U.S. Department of Labor

Mine Safety and Health Administration
1030 London Drive, Suite 400
Birmingham, AL 35211-4542

DEC 31 2014

Lawrence Pasquale, Safety Manager
Concord Mine, ID No. 01-00329
Oak Grove Resources, LLC
8360 Taylors Ferry Road
Hueytown, AL 35023

Dear Mr. Pasquale:

Your request for excavation of in-place coarse refuse, dated June 16, 2014, for the purpose of enlarging the existing **Slurry Impoundment No. 3 (Site 2a) and the Coarse Coal Refuse Disposal Area (Site 2c), MSHA ID No. AL11-00093-01 and AL11-00043-02** has been reviewed.

The modified design plan for the facility appears to be in accordance with current prudent engineering practices for coal refuse facilities and is hereby **approved.**

If you have any questions concerning this matter, please contact the District Plans Group at (205) 290-7302, ext. 261.

Sincerely,

Steve Womack
for Richard A. Gates
District Manager

cc: Cardno MM&A
200 George Street, Suite 6
Beckley, WV 25801

Ron McCrary
UMWA Local #8982, ID No. 01-00329
P. O. Box 107
Dolomite, AL 35061

PROPOSED COAL REFUSE DISPOSAL PLAN

ENGINEERING REPORT

COAL REFUSE DISPOSAL AREAS
CONCORD PREPARATION PLANT
CLIFFS NATURAL RESOURCES – OAK GROVE MINE
JEFFERSON COUNTY, ALABAMA

POOL RAISING OF IMPOUNDMENT #3 (SITE 2a) FOR FCR DISPOSAL
AND INTERNAL EXCAVATION OF OVERBUILT EMBANKMENT

FACILITY ID No. 01-00329
MSHA ID 1211-AL11-00043-02 (Site 2c - CCR Disposal)
MSHA ID 1211-AL11-00093-01 (Impoundment #3, Site 2a)
MSHA ID 1211-AL11-00093-02 (Impoundment #4, Site 2b)

February 22, 2012

Revision 1, July 2013
(Per MSHA Comments 4/19/2013) (**REVISIONS APPEAR IN THIS FONT**)

Revision 2, January 2014
(Per ASMC Comments January 2014) (***REVISIONS APPEAR IN THIS FONT***)

Revision 3, February 2015
(Internal Excavation of Overbuilt Embankment) (Revisions appear in this font)

Prepared For:
Cliffs Natural Resources
Oak Grove Mine
Jefferson County, Alabama

Prepared By: **Marshall Miller & Associates, Inc.**
200 George Street, Suite 6, Beckley, WV 25801

I hereby certify that this document was prepared by me or under my direct personal supervision and is correct to the best of my knowledge and belief and that I am a duly licensed Professional Engineer under the laws of the State of ALABAMA.

William O. Dickey Jr.
(Signature)

Date: 2/24/15

State of West Virginia
County of Raleigh
Acknowledged before me, a Notary Public
This 24 day of February 2015
My commission expires 10/17/2017

ALABAMA LICENSED No. 31771 PROFESSIONAL ENGINEER WILLIAM O. DICKEY

NOTARY PUBLIC
STATE OF WEST VIRGINIA
STEPHANIE D. HILL
357 OAK GROVE ROAD
BECKLEY, WV 25801
My commission expires October 17, 2017

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REVISION 2, JANUARY 2014

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REVISION 2, JANUARY 2014

ENGINEERING REPORT
COAL REFUSE DISPOSAL AREAS
CONCORD PREPARATION PLANT
CLIFFS NATURAL RESOURCES – OAK GROVE MINE
JEFFERSON COUNTY, ALABAMA

POOL RAISING OF IMPOUNDMENT #3 (SITE 2a) FOR FCR DISPOSAL
AND INTERNAL EXCAVATION OF OVERBUILT EMBANKMENT

1.0 GENERAL INFORMATION

Marshall Miller and Associates (MMA) has prepared this Engineering Report for a proposed plan (Plan) for modifications to Slurry Impoundment #3 (Site 2a) fine coal refuse (FCR) disposal at the Oak Grove Resources LLC (OGR) Concord Preparation Plant in Jefferson County, Alabama. This report encompasses the features of work that are necessary to prepare the sites being modified for coal refuse disposal, including:

- Implementation of local erosion and sedimentation controls (E&SC);
- Development of access and haul roads;
- Storm drainage controls (channels/ditches and culverts);
- Special provisions for CCR placement over FCR; and
- Related tasks necessary to prepare the sites for coal refuse disposal.

Refuse disposal requirements, instrumentation, and abandonment capping details and storm water drainage controls are addressed in the existing, previously approved, documents: (1) Report – Proposed Coal Refuse Disposal Area – Expansion Plan, Project No. 90-555-27, September 1991 by Almes and Associates (Almes, 1991) and (2) Oak Grove Resources, LLC – Concord Preparation Plant – Refuse Disposal Area Expansion by PERC Engineering Co., Inc. (PERC, 2007). The requirements of these previously approved plans remain in affect except as modified herein.

