclosure."

The maximum height of FGD Pond #1 is 32.5 feet.

Jim Bridger Power Station Response to Request No. 9

"Please provide a brief history of known spills or unpermitted releases from the unit within the last ten years, whether or not these were reported to State or federal regulatory agencies. For purposes of this question, please include only releases to surface water or to the land (do not include releases to groundwater)."

Seepage from FGD Pond #1 surfaced on its south side within the last ten years. The seepage has been controlled with a cut off trench and pumped back into FGD Pond #1. Once FGD Pond #1 was taken out of service and partially dewatered, the seepage ceased. The seepage was reported to the Wyoming Department of Environmental Quality.

Jim Bridger Power Station Response to Request No. 10

"Please identify all current legal owner(s) and operator(s) at the facility".

The current legal owner(s) of the Jim Bridger Power Station are PacifiCorp and Idaho Power Company. The current operator of the Jim Bridger Power Station is PacifiCorp.

Response To Enclosure A For FGD Pond #2

The term "FGD Pond #2" as used in this response means a single pond with no discharge which receives flue gas desulphurization solution from the plant scrubbers. EPA's Enclosure A requests are reproduced below in italics and separated within request numbers for ease of response. The responses below are offered without waiving any of the objections noted herein and in the cover letter.

Jim Bridger Power Station Response to Request No. 1

"Relative to the National Inventory of Dams criteria for High, Significant, Low, or Less-than-Low, please provide the potential hazard rating for each management unit"

The rating for FGD Pond #2 is Significant.

"Indicate who established the rating"

Wyoming State Engineer's Office.

"What the basis of the rating is"

As per the Wyoming State Engineer's Office, in the event of a dam failure, substantial property damage could be expected, but loss of life, although possible, is not expected.

"What federal or state agency regulates the unit(s)"

Wyoming State Engineer's Office.

"If the unit(s) does not have a rating, please note that fact"

NA

Jim Bridger Power Station Response to Request No. 2

"What year was each management unit commissioned and expanded?"

FGD Pond #2 was placed in service in 1990.

FGD Pond #2 was expanded in 2002 and 2003.

Jim Bridger Power Station Response to Request No. 3

"What materials are temporarily or permanently contained in the unit? Use the following categories to respond to this question: (1) fly ash; (2) bottom ash: (3) boiler slag; (4) flue gas emission control residuals; (5) other. If the management unit contains more than one type of material, please identify all that apply. Also, if you identify "other," please specify the other types of materials that are temporarily or permanently contained in the unit(s)."

The following categories of material have been placed in FGD Pond #2: fly ash (small amount collected in the scrubber after the electrostatic precipitators); flue gas emission control residuals.

Jim Bridger Power Station Response to Request No. 4

"Was the management unit(s) designed by a Professional Engineer?"

Yes

"Is or was the construction of the waste management unit(s) under the supervision of a Professional Engineer?"

Yes

"Is inspection and monitoring of the safety of the waste management unit(s) under the supervision of a Professional Engineer?"

The Wyoming State Engineer's Office periodically inspects FGD Pond #2.

Jim Bridger Power Station Response to Request No. 5

"When did the company last assess or evaluate the safety (i.e., structural integrity) of the management unit(s)?"

FGD Pond #2 was last inspected by an internal engineer on February 14, 2009. An inspection by external consultants was performed on March 4 and 5, 2009.

"Briefly describe the credentials of those conducting the structural integrity assessments/evaluations."

The internal inspection of FGD Pond #2 was completed, by PacifiCorp employee Roger L. Raeburn, whose title is Engineering Manager, Dam Safety and who is licensed as a Professional Engineer in the state of Oregon. The external inspection was completed by Cornforth Consultants, Inc., a geotechnical firm staffed with professional engineers and certified engineering geologists.

"Identify actions taken or planned by facility personnel as a result of these assessments or evaluations."

The recent inspections will be evaluated as they are received, and actions, if any, will be based on the results.

"If corrective actions were taken, briefly describe the credentials of those performing the corrective actions, whether they were company employees or contractors."

No corrective actions were identified.

"If the company plans an assessment or evaluation in the future, when is it expected to occur?"

PacifiCorp has commissioned an in-depth design review of the management unit design and geology by Cornforth Consultants, Inc.

Jim Bridger Power Station Response to Request No. 6

"When did a State or a Federal regulatory official last inspect or evaluate the safety (structural integrity) of the management unit(s)?"

FGD Pond #2 was last inspected by the Wyoming State Engineer's Office on June 21, 2004.

"If you are aware of a planned state or federal inspection or evaluation in the future, when is it expected to occur?"

The Wyoming State Engineer's Office typically inspects this type of facility on a five year interval. While no notice has been received, an inspection is anticipated in 2009.

"Please identify the Federal or State regulatory agency or department which conducted or is planning the inspection or evaluation."

See response above.

"Please provide a copy of the most recent official inspection report or evaluation"

See Attachment.

Jim Bridger Power Station Response to Request No. 7

"Have assessments or evaluations, or inspections conducted by State or Federal regulatory officials conducted within the past year uncovered a safety issue(s) with the management unit(s)?"

No

"If so, describe the actions that have been or are being taken to deal with the issue or issues"

NA

"Please provide any documentation that you have for these actions."

NA

Jim Bridger Power Station Response to Request No. 8

"What is the surface area (acres) and total storage capacity of each of the management units?"

The FGD Pond #2 surface area is 392 acres.

The FGD Pond #2 storage capacity is 11,534 acre-feet.

"What is the volume of material currently stored in each of the management unit(s)?"

The volume of material in FGD Pond #2 is approximately 2,958 acre-feet.

"Please provide the date that the volume measurement(s) was taken. '

Exact measurements were not taken. Storage volume was estimated using pond depth readings taken March 13, 2009.

"Please provide the maximum height of the management unit(s). The basis for determining maximum height is explained later in this Enclosure."

The maximum height of FGD Pond #2 is 42 feet.

Jim Bridger Power Station Response to Request No. 9

"Please provide a brief history of known spills or unpermitted releases from the unit within the last ten years, whether or not these were reported to State or federal regulatory agencies. For purposes of this question, please include only releases to surface water or to the land (do not include releases to groundwater)."

Seepage from FGD Pond #2 has surfaced on its north side within the last ten years. FGD Pond #2 at this location was constructed with a toe drain and collection sump. The design engineer anticipated seepage could occur due to fractures in the base shale. The seepage is controlled by a pump in the collection sump that pumps the collected fluid back into FGD Pond #2. Seepage is estimated at 10,000 gallons per month based on the pump back system's electrical demand. Core drilling and a dye study confirmed the seepage is through the base formation. The seepage was reported to the Wyoming Department of Environmental Quality.

Jim Bridger Power Station Response to Request No. 10

"Please identify all current legal owner(s) and operator(s) at the facility."

The current legal owner(s) of the Jim Bridger Power Station are PacifiCorp and Idaho Power Company. The current operator of the Jim Bridger Power Station is PacifiCorp.

Objections To Enclosure A

Jim Bridger Power Station Objections to the Introductory Paragraph of Enclosure A: PacifiCorp objects to the general request for information contained in the introductory paragraph of Enclosure A, including the information "requested below," on the grounds that the request is outside the scope of EPA's authority as contained in Section 104(e) of the Comprehensive Environmental Response, Compensation and Liability Act, 42 U.S.C. 9604(e). Moreover, PacifiCorp objects to this general request because it contains undefined and ambiguous terms such as "surface impoundment" "similar diked or bermed management unit(s)," "landfills," "liquid-borne material," "storage or disposal," "no longer receive," "coal combustion residues," "residuals or byproducts," "residues or by-products" and "free liquids" and because some of these terms seem to be used interchangeably within the introductory paragraph and in other requests without an explanation of whether they are intended to have the same meaning.

Jim Bridger Power Station Objections to Request No. 1: PacifiCorp objects to Request No. 1 because it contains undefined and ambiguous terms such as "management unit" and "unit(s)" and because some or all of these terms seem to be used interchangeably within this request and in other requests without an explanation of whether they are intended to have the same meaning.

Jim Bridger Power Station Objections to Request No. 2: PacifiCorp objects to Request No. 2 because it contains undefined and ambiguous terms such as "management unit," "unit(s)", "commissioned" and "expanded" and because some or all of these terms seem to be used interchangeably within this request and in other requests without an explanation of whether they are intended to have the same meaning.

Jim Bridger Power Station Objections to Request No. 3: PacifiCorp objects to Request No. 3 because it contains undefined and ambiguous terms such as "temporarily," "permanently," "management unit(s)" and "unit(s)" and because some or all of these terms seem to be used interchangeably within this request and in other requests without an explanation of whether they are intended to have the same meaning.

Jim Bridger Power Station Objections to Request No. 4: PacifiCorp objects to Request No. 4 because it contains undefined and ambiguous terms such as "management unit(s)", "designed," "construction," "waste management unit(s)", "inspection," and "monitoring" and also because it seems to use the terms "management unit(sand because some or all of these terms seem to be used interchangeably within this request and in other requests without an explanation of whether they are intended to have the same meaning.

Jim Bridger Power Station Objections to Request No. 5: PacifiCorp objects to Request No. 5 because it contains undefined and ambiguous terms such as "safety," "structural integrity," "management unit(s)," "assessments," "evaluations," "actions," "corrective actions," and because some or all of these terms seem to be used interchangeably within this request and in other requests without an explanation of whether they are intended to have the same meaning.

Jim Bridger Power Station Objections to Request No. 6: PacifiCorp objects to Request No. 6 because it contains undefined and ambiguous terms such as "official," "safety," "structural integrity," "management unit(s)," "inspection," "evaluation," "actions," "official inspection report," and because some or all of these terms seem to be used interchangeably within this request and in other requests without an explanation of whether they are intended to have the same meaning.

Jim Bridger Power Station Objections to Request No. 7: PacifiCorp objects to Request No. 7 because it contains undefined and ambiguous terms such as "assessments," "evaluations," "inspections," "officials," "safety issue(s)," "management unit(s)," "actions," and "deal with" and because some or all of these terms seem to be used interchangeably within this request and in other requests without an explanation of whether they are intended to have the same meaning.

Jim Bridger Power Station Objections to Request No. 8: PacifiCorp objects to Request No. 8 because it contains undefined and ambiguous terms such as "surface area (acres)," "total storage capacity," "management units," "volume," "material," "stored," "volume measurements," and "maximum height" and because some or all of these terms seem to be used interchangeably within this request and in other requests without an explanation of whether they are intended to have the same meaning.

Jim Bridger Power Station Objections to Request No. 9: PacifiCorp objects to Request No. 9 because it contains undefined and ambiguous terms such as "known spills," "unpermitted releases," "unit," "surface water," "land," and "groundwater" and because some or all of these terms seem to be used interchangeably within this request and in other requests without an explanation of whether they are intended to have the same meaning.

Appendix E

Stability Check Analyses

E.1 FGD Pool 1

E.2 FGD Pool 2

US EPA ARCHIVE DOCUMENT

Appendix E.1

FGD Pond 1

US EPA ARCHIVE DOCUMENT

US EPA ARCHIVE DOCUMENT

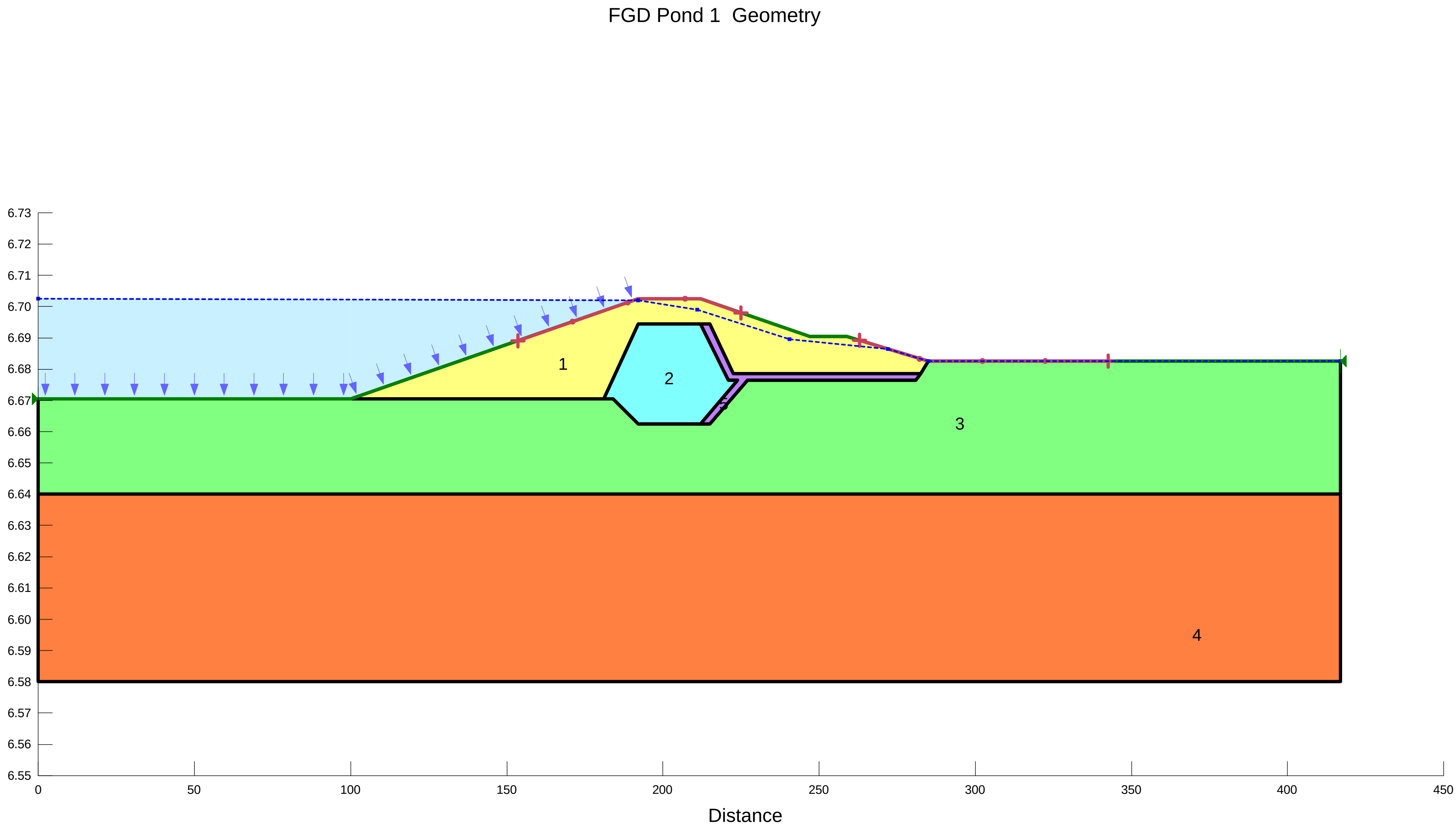


Figure E.1-1

US EPA ARCHIVE DOCUMENT

Loading Condition: Static - Steady Seepage
FGD Pond 1 Maximum Section
Simplified Core

1 Name: Shell- ss Model: Mohr-Coulomb Unit Weight: 125 pcf Unit Wt. Above Water Table: 120 pcf Cohesion: 0 psf Phi: 33 °
2 Name: Core-ss Model: Mohr-Coulomb Unit Weight: 120 pcf Unit Wt. Above Water Table: 115 pcf Cohesion: 200 psf Phi: 16 °
3 Name: Foundation-ss Model: Mohr-Coulomb Unit Weight: 122 pcf Unit Wt. Above Water Table: 113 pcf Cohesion: 0 psf Phi: 28 °
4 Name: Wxd Bedrock--ss Model: Mohr-Coulomb Unit Weight: 120 pcf Unit Wt. Above Water Table: 115 pcf Cohesion: 0 psf Phi: 35 °
5 Name: Drain-ss Model: Mohr-Coulomb Unit Weight: 135 pcf Unit Wt. Above Water Table: 130 pcf Cohesion: 0 psf Phi: 35 °

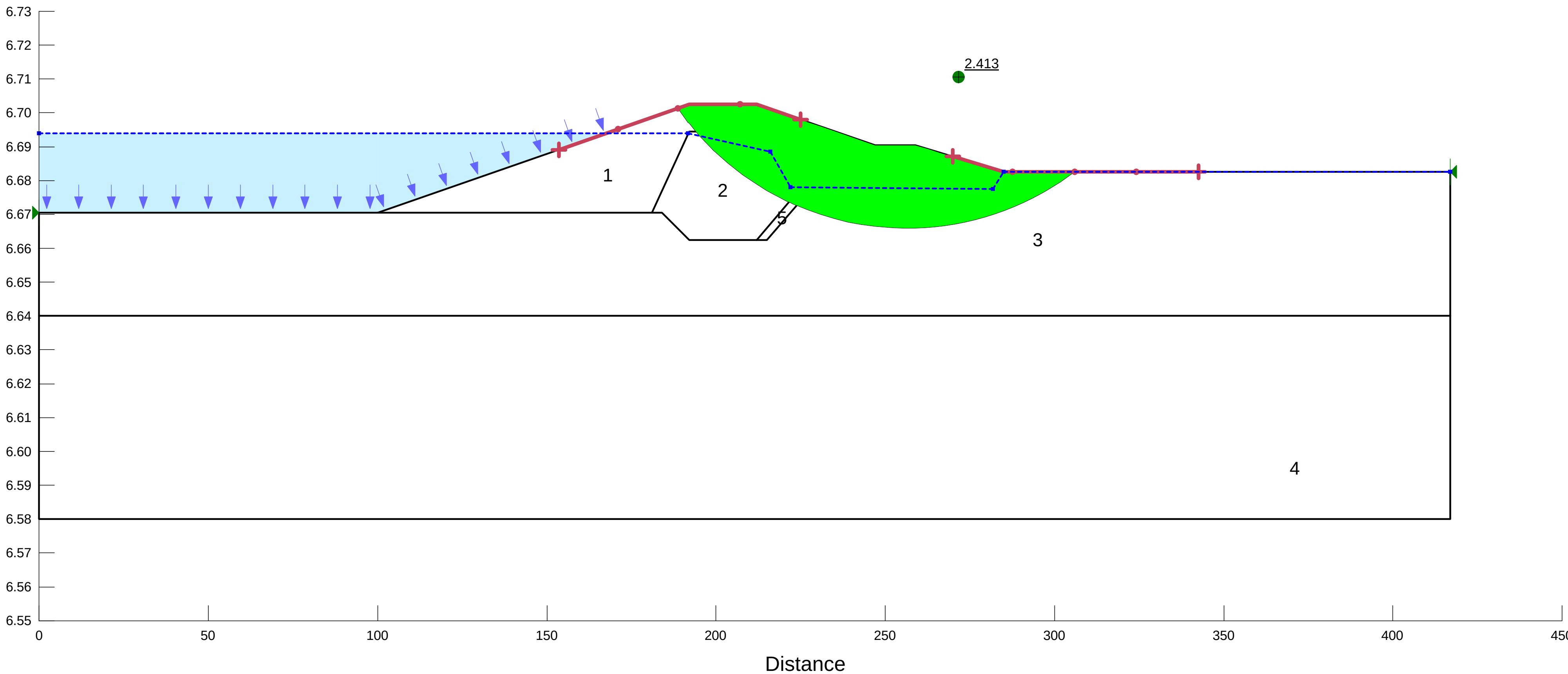


Figure E.1-2

US EPA ARCHIVE DOCUMENT

Loading Condition: Static - Steady Seepage
FGD Pond 1 Maximum Section
Simplified Core