1.1 OVERVIEW OF PROPOSED PLAN

The existing conditions are shown on Figure 2 and the overall proposed expansion plan and site designations are shown on the Key Plan, Figure 3 located in Appendix A. The proposed expansion Plan will maintain the currently approved slurry impoundment crest elevation, EL 730. Impoundment #3 (Site 2a) will have an small upstream stage embankment constructed on its western side. This will enable the previously approved FCR pool elevation, EL 683 to be increased to EL 718. In addition, a new Haul Road No. 1 will be constructed on the north side of Site 2b. This haul road will allow for a more efficient transportation of coarse refuse to Site 2b and Site 2c. Coarse refuse will continue to be placed in Site 2b to complete the previously approved capping of Slurry Impoundment #4 (Site 2b) and in Site 2c to complete the previously approved coarse refuse buttress. **IMPOUNDMENT #3 IS A HIGH HAZARD POTENTIAL STRUCTURE.**

MM&A has also evaluated the technical viability of enlarging the Concord Slurry Impoundment No. 3 (SI#3) by excavating excess coarse coal refuse (CCR) from overbuilt embankment sections bordering the impoundment. The impetus for this study stems from Oak Grove Resources, LLC (OGR)'s projected need to identify additional fine coal refuse (FCR) disposal capacity to support near-term operations, within the existing footprint of permitted refuse disposal. At the SI#3 facility, the existing northern and southern/southeastern impounding embankments are excessively over-built relative to the minimum dam cross-section stipulated in the recently approved Pool EL 718 modification. Therefore, the impoundment could be enlarged along this portion of the perimeter by excavating some of this excess CCR. The Figures in Appendix A are provided to clarify this proposal. The figures show the maximum excavation investigated at each area; excavation of all or some portion of that shown will depend on operational constraints and timing. The analysis was conducted on maximum excavation. Partial excavation within the limits shown will not adversely affect stability. To ensure the stability and safety of the work area a 2:1 or flatter slope and a safety berm around the pool area of SI#3 will be maintained at all times.

Revision 3, February 2015

Drainage control for the entire site will be slightly modified with some new diversion ditches and riprapped flumes. Overall these changes will be relatively minor: a new haul road at Site 2b. These items are included in this Plan and will comply with current criteria of the Mine Safety and Health Administration (MSHA) and ASMC.

The following companion documents are enclosed in support of the Plan for the proposed expansion ***and internal excavation*** of Site 2a, Impoundment #3 (FCR):

- Figures 1-15 (Design Drawings) – Appendix A
- Guideline Technical Specifications – Appendix B
- Calculation Brief – Appendix C
- Geotechnical Data and Laboratory Testing Reports – Section B, Calculation Brief Appendix C
- ALMES, 1991 & PERC 2007 Approved Plans – Appendix E (on DVD disc only)

Together these documents comprise the engineering submission for the proposed Plan. Figures 2, 3, and 5, Appendix A, present an existing conditions plan, an overall key plan of the proposed expansion***, internal excavation,*** and the final disposal configurations for Site 2. Several concepts for the final reclamation and abandonment of the sites are proposed, the details of which will be developed and finalized prior to abandonment. Two of the three abandonment options are very similar to what is currently shown in the approved Almes, 1991 and PERC, 2007 plans.

1.2 FACILITY IDENTIFICATION [§ 77.216-2(A) (1)]

Oak Grove Resources, LLC (OGR) is currently operating the Concord Refuse Disposal Facility (Facility) Facility ID No. 01-00329. The MSHA ID Numbers are: 1211-AL11-00093-01 (Impoundment #3,Site 2a); 1211-00093-02 (Impoundment #4, Site 2b); 1211-

AL11-00043-02 (Site 2c - CCR Disposal). OGR is seeking the approval of MSHA and ASMC for the modification to its currently approved plan as defined by Almes, 1991 and PERC, 2007. The Facility is operated by:

Oak Grove Resources LLC
8800 Oak Grove Mine Road
Adger, AL 35006
Contact: Mr. Ralph Lopez
Telephone: (205) 497-3615

1.3 SITE LOCATION [§ 77.216-2(A) (2)]

The Facility is located in Jefferson County, approximately 0.5 miles North of Hueytown, AL off of Warrior River Road, towards Concord, AL. OGR owns the surface property within the existing and proposed permit boundary. This Facility has been previously operated by other mining companies since the earlier 1950's.

1.4 FACILITY PURPOSE [§ 77.216-2(A) (3)]

The proposed expansion of the Facility is necessary for the continued operation of the Oak Grove Mine and Concord Preparation Plant. Site 2a, the existing Impoundment #3 has a limited life. The remaining FCR disposal capacity is estimated to last until late 2015. The predicted refuse generation rates and the stage-storage information for the impoundment are provided in the Calculation Brief, Appendix C. After evaluating the proposed coal production from this facility, OGR has requested that its life be extended for continuous operation until early 2020 . Various options were evaluated by MMA to expand the life of the refuse facility. Some options could have added several years in excess of the minimum required life, but those options would have resulted in a much larger footprint than the currently proposed Plan. The larger footprint would require considerable additional acreage. Higher crest elevations, with significant upstream construction stages were also investigated. All of these options were evaluated and it was determined that the currently proposed Plan would minimize the impacts associated with all of these variables while satisfying operational needs of the Facility.

1.5 WATERSHED INFORMATION [§ 77.216-2(A) (4)]

The existing refuse facility area is located on the drainage divide between two unnamed tributaries of Lick Creek. A freshwater reservoir (Impoundment 1), used as water supply for the coal preparation plant, is located on the head waters of the unnamed tributary along the west side of the Facility. The Concord coal preparation plant is located on the north side of the Facility and a series of sedimentation ponds, water treatment ponds and associated features are located on the east side.