	Name	Model	Unit Weight	Unit Wt. Above Water Table	Cohesion	Phi
1	Name: Shell- ss	Model: Mohr-Coulomb	Unit Weight: 125 pcf	Unit Wt. Above Water Table: 120 pcf	Cohesion: 0 psf	Phi: 33 °
2	Name: Core-ss	Model: Mohr-Coulomb	Unit Weight: 120 pcf	Unit Wt. Above Water Table: 115 pcf	Cohesion: 200 psf	Phi: 16 °
3	Name: Foundation-ss	Model: Mohr-Coulomb	Unit Weight: 122 pcf	Unit Wt. Above Water Table: 113 pcf	Cohesion: 0 psf	Phi: 28 °
4	Name: Wxd Bedrock--ss	Model: Mohr-Coulomb	Unit Weight: 120 pcf	Unit Wt. Above Water Table: 115 pcf	Cohesion: 0 psf	Phi: 35 °
5	Name: Drain-ss	Model: Mohr-Coulomb	Unit Weight: 135 pcf	Unit Wt. Above Water Table: 130 pcf	Cohesion: 0 psf	Phi: 35 °

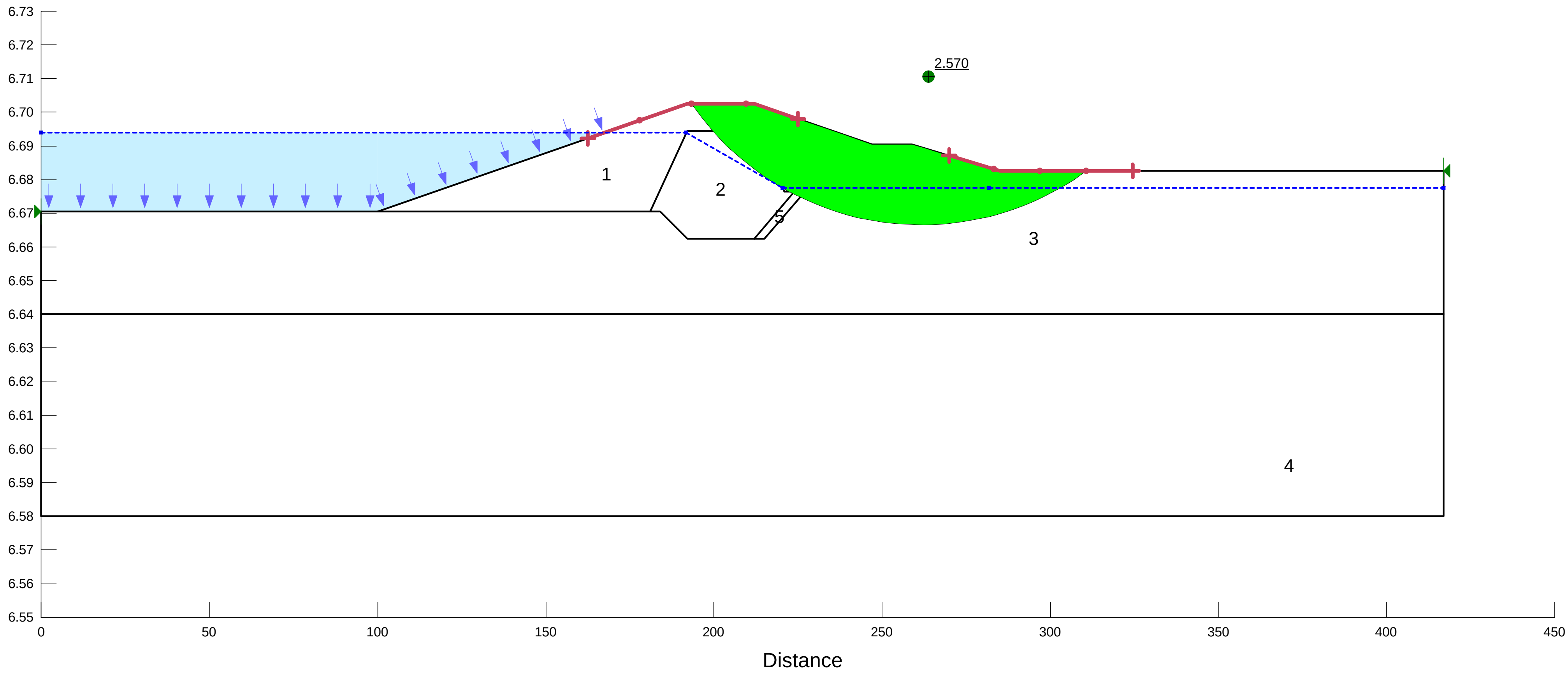


Figure E.1-3

US EPA ARCHIVE DOCUMENT

Loading Condition: Static - Steady Seepage
FGD Pond 1 Maximum Section
Simplified Core

1 Name: Shell- ss Model: Mohr-Coulomb Unit Weight: 125 pcf Unit Wt. Above Water Table: 120 pcf Cohesion: 0 psf Phi: 33 °
2 Name: Core-ss Model: Mohr-Coulomb Unit Weight: 120 pcf Unit Wt. Above Water Table: 115 pcf Cohesion: 200 psf Phi: 16 °
3 Name: Foundation-ss Model: Mohr-Coulomb Unit Weight: 122 pcf Unit Wt. Above Water Table: 113 pcf Cohesion: 0 psf Phi: 28 °
4 Name: Wxd Bedrock--ss Model: Mohr-Coulomb Unit Weight: 120 pcf Unit Wt. Above Water Table: 115 pcf Cohesion: 0 psf Phi: 35 °
5 Name: Drain-ss Model: Mohr-Coulomb Unit Weight: 135 pcf Unit Wt. Above Water Table: 130 pcf Cohesion: 0 psf Phi: 35 °

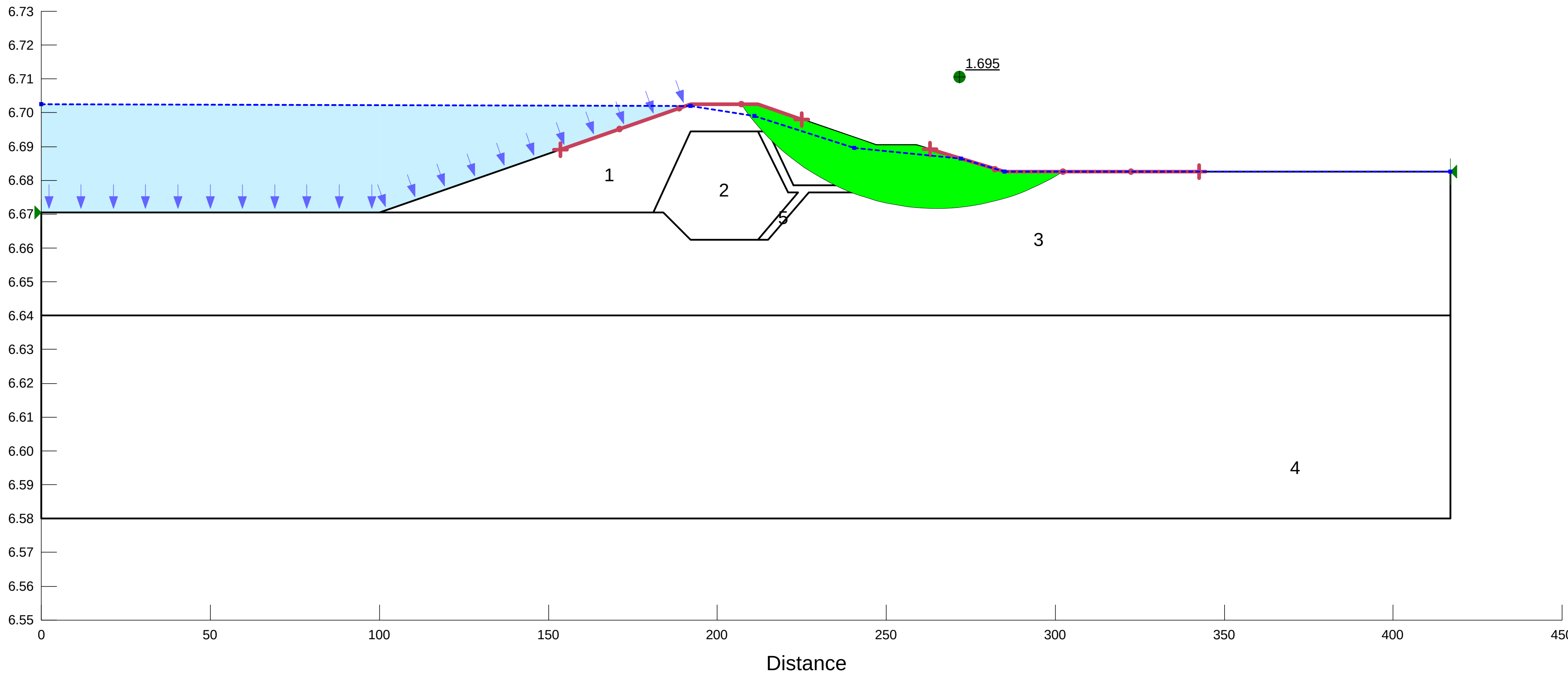


Figure E.1-4

Appendix E.2

FGD Pond 2

US EPA ARCHIVE DOCUMENT

Station 8+00 Geometry

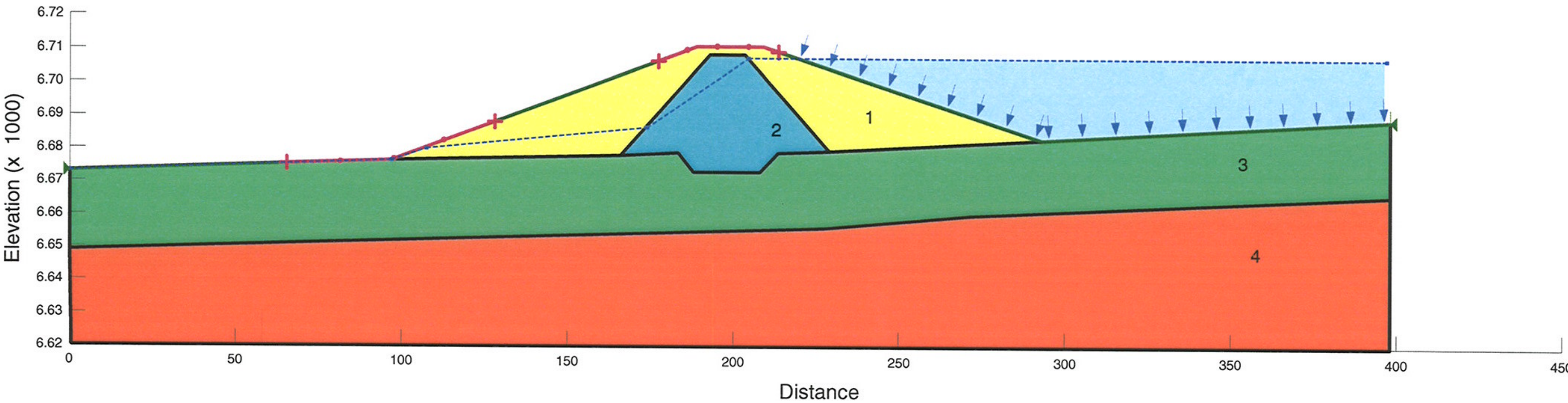


Figure E.2-1

Loading Condition: Static - Steady Seepage
Station 8+00

1 Name: Shell-ss Model: Mohr-Coulomb Unit Weight: 122 pcf Unit Wt. Above Water Table: 113 pcf Cohesion: 0 psf Phi: 33 °
2 Name: Core-ss Model: Mohr-Coulomb Unit Weight: 125 pcf Unit Wt. Above Water Table: 120 pcf Cohesion: 200 psf Phi: 16 °
3 Name: Foundation-ss Model: Mohr-Coulomb Unit Weight: 122 pcf Unit Wt. Above Water Table: 113 pcf Cohesion: 0 psf Phi: 28 °
4 Name: Wxd Bedrock-ss Model: Mohr-Coulomb Unit Weight: 130 pcf Unit Wt. Above Water Table: 125 pcf Cohesion: 0 psf Phi: 35 °

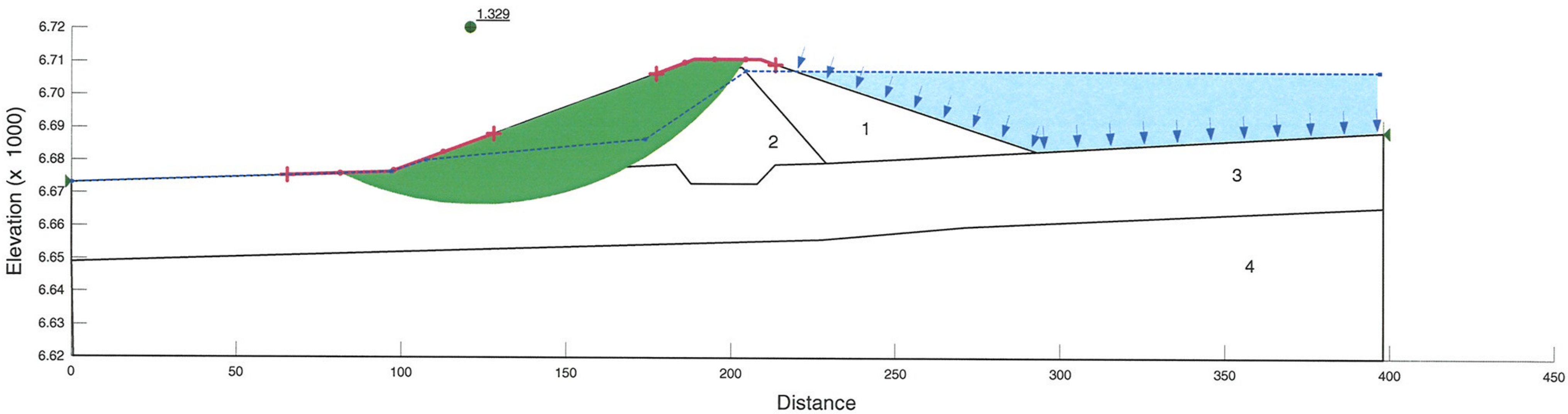


Figure E.2-2

Loading Condition: End Of Construction
Station 8+00

1 Name: Shell-eoc Model: Mohr-Coulomb Unit Weight: 122 pcf Unit Wt. Above Water Table: 113 pcf Cohesion: 0 psf Phi: 33 °
2 Name: Core-eoc Model: Undrained (Phi=0) Unit Weight: 125 pcf Unit Wt. Above Water Table: 120 pcf Cohesion: 1000 psf
3 Name: Foundation-eoc Model: Undrained (Phi=0) Unit Weight: 122 pcf Unit Wt. Above Water Table: 113 pcf Cohesion: 1000 psf
4 Name: Wxd Bedrock-eoc Model: Mohr-Coulomb Unit Weight: 130 pcf Unit Wt. Above Water Table: 125 pcf Cohesion: 0 psf Phi: 35 °

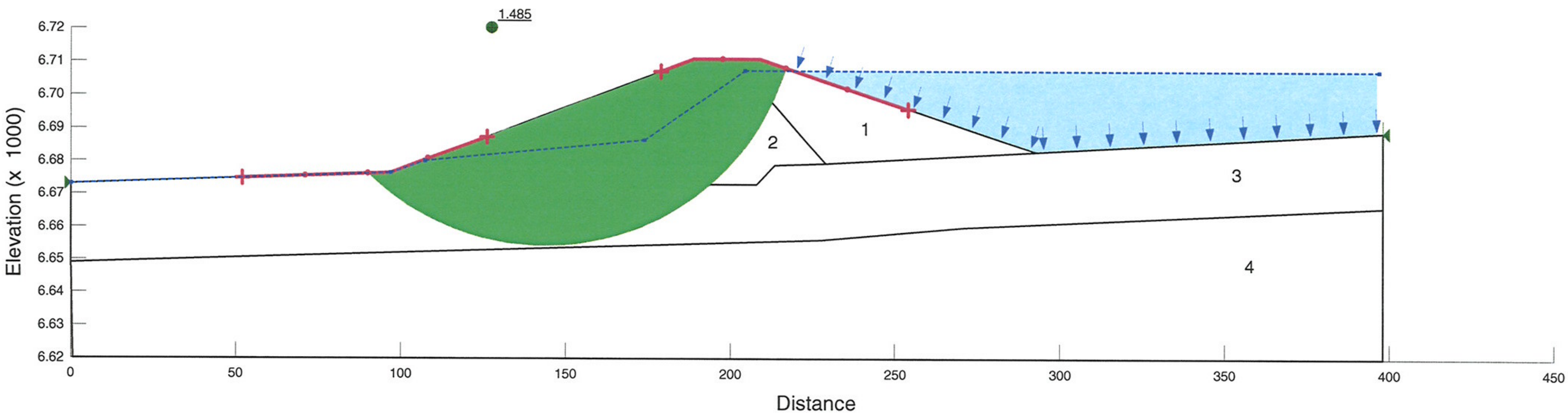


Figure E.2-3

Station 18+00   Geometry

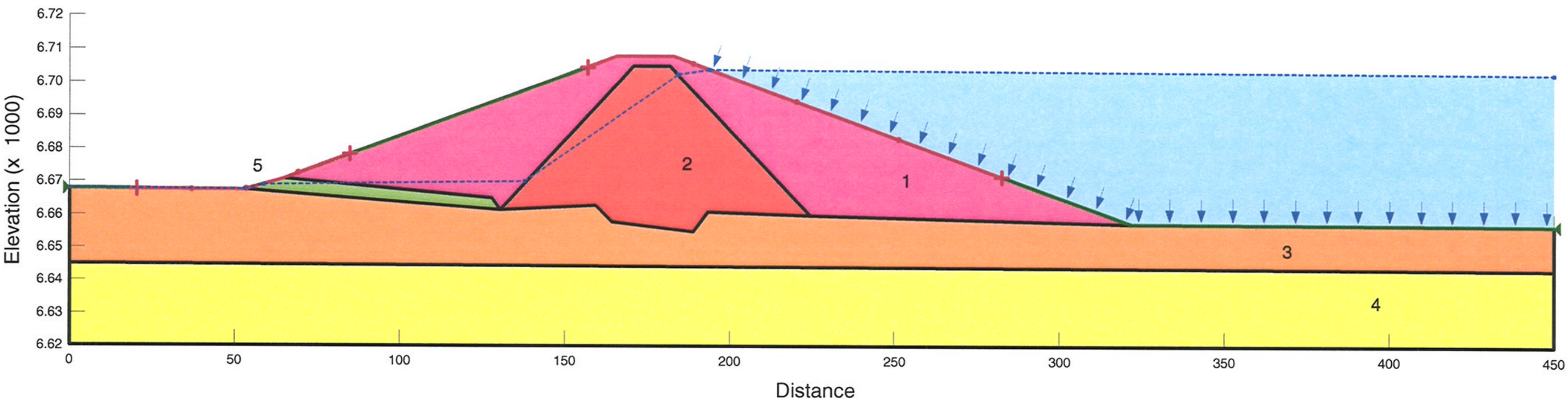


Figure E.2-4

Loading Condition: Static - Steady Seepage
Station 18+00

1 Name: Shell-ss Model: Mohr-Coulomb Unit Weight: 122 pcf Unit Wt. Above Water Table: 113 pcf Cohesion: 0 psf Phi: 33 °
2 Name: Core-ss Model: Mohr-Coulomb Unit Weight: 125 pcf Unit Wt. Above Water Table: 120 pcf Cohesion: 200 psf Phi: 16 °
3 Name: Foundation-ss Model: Mohr-Coulomb Unit Weight: 122 pcf Unit Wt. Above Water Table: 113 pcf Cohesion: 0 psf Phi: 28 °
4 Name: Wxd Bedrock-ss Model: Mohr-Coulomb Unit Weight: 130 pcf Unit Wt. Above Water Table: 125 pcf Cohesion: 0 psf Phi: 35 °
5 Name: Drain-ss Model: Mohr-Coulomb Unit Weight: 135 pcf Unit Wt. Above Water Table: 130 pcf Cohesion: 0 psf Phi: 35 °