1.6 EFFECTS OF UNDERGROUND MINE WORKINGS [§ 77.216-2(A) (13 & 14)]

Documentation of previous mining beneath the Facility is included on Figure 2. The abandoned mine works lies approximately 600 feet below natural grade. The impact of mine works under this facility has been previously studied and included with previously approved expansion plans (Almes, 1991). The summary within the Almes report indicates "future subsidence affects are unlikely since the majority of subsidence in this area has probably already occurred."

The proposed modifications included in this Plan will not increase the crest height of the approved Facility nor will it increase the overall footprint of the Site 2a, Impoundment #3, area.

2.0 FOUNDATION CHARACTERISTICS

2.1 SITE EXPLORATION [§ 77.216-2(A) (5)]

The exploration program undertaken by MMA in the Spring of 2011 is presented on Figure 4. In Site 2a and 2b the exploration focused on the region from the centerline of the existing impoundment crest upstream out over the impounded fine coal refuse (FCR). At that time upstream embankment construction was anticipated along the western side of the Site 2a perimeter and in the Site 2b, Impoundment #4, FCR pool as well. The option for upstream construction in the Site 2b, Impoundment #4, was later discarded due to the poor characteristics of the materials found there. The previous studies and expansion plan designs (Almes, 1991 and PERC, 2007) already have addressed the existing CCR dams and embankments and downstream stability.

The Site 2 exploration included four (4) locations of seismic cone penetrometer testing (SCPTu-1 through SCPTu-4) and eight (8) conventional test borings (MMA-1 through MMA-8) to explore the impounded FCR, portions of the CCR embankments, and the native foundation materials. OGR constructed CCR work platforms out into the Site 2a impoundment and out over the Site 2b exposed FCR and cap materials for exploration access. Southern Earth Sciences, Inc. (SESI) performed the drilling and cone penetrometer testing on the project, under the supervision of MMA personnel.

The SCPTu exploration included cone penetration testing, shear wave velocity measurements, and pore pressure dissipation tests. Standard Penetration Testing (SPT), undisturbed piston-tube sampling of FCR and native soil, and selective rock coring (to confirm bedrock) were performed in the conventional borings. Section B – *Geotechnical Properties* of the Calculation Brief, Appendix C includes:

1. Excerpts of previous design information from the Almes,1991 and PERC, 2007 expansion plans;
2. Survey data, exploration information, key elevations, and a report of the SPT-system Energy Transfer for the two drilling rigs employed by SESI (Diedrich B-50 and CME 45-B);
3. Boring logs;

4. SPT data, including raw blow counts (N-values) and corrected N-values from N_1 through $N_{1,60(cs)}$ (overburden, energy transfer, and clean sand corrections);
5. Laboratory Test results, including index and shear strength testing results; and
6. SCPTu project-specific data interpretation, sounding plots, shear wave velocity and pore pressure dissipation test data, and SESI SCPTu data and QA/QC information.

2.2 REGIONAL GEOLOGY [§ 77.216-2(A) (5)]

The regional geology was previously presented in the Almes,1991 Engineering Report.

2.3 SITE FOUNDATION SOILS [§ 77.216-2(A) (5)]

2.3.1 Description

<u>Site 2a (Impoundment # 3) and Site 2b (Impoundment # 4):</u>

Referring to Figures 2, 3 & 4, Site 2a is the existing, active slurry impoundment (#3); whereas, Site 2b is an inactive, partially capped, former impoundment (#4). SCPTu-1 through SCPTu-4 and MMA-1 through MMA-8 explored the impounded fine coal refuse (FCR), portions of the CCR embankments, and the native foundation. Initially, extensive upstream embankment construction was being contemplated in Site 2b to enlarge and vertically expand the existing slurry impoundment (i.e., by merging Sites 2a and 2b). However, via SCPTu-1 through SCPTu-3, the impounded FCR in Site 2b was found to be very loose with significant zones classifying as sensitive. Given these unfavorable FCR conditions and the seismic hazard assessment (SHA) determination (Calculation Brief, Appendix C) that the site is in a Moderate to High Seismic Hazard region, the concept of re-activating Site 2b for slurry disposal was abandoned. In contrast, SCPTu-4 indicates that the FCR conditions in Site 2a are markedly more favorable. Additionally, vertical expansion of the Site 2a FCR pool requires much less extensive upstream embankment construction.

In general, the impounded FCR has low plasticity or is non-plastic, requiring that it be treated as “sand-like” in assessing its susceptibility to strength loss under seismic loading. Based on simplified strength loss screening criteria ($Q_{tn1} < 75$ and $N_{1(60)} < 15$ indicate susceptibility to strength loss), the FCR is assumed to be susceptible to strength loss.

Where embankment CCR was encountered, it was generally medium dense to dense in consistency. The observed moisture condition of the CCR indicates that the phreatic surface through the existing dams is depressed. Seepage, where inferred to exist from the exploration data, is minor and is isolated and/or perched in extent.

Auger refusal, inferred to indicate bedrock, was encountered immediately below the refuse zone in MMA-1, MMA-3 through MMA-5, MMA-7 and MMA-8. In MMA-2 and MMA-6, a layer of very stiff to hard clay to sandy clay was encountered over medium dense to very dense sand with some silt or clay. Although the Almes 1991 stability analyses modeled a native foundation soil layer with shear strength lower that the overlying CCR, MMA-1 through MMA-8 did not encounter a notably weaker foundation layer. However, for conservatism, the Almes properties for the native foundation materials were used.