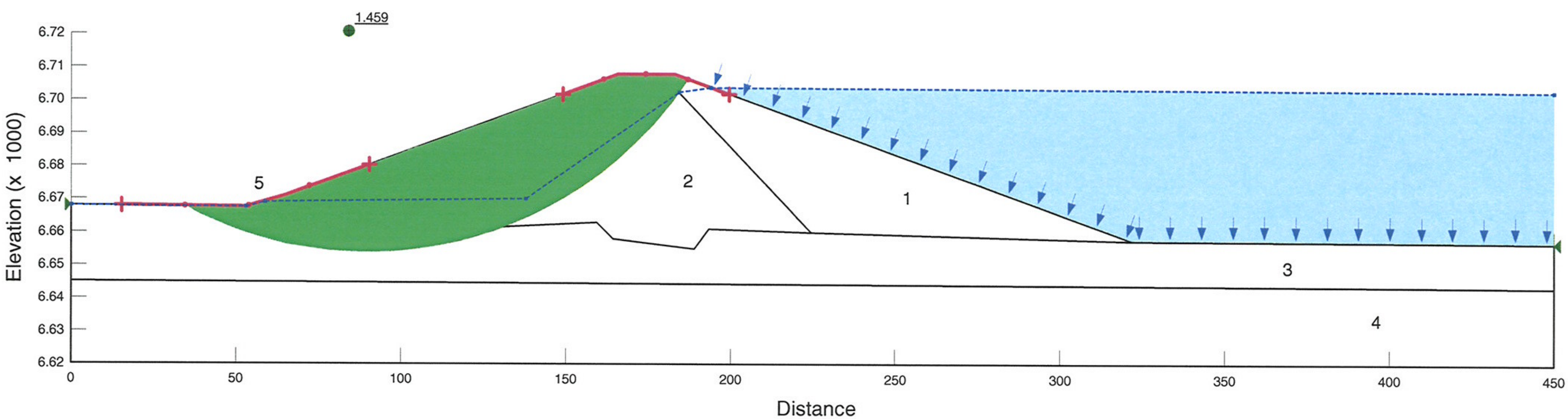


Figure E.2-5

Loading Condition: End of Construction
Station 18+00

1 Name: Shell-eoc Model: Mohr-Coulomb Unit Weight: 122 pcf Unit Wt. Above Water Table: 113 pcf Cohesion: 0 psf Phi: 33 °
2 Name: Core-eoc Model: Undrained (Phi=0) Unit Weight: 125 pcf Unit Wt. Above Water Table: 120 pcf Cohesion: 1000 psf
3 Name: Foundation-eoc Model: Undrained (Phi=0) Unit Weight: 122 pcf Unit Wt. Above Water Table: 113 pcf Cohesion: 1000 psf
4 Name: Wxd Bedrock-eoc Model: Mohr-Coulomb Unit Weight: 130 pcf Unit Wt. Above Water Table: 125 pcf Cohesion: 0 psf Phi: 35 °
5 Name: Drain-eoc Model: Mohr-Coulomb Unit Weight: 135 pcf Unit Wt. Above Water Table: 130 pcf Cohesion: 0 psf Phi: 35 °

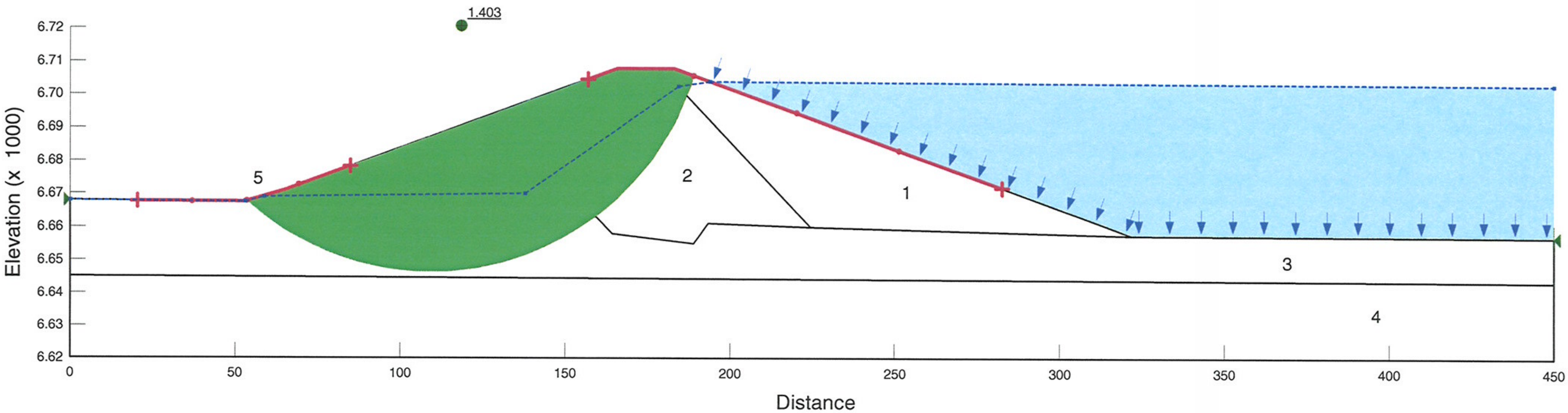


Figure E.2-6

Loading Condition: Psuedo-Static 0.10g
Station 18+00

1 Name: Shell-ss Model: Mohr-Coulomb Unit Weight: 122 pcf Unit Wt. Above Water Table: 113 pcf Cohesion: 0 psf Phi: 33 °
2 Name: Core-ss Model: Mohr-Coulomb Unit Weight: 125 pcf Unit Wt. Above Water Table: 120 pcf Cohesion: 200 psf Phi: 16 °
3 Name: Foundation-ss Model: Mohr-Coulomb Unit Weight: 122 pcf Unit Wt. Above Water Table: 113 pcf Cohesion: 0 psf Phi: 28 °
4 Name: Wxd Bedrock-ss Model: Mohr-Coulomb Unit Weight: 130 pcf Unit Wt. Above Water Table: 125 pcf Cohesion: 0 psf Phi: 35 °
5 Name: Drain-ss Model: Mohr-Coulomb Unit Weight: 135 pcf Unit Wt. Above Water Table: 130 pcf Cohesion: 0 psf Phi: 35 °

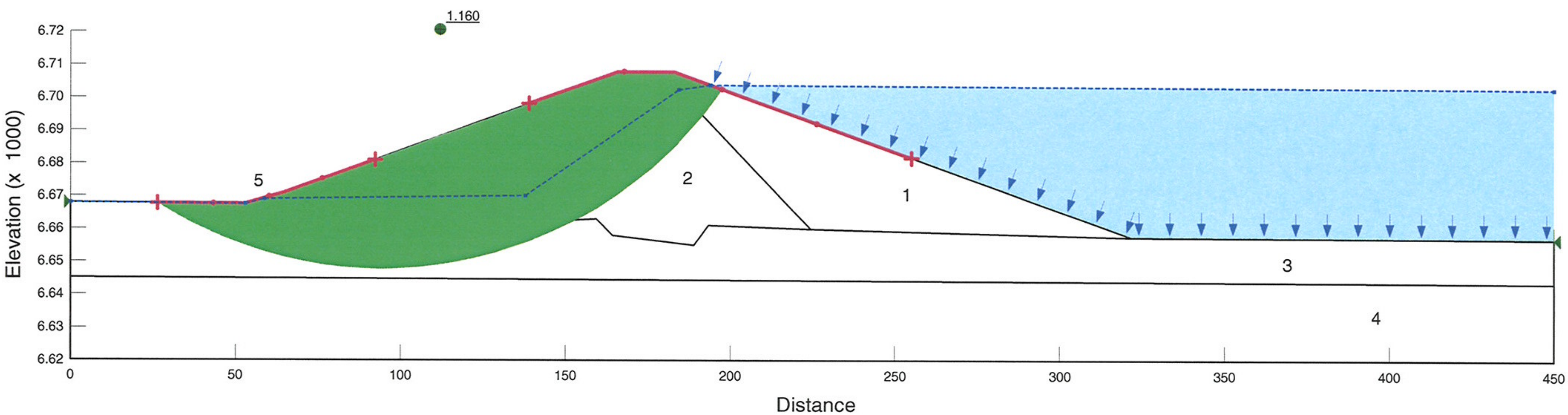


Figure E.2-7

Station 40+00 Geometry

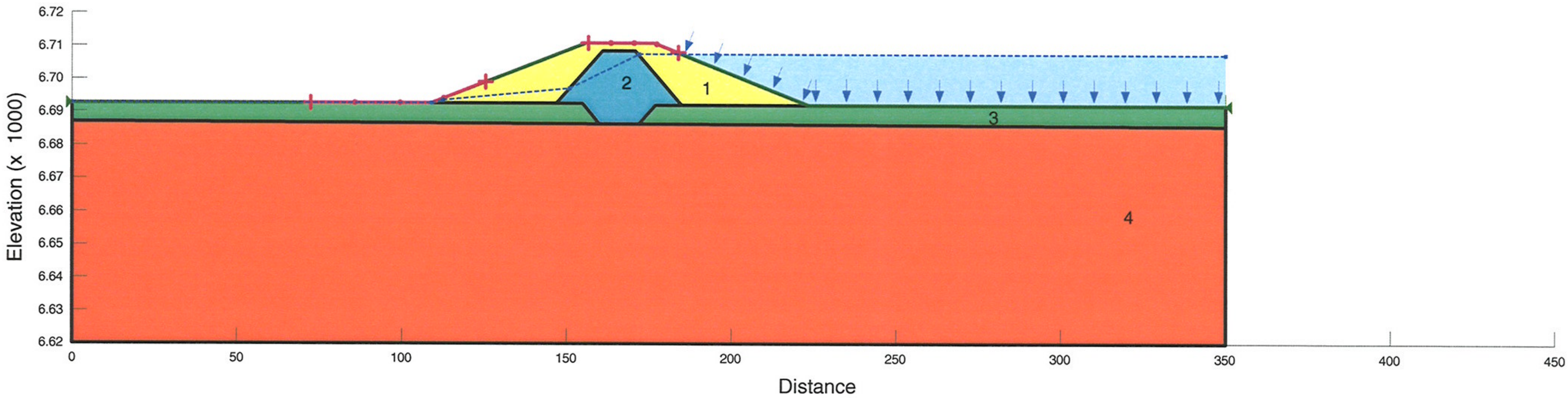


Figure E.2-8

Loading Condition: Static - Steady Seepage
Station 40+00

1 Name: Shell-ss Model: Mohr-Coulomb Unit Weight: 122 pcf Unit Wt. Above Water Table: 113 pcf Cohesion: 0 psf Phi: 33 °
2 Name: Core-ss Model: Mohr-Coulomb Unit Weight: 125 pcf Unit Wt. Above Water Table: 120 pcf Cohesion: 200 psf Phi: 16 °
3 Name: Foundation-ss Model: Mohr-Coulomb Unit Weight: 123 pcf Unit Wt. Above Water Table: 113 pcf Cohesion: 0 psf Phi: 28 °
4 Name: Wxd Bedrock-ss Model: Mohr-Coulomb Unit Weight: 130 pcf Unit Wt. Above Water Table: 125 pcf Cohesion: 0 psf Phi: 35 °

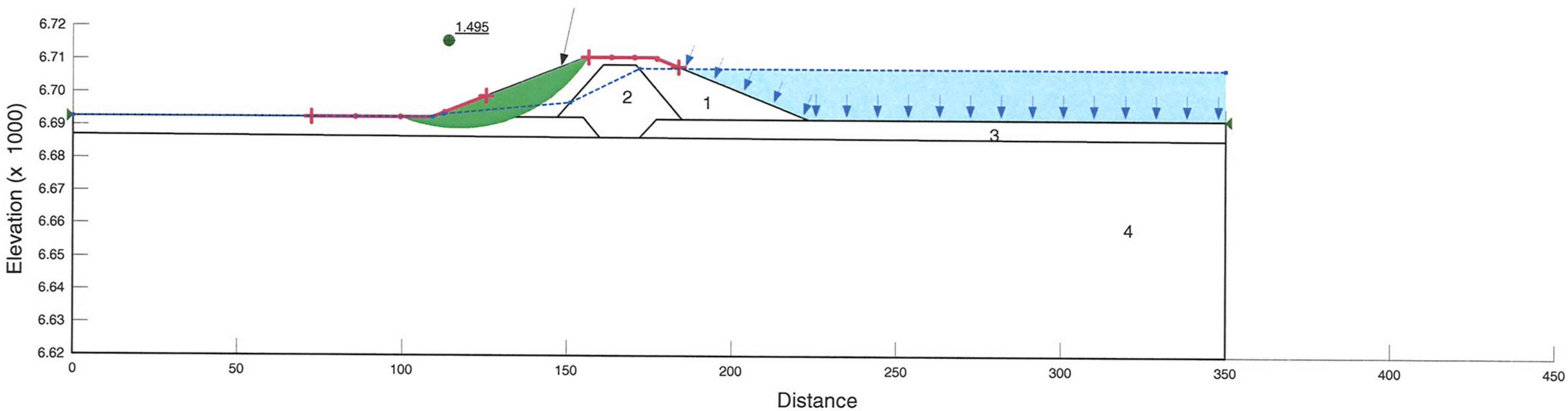


Figure E.2-9

Loading Condition: End of Construction
Station 40+00

1 Name: Shell-eoc Model: Mohr-Coulomb Unit Weight: 122 pcf Unit Wt. Above Water Table: 113 pcf Cohesion: 0 psf Phi: 33 °
2 Name: Core-eoc Model: Undrained (Phi=0) Unit Weight: 125 pcf Unit Wt. Above Water Table: 120 pcf Cohesion: 1000 psf
3 Name: Foundation-eoc Model: Undrained (Phi=0) Unit Weight: 123 pcf Unit Wt. Above Water Table: 113 pcf Cohesion: 1000 psf
4 Name: Wxd Bedrock-eoc Model: Mohr-Coulomb Unit Weight: 130 pcf Unit Wt. Above Water Table: 125 pcf Cohesion: 0 psf Phi: 35 °

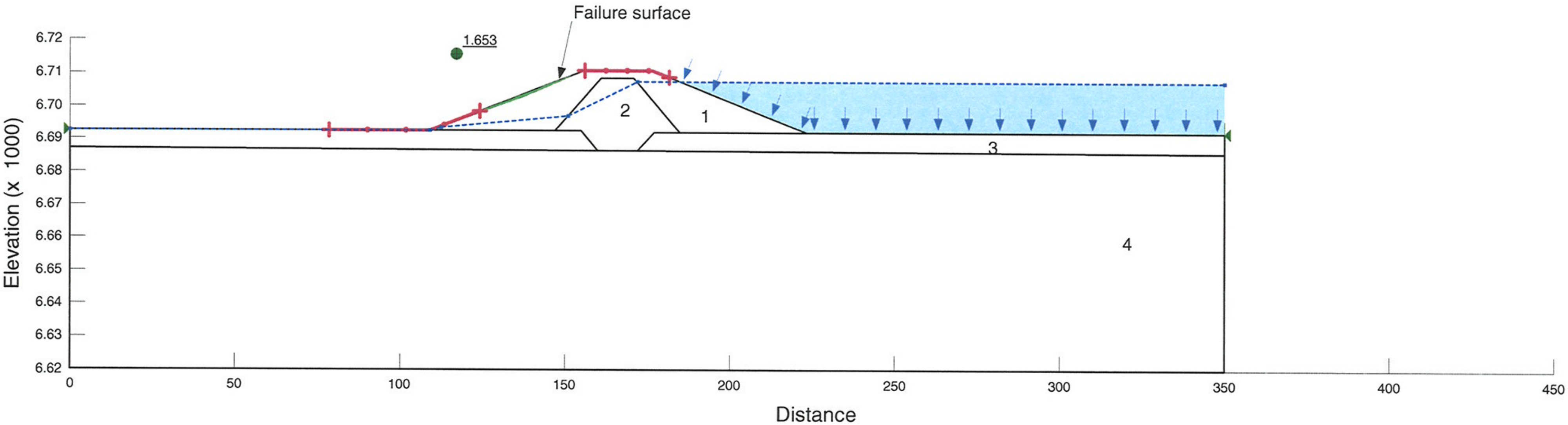


Figure E.2-10

Station 62+00 Geometry

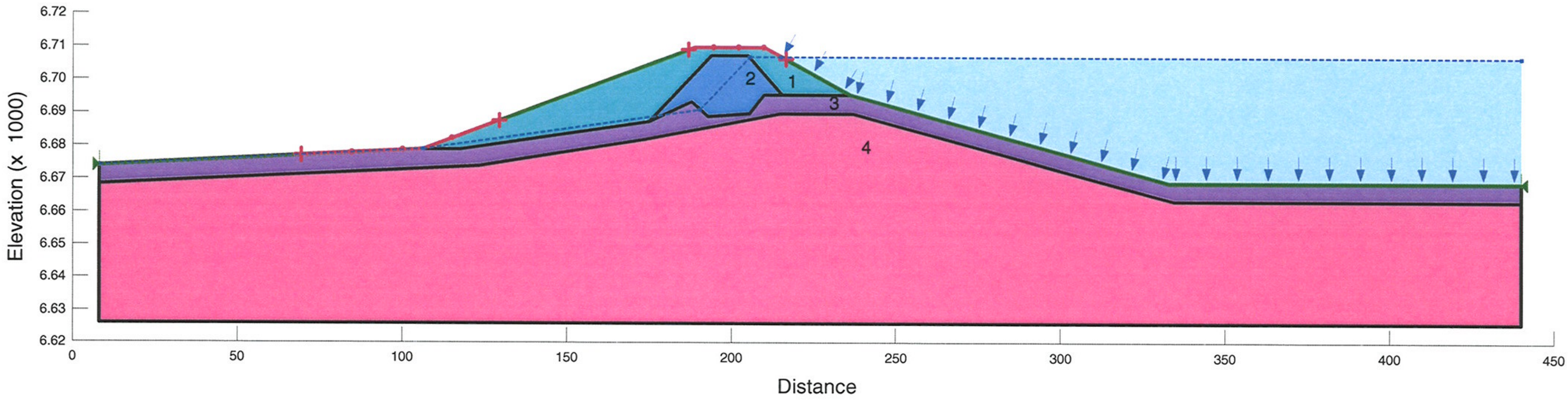


Figure E.2-11

Loading Condition: Static - Steady Seepage
Station 62+00

1 Name: Shell-ss Model: Mohr-Coulomb Unit Weight: 122 pcf Unit Wt. Above Water Table: 113 pcf Cohesion: 0 psf Phi: 33 °
2 Name: Core-ss Model: Mohr-Coulomb Unit Weight: 125 pcf Unit Wt. Above Water Table: 120 pcf Cohesion: 200 psf Phi: 16 °
3 Name: Foundation-ss Model: Mohr-Coulomb Unit Weight: 122 pcf Unit Wt. Above Water Table: 113 pcf Cohesion: 0 psf Phi: 28 °
4 Name: Wxd Bedrock-ss Model: Mohr-Coulomb Unit Weight: 130 pcf Unit Wt. Above Water Table: 125 pcf Cohesion: 0 psf Phi: 35 °