2.3.2 Design Parameters

Pertinent geotechnical design parameters are summarized in Table B-1, Calculation Brief Section B, Appendix C. The design parameters for native foundation materials were selected based on the results of the recent subsurface exploration and laboratory geotechnical testing, typical values for similar materials, previously obtained data, and MMA's experience with similar materials. For consistency with the Almes 1991 design (refer to Table B-2 in Section B1.1 of Calculation Brief), MMA presumed the existence of a native foundation soil layer with lower shear strength (effective stress friction angle of 31 degrees), although a lower shear strength native layer was not encountered in MMA-1 through MMA-11. Bedrock/Weathered Rock properties were selected to effectively represent bedrock as a limiting boundary for slope stability analyses. The foundation rock is markedly stronger than the embankment materials, such that the bedrock does not influence slope stability. The critical slope stability failure surfaces are confined to the embankment, and foundation soils (where present).

The design parameters for coal refuse materials (CCR, Intermixed CCR:FCR, and FCR) are discussed in Section 3.0 Embankment Characteristics.

3.0 EMBANKMENT CHARACTERISTICS

3.1 COAL REFUSE MATERIALS [§ 77.216-2(A) (6)]

3.1.1 Description of Materials

The cross section locations are labeled in plan on Figures 5 and shown on Figures 11, 12 & 13. Cross sections A thru E are the same as Almes, 1991. They identify the primary zones of embankment, impoundment and foundation materials encountered in the recent site exploration (Spring 2011) and ascertained from the previous Almes,1991 and PERC, 2007 studies. The upstream expansion of the Site 2a embankment will be constructed of coarse coal refuse (CCR) and will impound fine coal refuse (FCR) slurry. The CCR used for embankment construction will be similar in composition to CCR used for construction of previous embankments at the Concord Facility. The FCR slurry is assumed to be similar to FCR in the active Site 2a slurry impoundment at the Concord Facility, as evaluated from SCPTu-4, MMA-4 and MMA-8. In the limited areas of planned upstream embankment construction (around Sections K-K and L-L), a transition zone of Intermixed CCR:FCR is anticipated beneath the CCR embankment pushout. SPT, SCPTu, and laboratory test data for CCR and FCR from Sites 2a & 2b are summarized in Section B of the Calculation Brief, Appendix C.

3.1.2 Design Properties

The design unit weights, effective stress and total stress shear strength properties, and hydraulic properties for pertinent materials within the site dams, impoundment, and foundation are summarized in Table B-1, Section B of the Calculation Brief (Appendix C) along with supporting data.

The design effective stress shear strength properties for CCR are based on SPT-based correlation, SCPTu correlations, laboratory testing, and previously reported data. Notably, the present evaluations and data support higher effective stress shear strength properties for CCR than applied in the Almes 1991 design (refer to Table B-2 in Section B1.1 of Calculation Brief). Undrained conditions are typically not applicable to CCR because of its granular, cohesionless nature and drainage characteristics; and therefore, were not characterized.

The design effective stress shear strength properties for Intermixed CCR:FCR and settled FCR are based on SCPTu correlations for “mixed soils,” laboratory testing of undisturbed

(fixed piston) samples (refer to Table B-3, Section B5.2 of the Calculation Brief located in Appendix C) and previously reported data. As noted previously, the FCR is assumed to be "sand-like" and susceptible to strength loss. For conservatism, the Intermixed CCR:FCR is also assumed to be susceptible to strength loss, but is anticipated to have higher steady-state undrained shear strengths. The steady-state undrained shear strengths of the Intermixed CCR:FCR and FCR were evaluated from the SCPTu data, and design undrained shear strength ratios (s_u/σ'_v) were inferred. The design steady-state undrained shear strengths were selected understanding that the Intermixed CCR:FCR and FCR materials will be under higher effective confinement and at lower void ratio by the time the limited upstream embankment areas function as dams.

The MMA interpretation of the SCPTu data is extensive given the volume of data, necessary data reduction, numerous correlations, and expertise and judgment involved in weighting the applicability of different correlations and generalizing the conditions. The Reviewer is directed to Calculation Brief , Section B6.1 on the SCPTu program, native Excel file of data interpretation and the technical references cited therein. See also the reference: Robertson, P.K. – June 2008, "*Interpretation of Cone Penetration Tests – a unified approach*," Canadian Geotechnical Journal. Notably, notwithstanding the complexity of steady-state shear strength characterization, the interpreted design undrained shear strength ratios (s_u/σ'_v) are within the range of reported values for coal tailings in the MSHA Design Manual.

4.0 FACILITY LAYOUT AND OPERATION

4.1 GENERAL BACKGROUND

Figure 3 provides the overall Key Plan for the proposed expansion of Site 2a. The Plan also discusses a proposed construction sequence for accomplishing the planned development. The proposed Plan primarily involves:

- Implementation of local erosion and sedimentation controls (E&SC);
- Development of modified access and haul road system;
- Upstream construction of Site 2a embankments ***WITH CONTINUED***;
- Operation of the Site 2a slurry impoundment (#3)
- ***Internal excavation of overbuilt embankment of Site 2***; and
- Discussion of the final abandonment cover and storm drainage controls.

4.2 HAUL ROADS AND ACCESS ROADS [§ 77.216-2(A) (7)]

The proposed major access roads and haul roads are shown on the Site 2 Plan, Figure 5. Haul roads were configured with a maximum grade of 10 percent, transverse slope of 2 to 5 percent, an appropriate traffic width, surface drainage collection ditches and outslope berms. Figures 6 includes plans, profiles, and representative cross sections detailing Haul Road No. 1.

4.3 STAGING VOLUMES [§ 77.216-2(A) (7&9)]

No specific construction staging is proposed in this Plan. There is not a need to raise the embankment in stages to provide sufficient FCR storage while balancing FCR and CCR production as is typical for other ***NEW*** facilities. The quantity of CCR required to develop the Site 2a embankment to the planned crest elevation, EL. 730 is relatively small, such that this construction can be accomplished relatively quickly without posing any staging concerns. ***THE POOL CAN BE RAISED CONCURRENTLY WITH THE UPSTREAM WORKING/FILL SURFACE SO LONG AS THE SURFACE DOES NOT BECOME INUNDATED BY WATER OR FINE COAL REFUSE (FCR). AND THE POOL CAN BE RAISED CONCURRENTLY WITH THE DAM CREST PROVIDED 12 FEET OF ELEVATION DIFFERENCE (TWO PMPS AND 3 FEET OF FREEBOARD) IS MAINTAINED BETWEEN THE POOL AND THE MINIMUM PERIMETER CONTAINMENT/DAM CREST LEVEL.***

The proposed construction sequencing is discussed later in this report.

A stage storage table for FCR volumes vs. elevation is provided in the Section A of the Calculation Brief located in Appendix C. A table of expected coal production quantities along with CCR and FCR generation rates can also be found there.

5.0 IMPOUNDMENT HYDRAULIC & HYDROLOGIC DESIGN [§ 77.216-2(A) (7 & 12)]

5.1 GENERAL CONSTRUCTION SEQUENCE

This general construction sequence is suggested, but many of the tasks may be done concurrently or in different order, depending upon the amount of coarse refuse and fine refuse production from the preparation plant. The construction shall be in accordance with the Guideline Technical Specifications (GTS). The initial focus will be the construction of Site 2a upstream embankment on the west side of the impoundment to allow for the timely placement of FCR above the currently approved elevation, EL. 683.

The General Construction Sequence, is as follows:

Site 2a and 2b

- Construct Haul Road No. 1
- Establish road drainage according to plans.
- Install new internal drain along west side of impoundment.
- Convert existing abandoned slurry pipes to outlets for the new internal drain.
- Construct upstream push-out with coarse refuse material.
- Raise remainder of crest to maximum elevation of 730 ***WHILE RAISING POOL ELEVATION AND MAINTAINING 12 FEET OF STORM STORAGE AND FREEBOARD***
- ***EXCAVATE OVERBUILT CCR EMBANKMENT SECTIONS IN THE NORTHERN AND SOUTHERN/SOUTHEASTERN SECTION OF SI#3***
- Install required instrumentation as needed.
- Install and maintain surface drainage controls as needed.

5.2 SITE 2a - SLURRY IMPOUNDMENT #3

The proposed expansion of the Site 2a slurry impoundment will involve the placement of a small upstream staged embankment on the west side of the existing impoundment. This is required to enable raising the FCR pool to EL 718 while providing a 50 foot

minimum crest. The other sides of the impoundment will be raised to EL 730, which is the currently approved elevation.

Design Guidelines and Criteria

The Site 2a slurry impoundment was designed per the appropriate MSHA publications, guidelines, and regulations, as applicable.

Aspects of the Site 2a slurry impoundment design are summarized in the subsequent sections. The design of the supporting E&SC structures is summarized in the Section F of the Calculation Brief in Appendix C. The MEC design information, included in Appendix D, deals with the E&SC and drainage once it comes off the Site 3a embankment. Other drainage aspects of Site 2 remain the same as the currently approved permit (Almes, 1991 and PERC, 2007), except for the localized changes associated with Haul Road No. 1

Pump Dewatering System

The pumping dewatering system will continue to function as described in the currently approved permit (Almes, 1991)

Design Storm

The Site 2a slurry impoundment (#3) will continue to provide sufficient volumetric capacity to store two 72 hour Probable Maximum Precipitation (PMP) events (100 inches). This is consistent with the provisions of the currently approved Almes, 1991 design. As required, and currently provided for, at least 3 feet of freeboard to the top of the dam crest will be maintained. The requirements for this storm event are discussed in Comment #4 of the MSHA comment letter dated January 29, 1992 and Almes response letter dated June 10, 1992. The calculation for storage of these storm events, along with the referenced letters, are provided in Section D of the Calculation Brief located in Appendix C. With the Site 2a dam crest at EL. 730 (minimum) the normal pool level is EL. 718.

6.0 EROSION AND SEDIMENT CONTROLS (E&SC)

6.1 EXISTING SEDIMENTATION PONDS

The existing sedimentation ponds will remain in place.

6.2 LOCAL EROSION AND SEDIMENT CONTROLS

Local E&SC measures will be of the same types as currently specified by Almes, 1991 and PERC, 2007. Details of the new ditches and flumes associated with this Plan (Site 2b and 3a) are provided on Figure 15. Also, see Section F of the Calculation Brief.