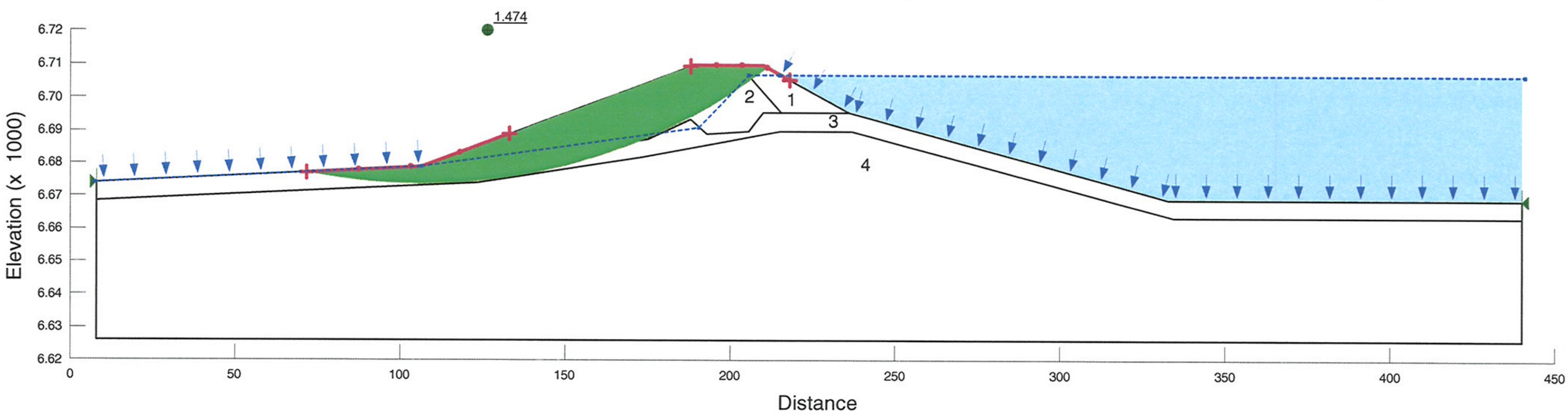


Figure E.2-12

Loading Condition: End of Construction
Station 62+00

1 Name: Shell- eoc Model: Mohr-Coulomb Unit Weight: 122 pcf Unit Wt. Above Water Table: 113 pcf Cohesion: 0 psf Phi: 33 °
2 Name: Core-eoc Model: Undrained (Phi=0) Unit Weight: 125 pcf Unit Wt. Above Water Table: 120 pcf Cohesion: 1000 psf
3 Name: Foundation-eoc Model: Undrained (Phi=0) Unit Weight: 122 pcf Unit Wt. Above Water Table: 113 pcf Cohesion: 1000 psf
4 Name: Wxd Bedrock-eoc Model: Mohr-Coulomb Unit Weight: 130 pcf Unit Wt. Above Water Table: 125 pcf Cohesion: 0 psf Phi: 35 °

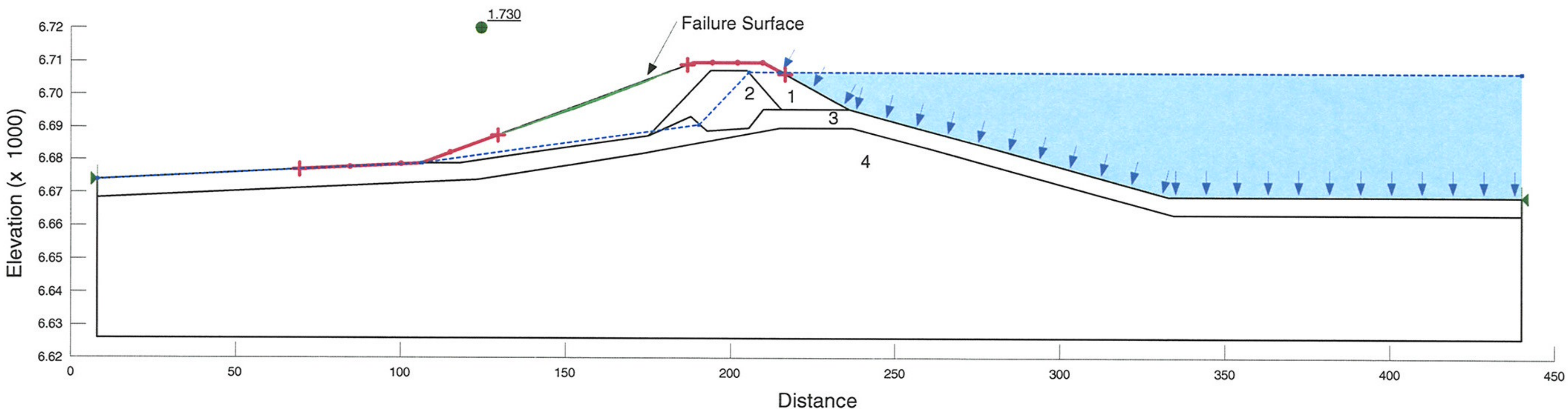


Figure E.2-13

Station 84+00 Geometry

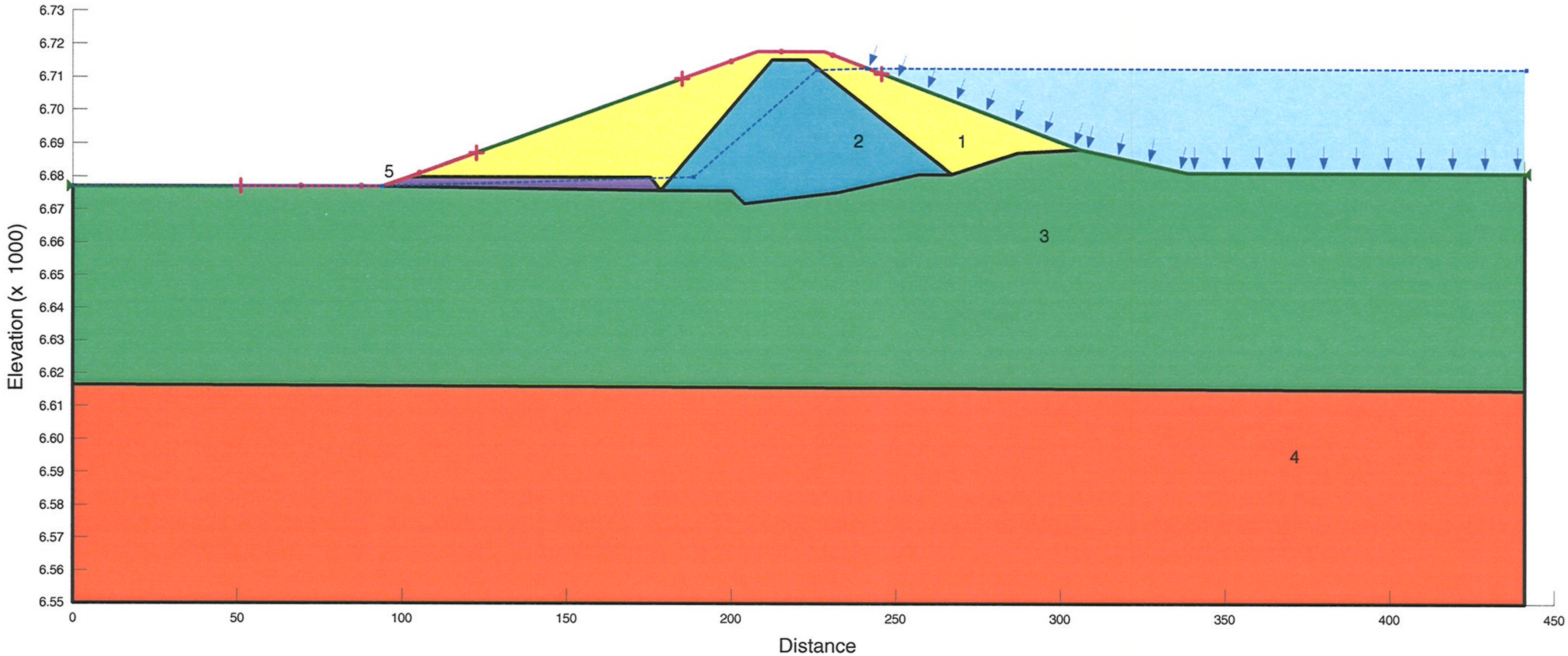


Figure E.2-14

Loading Condition: Static - Steady Seepage
Station 84+00

1 Name: Shell- ss Model: Mohr-Coulomb Unit Weight: 125 pcf Unit Wt. Above Water Table: 120 pcf Cohesion: 0 psf Phi: 33 °
2 Name: Core-ss Model: Mohr-Coulomb Unit Weight: 120 pcf Unit Wt. Above Water Table: 115 pcf Cohesion: 200 psf Phi: 16 °
3 Name: Foundation-ss Model: Mohr-Coulomb Unit Weight: 122 pcf Unit Wt. Above Water Table: 113 pcf Cohesion: 0 psf Phi: 28 °
4 Name: Wxd Bedrock--ss Model: Mohr-Coulomb Unit Weight: 120 pcf Unit Wt. Above Water Table: 115 pcf Cohesion: 0 psf Phi: 35 °
5 Name: Drain-ss Model: Mohr-Coulomb Unit Weight: 135 pcf Unit Wt. Above Water Table: 130 pcf Cohesion: 0 psf Phi: 35 °