Hydraulic Capacity

Permanent channels are designed to convey the peak runoff rate due to a Type II, 24-hour duration, 100-year recurrence interval design storm, per MSHA guidelines.

Freeboard

The freeboard depth for each channel was determined as recommended by the MSHA Engineering and Design Manual for Coal Refuse Disposal Facilities as follows:

$$\text{Freeboard} = C + 0.025VD^{1/3} \quad \text{(feet) where,}$$

C= 0.25 feet for minor channels or,

C = 1.0 feet for more critical channels

A minimum of one foot of freeboard was provided in all cases.

Channel Linings

All permanent drainage structures have been provided with the appropriate protections to minimize the potential for channel erosion. If velocities exceeded 5.0 feet per second then riprap channel lining protections were used. The two primary types of channel lining prescribed for the project are:

- Vegetated Channel Linings (i.e., grass-lined used on gutter drains)
- Riprap (used on haulroad/down drains)

6.3 MISCELLANEOUS BEST MANAGEMENT PRACTICES (BMPS)

Other miscellaneous E&S control structures will be implemented during the initial site development and CRDA construction and operation, as needed. These structures include:

- Coarse aggregate surfacing will be provided on permanent access and haul road corridors, and on construction support and staging areas to stabilize the areas and reduce erosion.
- Rock construction entrances will be constructed/maintained at the main site access points to reduce the transport of sediment away from the permitted work area.
- Fill slopes will be covered with topsoil (where the fill soil is not suitable for direct vegetation) and be vegetated, as soon as practical, to reduce erosion potential.
- Similarly, soil cut slopes will be directly seeded as soon as practical following completion.
- Temporary siltation measures such as siltation fences, straw bales, and/or temporary sumps may be used as necessary for erosion protection.

7.0 GEOTECHNICAL ANALYSES AND DESIGN

7.1 EMBANKMENT/DAM SEEPAGE CONTROL [§ 77.216-2(A) (6 & 7)]

7.1.1 Methods of Analysis and Assumptions

The seepage analysis for the Site 2a impoundment was performed using the Finite Element Method (FEM) with the computer program SLIDE Version 6.0 by Rocscience, Inc. A seepage model was developed for Section K-K (Figure 12), which represents a more critical section around the dam perimeter. The seepage model, which included the embankment and foundation materials, was used for estimation of seepage rates and internal hydraulic gradients.

The different materials differentiated in the seepage model and their corresponding properties are identified in the Section E of the Calculation Brief, Appendix C. The materials include:

1. Bedrock
2. Native Foundation Soil
3. Coarse Coal Refuse (CCR) – Recent/New (Post-Almes 1991)
4. Coarse Coal Refuse (CCR) – Existing/Old (Pre-Almes 1991)
5. Fine Coal Refuse (FCR)

The hydraulic properties for the different materials were selected based on past experience with and testing of similar materials, and understanding of the probable ranking of the permeability of the saturated material (i.e., from higher to lower, or lower to higher permeability). Additionally, an anisotropy ratio (10) was assumed for horizontally placed fill materials, which is typical for earth fill and coarse coal refuse materials. The normal head of water above the settled fine coal refuse level, relative permeability relationships among the materials, and the anisotropy ratios influence the seepage regime through the dam, more than the permeability magnitudes.

Historically, natural processes have maintained a low water level within the slurry impoundment. The lengthy dam perimeter relative to the small impoundment area, natural seepage through the embankment CCR, low specific discharge capacity of the FCR, and limited availability of “free” water in the impoundment combine to control seepage and preclude development of a substantive seepage front through the dam. Similarly, in the future under normal conditions, the settled FCR level should not lag the

normal pool level substantially. During storm conditions, storm surcharge pool levels and the corresponding depths of "free" water against the upstream face of the dam would only be sustained for short durations; too short to support development of an elevated phreatic surface through the dam. Based on these observations, past experience with other slurry impoundment operations, and requirements of this Plan, the following two cases were adopted for seepage analysis:

1. Maximum Normal Pool, EL. 721 with settled FCR at EL. 718; and
2. Design Peak Pool, EL. 727 with settled FCR at EL. 718.

A maximum normal pool at EL. 721 was conservatively adopted for the seepage and slope stability analyses, while (given the observed impoundment behavior), a normal pool at EL. 718 was deemed to be a reasonable level for the design storm storage requirements with the dam crest at EL. 730. determined

7.1.2 Results of Seepage Analysis

Given the seepage impeding effects of the FCR, drainage effect of the embankment CCR combined with the low specific discharge capacity of the FCR, and the low head of water above the settled FCR in both analysis cases, the predicted unit seepage flow rates through the existing CCR proximal to the toe are low (on the order of 2.4 cubic feet/day/foot). This is shown on the output Figure E-2.2 in Section E of the Calculation Brief. The predicted phreatic surface is depressed through most of the dam, and the predicted hydraulic gradients through the downstream zone of the dam are low. The depressed and irregular steady-state phreatic surface predicted through the dam is consistent with observed conditions in many existing slurry impoundment dams where the FCR level does not lag the pool level substantially. For conservatism, a more elevated and extensive phreatic surface was adopted in the slope stability analyses. See Figures E-2.1& E-2.3 in Section E of the Calculation Brief.

7.1.3 Approach for Seepage Control

As explained previously, seepage through the Site 2a dam is controlled by natural processes, given the limited impoundment area relative to the dam perimeter (and embankment seepage area), limited volume of "free" water to drive seepage, and low specific discharge of the settled FCR. However, for enhanced seepage control, the

REVISION 1, JULY 2013

REVISION 2, JANUARY 2014

proposed Plan prescribes a higher relative compaction requirement (100% of Standard Procter) for the new CCR material in the upstream push-out and requires continued maintenance of a low pool level and shallow depth of "free" water relative to the settled FCR level. In combination with the above noted seepage control aspects, a discrete internal drain will be constructed along the western side of the embankment. This internal drain is incorporated as a measure of good practice to facilitate consolidation of the fine coal refuse in areas of upstream construction and as added seepage in the event that "hard pan" surfaces within the upper portion of the dam promote perched seepage horizons. The location, geometry and details of this internal drain are shown on Figures 7 & 8. **FILTER CALCULATIONS FOR THE MATERIALS USED IN CONSTRUCTING THE INTERNAL DRAIN ARE PROVIDED IN THE FILTER/ COMPATIBLY CHECKS SHOWN IN SECTION F, OF APPENDIX C.**

7.1.4 Monitoring

Seepage will be monitored by observation of the dam, measured flow rates at internal drain outlet pipes, and piezometers, during the MSHA 7-day inspections. The locations and details of the piezometers and weirs are given on Figures 4 & 14.

7.2 EMBANKMENT SLOPE STABILITY [§ 77.216-2(A) (13)]

The upstream and downstream slopes of the Site 2 dam meet minimum factors of safety for applicable loading conditions, as required by MSHA ***AND ASMC*** (1.5 for static and 1.2 for seismic cases). A summary Results of Analysis, Section 7.2.3 is provided below. Detailed results are provided in Section E of the Calculation Brief, Appendix C. The findings reported in this section pertain to the final embankment configurations of Site 2a.

7.2.1 Methods of Analysis and Assumptions

Slope stability analyses were performed for the upstream and downstream slopes of the Site 2a dam for pertinent conditions using the slope stability module of the computer program SLIDE version 6.0 by Rocscience, Inc. The slope stability analyses evaluated the final dam and embankment configurations.

The following cases were considered for the Site 2a dam:

1. End-of-Construction – ***PER REQUEST OF ASMC. SEE DESCRIPTION IN APPENDIX C, SECTION E 3.1.***

2. Steady-State (Static) with Maximum Normal Pool EL. 721 – As indicated previously, at Section K-K a more elevated and extensive phreatic surface than predicted was adopted in the slope stability analyses; ***SEE FURTHER DESCRIPTION IN APPENDIX C, SECTION E 3.1.***

3. Rapid Drawdown from Maximum Normal Pool EL. 721 and Design Peak Pool EL. 727 – Not applicable, as rapid drawdown is precluded by maintaining the pool level in close proximity to the settled FCR level, and by the limited capacity of the operator's pumping system to artificially create a rapid drawdown situation. Additionally, the Facility does not include decant outlet works that could promote rapid unwatering and CCR is not typically prone to rapid drawdown failure because of its drainage characteristics.

4. Seismic – ***PSEUDO STATIC*** with Normal Pool EL. 721 – This case is applicable to the upstream stability of dam sections in areas of planned upstream construction along the west side of the impoundment (around Sections K-K and L-L), as the FCR beneath the upstream portion of the embankment and the impounded FCR are assumed susceptible to strength loss. ***SEE FURTHER DESCRIPTION IN APPENDIX C, SECTION E 3.1.***

5. ***"INTERIM" STATIC/STEADY STATE ANALYSIS OF THE WEST EMBANKMENT WORKING SURFACE AT AN INTERMEDIATE LEVEL. THIS CASE WILL USE WORKING SURFACE EF 705; POOL EL 687; SETTLED FCR EL 685.***

Due to the unfavorable FCR conditions in Site 2b, Impoundment 4, upstream construction in Site 2b that was initially considered was dropped from this Plan. In contrast, the FCR conditions in Site 2a are more favorable and the planned extent of upstream construction is much more limited and much less extensive.

A detailed account of the procedures and methodology used for the slope stability analyses are presented in the Section E of the Calculation Brief. The phreatic surface used for stability analyses of steady-state seepage conditions corresponds to the maximum normal pool level, EL. 721.

7.2.2 Conditions Analyzed and Required Factors of Safety

The cases/conditions that were evaluated and the required factors of safety are summarized in the table below.

CASE/CONDITION	REQD SAFETY FACTOR
Static/Steady-State Seepage	1.5
End-of-Construction with No Pool(1)	1.3
Rapid Drawdown(2)	1.3
Seismic – ***PSEUDO STATIC***	1.2

NOTES:

(1) The native foundation does not include substantive clayey soil layers or fill zones, so the end-of-construction case is not applicable and would not govern over the static/steady-state seepage case. Also, future construction would not have a widespread influence on any clayey soil zones whereby significant excess pore pressures would be induced over a large area of the foundation.

(2) The upstream slope stability for the rapid drawdown case reduces to a steady-state seepage case, as the facility does not have a low level outlet, the settled FCR level should not lag the pool level greatly, pumping drawdown rates will be limited, and pool fluctuations occur too slowly over too small a depth range to create "rapid" drawdown conditions.