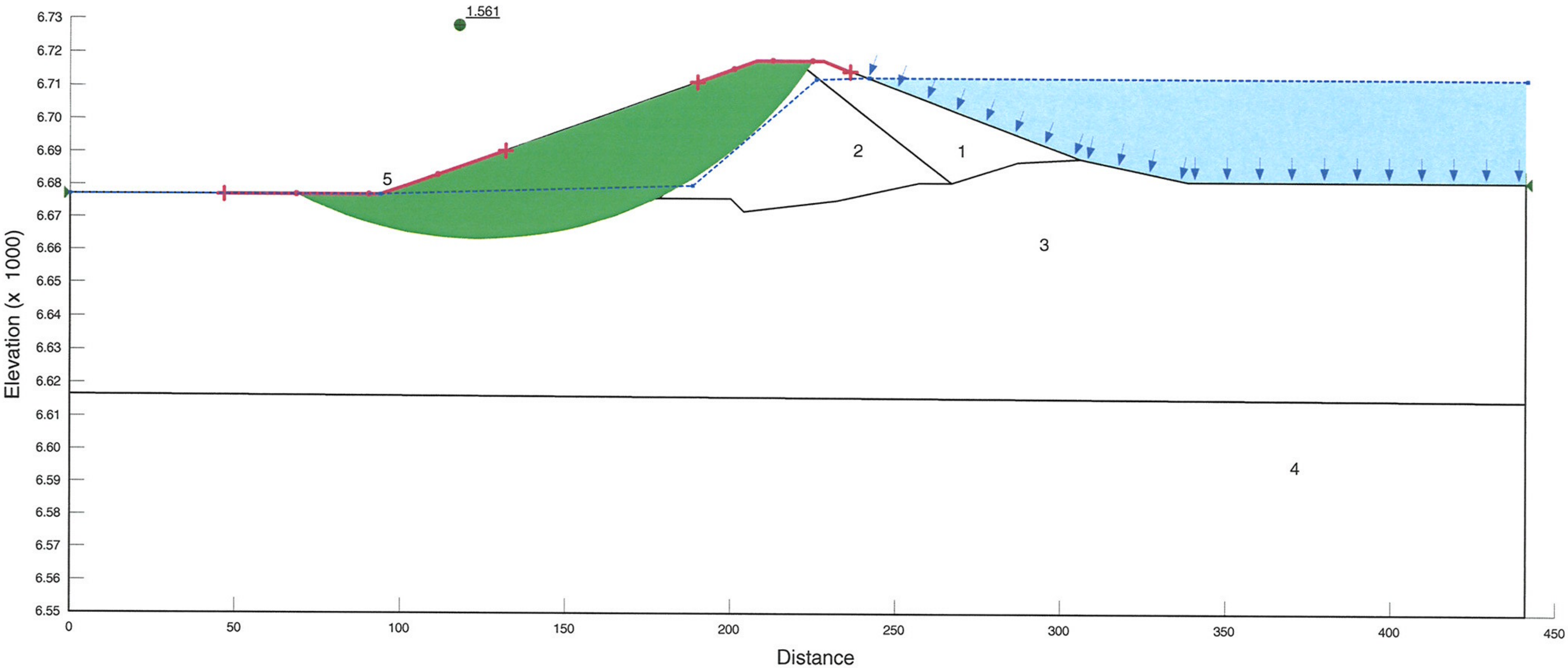


Figure E.2-15

Loading Condition: End of Construction
Station 84+00

1 Name: Shell- eoc Model: Mohr-Coulomb Unit Weight: 125 pcf Unit Wt. Above Water Table: 120 pcf Cohesion: 0 psf Phi: 33 °
2 Name: Core-eoc Model: Undrained (Phi=0) Unit Weight: 120 pcf Unit Wt. Above Water Table: 115 pcf Cohesion: 1000 psf
3 Name: Drain-eoc Model: Mohr-Coulomb Unit Weight: 135 pcf Unit Wt. Above Water Table: 130 pcf Cohesion: 0 psf Phi: 35 °
4 Name: Foundation-eoc Model: Undrained (Phi=0) Unit Weight: 122 pcf Unit Wt. Above Water Table: 113 pcf Cohesion: 1000 psf
5 Name: Wxd Bedrock--eoc Model: Mohr-Coulomb Unit Weight: 120 pcf Unit Wt. Above Water Table: 115 pcf Cohesion: 0 psf Phi: 35 °

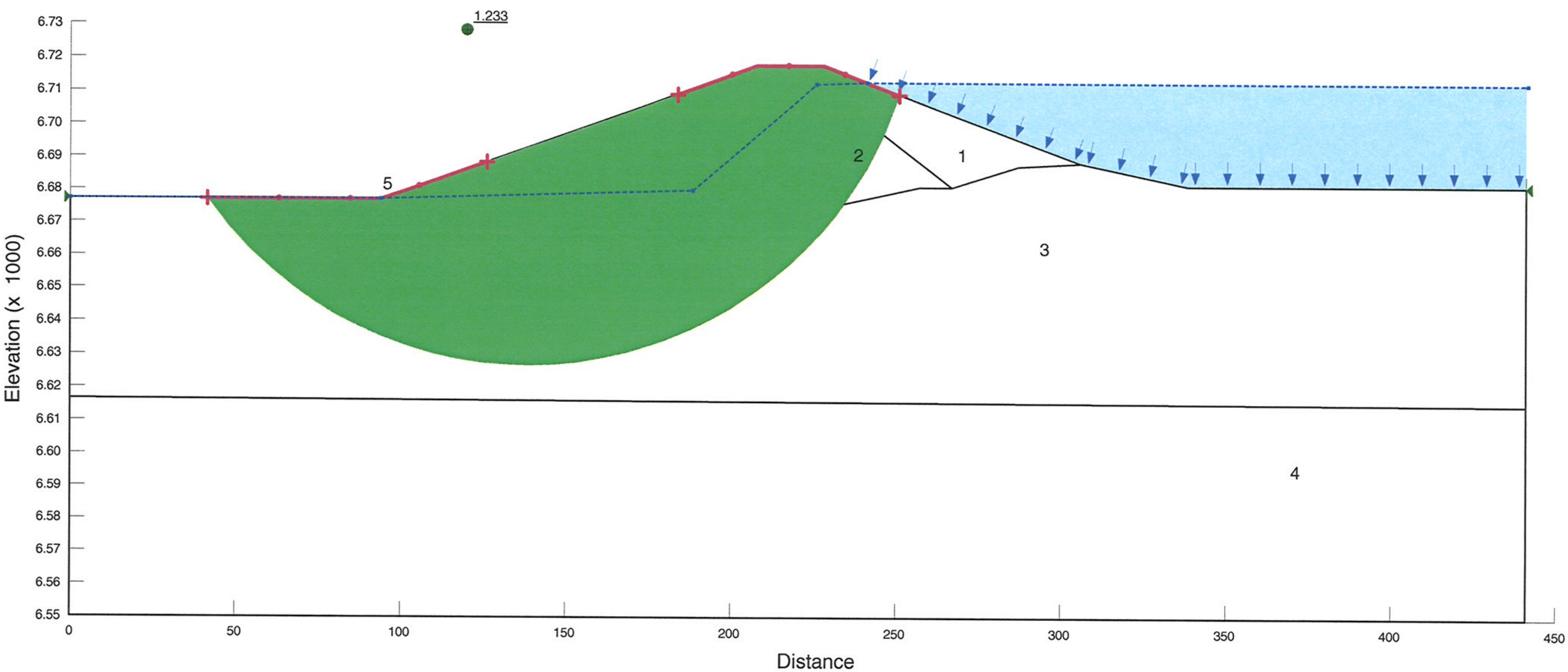


Figure E.2-16

Loading Condition: Psuedo-Static 0.10g
Station 84+00

1	Name: Shell- ss	Model: Mohr-Coulomb	Unit Weight: 125 pcf	Unit Wt. Above Water Table: 120 pcf	Cohesion: 0 psf	Phi: 33 °
2	Name: Core-ss	Model: Mohr-Coulomb	Unit Weight: 120 pcf	Unit Wt. Above Water Table: 115 pcf	Cohesion: 200 psf	Phi: 16 °
3	Name: Foundation-ss	Model: Mohr-Coulomb	Unit Weight: 122 pcf	Unit Wt. Above Water Table: 113 pcf	Cohesion: 0 psf	Phi: 28 °
4	Name: Wxd Bedrock--ss	Model: Mohr-Coulomb	Unit Weight: 120 pcf	Unit Wt. Above Water Table: 115 pcf	Cohesion: 0 psf	Phi: 35 °
5	Name: Drain-ss	Model: Mohr-Coulomb	Unit Weight: 135 pcf	Unit Wt. Above Water Table: 130 pcf	Cohesion: 0 psf	Phi: 35 °

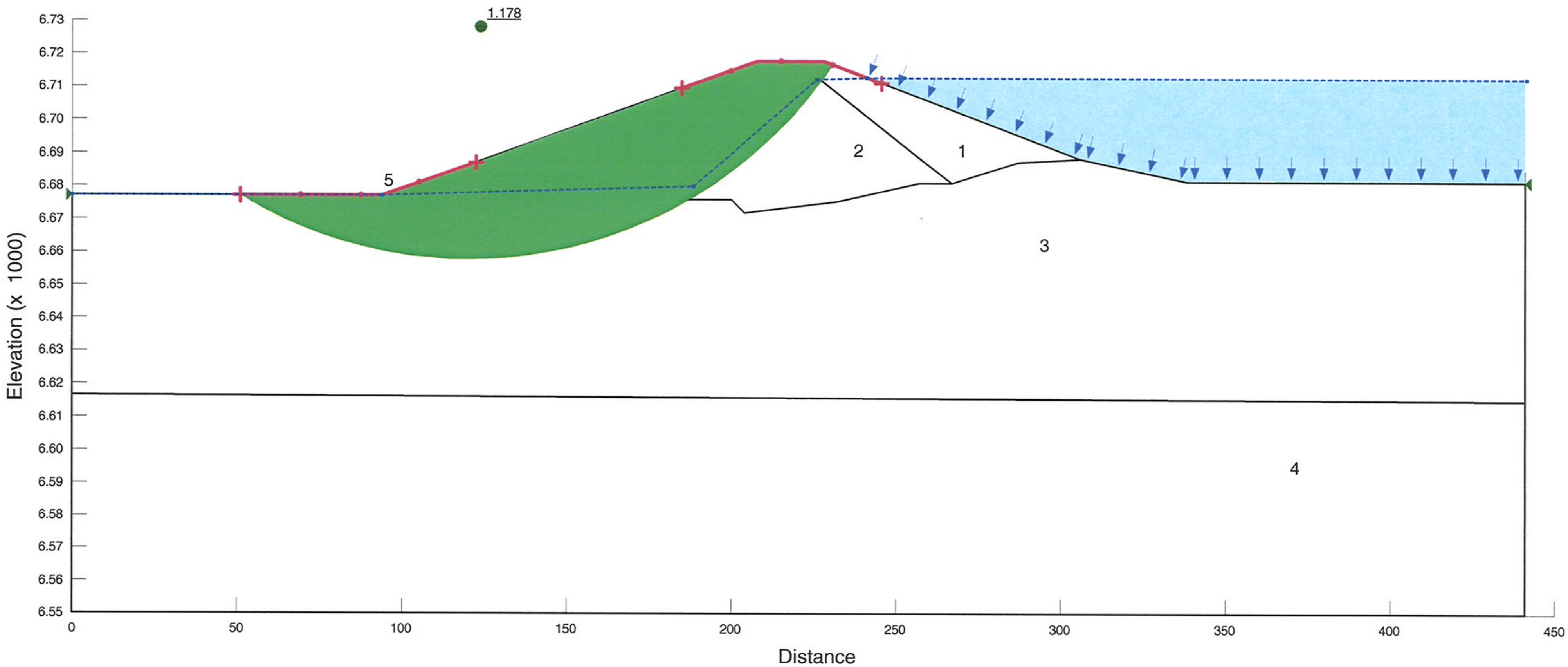


Figure E.2-17