7.2.3 Results of Analysis

As reflected by the supporting calculations, the proposed dam and embankment configurations satisfy the required minimum slope stability safety factors previously listed for all cases/conditions analyzed.

For the Site 2a dam, the minimum factors of safety calculated for long-term/steady-state (static) conditions for a slip surface that compromises the entire height of embankment is 1.8 for the downstream slope and ***1.7*** for the upstream slope at Cross Section K-K. The minimum factor of safety calculated for the seismic – pseudo static earthquake analyses is 1.2 for the upstream slope at Section K-K.

Refer to Section E of the Calculation Brief in Appendix C for detailed results of the slope stability analyses.

7.3 INTERNAL EXCAVATION OF OVERBUILT EMBANKMENT SLOPE STABILITY

7.3.1 Technical Evaluations

Based on a need to excavate interior CCR as soon as possible, the impoundment pool level is projected to be around EL 690 when the proposed excavation commences. MM&A assumed that excavation of CCR from overbuilt areas around the impoundment interior could be safely conducted down to EL 700, depending on the eventual scheduling and duration of this activity. Note that the excavation will be conducted in overbuilt areas of previously proposed CCR cap, such that the underlying foundation should be CCR and not settled FCR.

<u>Southern Excavation</u>

Recognizing that preliminary planning is underway to pursue expanding SI#3, possibly to Crest EL 760 or thereabouts, MM&A identified the minimum crest width required at EL 730 to support raising the impoundment perimeter to Crest EL 760 without necessitating upstream construction. Specifically, to define a minimum width of embankment to preserve at EL 730 along the southern and southeastern perimeters, we assumed possible expansion to Crest EL 760 with a 50-foot minimum crest width, a 2.5H:1V downstream slope and a 2H:1V upstream slope, and preservation of a 25-foot wide terrace at EL 730 (to limit the maximum vertical interval of terraces to around 50 feet).

Based on the aforementioned parameters, which are consistent with the currently permitted pool EL 718 configuration, the resulting minimum embankment width at the EL 730 crest, through the periphery of excavation shown on Section EX-B of Figure 13A, would be 210 feet compared to the required minimum crest width of 50 feet. We understand from OGR that embankment CCR above EL 690 in the area of proposed excavation was placed in conformance with requirements for "cap" material at 90% compaction. Given the less stringent standard of compaction that might have been applied in this

embankment area, the extra 160 feet of crest width (210 feet versus 50-feet minimum) at EL 730 compensates for possible variations in the density, permeability, and shear strength of the remaining CCR. Also, we anticipate that the existing embankment CCR has weathered and aged sufficiently that its permeability is similar to or possibly lower than a zone of more recently placed CCR compacted to a higher standard.

Based on the preceding technical evaluations, the embankment section that would remain along the southern and southeastern sides (following the excavation of interior CCR to enlarge the impoundment) would provide a more conservative configuration than the previously analyzed and approved Crest EL 730 dam (Pool EL 718) sections, in particular the west embankment sections.

<u>Northern Excavation</u>

The proposed embankment's downstream slope is flatter (and therefore more stable) than the previously approved embankments. Also, the embankment height as shown on Section EX-D is only approximately 50'. The toe of the embankment is founded on the existing impoundment, (SI#4) CCR cap. A slope stability analysis was performed for this cross section as discussed below. Toe elevation will be elevated to EL 730, as the capping of Impoundment SI#4 progresses, per currently approved plan. This will improve the embankment stability as it progresses.

7.3.2 Computational Analysis

To support this subjective analysis, downstream embankment slope stability was evaluated on Section EX-B (in the South) and EX-D (in the North) using the computer software program SLIDE. An elevated phreatic surface was conservatively adopted for the maximum normal pool, steady-state scenario. Material properties were adopted from recently approved Pool EL 718 modification. Failures that encompassed large portions of the downstream embankment were evaluated.

Revision 3, February 2015

For EX-B, circular failure modes were evaluated for both the entire downstream slope and for a failure that originates in the crest and terminates at the toe. The entire downstream slope is evaluated in model "Stability_SI#3 Eastern Excavation_MM&A Section EX-B_Entire" and shows a minimum Factor of Safety (FoS) of 1.74. A crest-to-toe failure is evaluated in model "Stability_SI#3 Eastern Excavation_MM&A Section EX-B_Crest to Toe" and shows a minimum FoS of 2.30 (See Appendix C).

EX-D was evaluated over the entire downstream slope in model "Stability_SI#3 Northern Excavation_MM&A Section EX-D_Entire" and shows a minimum Factor of Safety (FoS) of 2.31 (See Appendix C).

7.3.3 Findings and Conclusions

The option of enlarging the Concord Slurry Impoundment No. 3 (SI#3) by excavating excess coarse coal refuse (CCR) from the embankment interior along the southern and southeastern periphery is technically acceptable, and would provide an estimated maximum of 145,000 cubic yards (cy) of additional FCR disposal capacity between EL 700 and EL 718. From the existing crest elevations, this activity would require a maximum of approximately 220,000 cy of CCR excavation and relocation to an alternate area.

Excavation for the northern area is also technically acceptable and would provide an estimated maximum of 195,000 cy of additional FCR storage capacity. The maximum volume of CCR to be excavated is 222,900 cy; the volume of CCR to construct this configuration is 235,600 cy; requiring 12,700 cy of CCR from other sources.

8.0 INSTRUMENTATION [§ 77.216-2(A) (8)]

There are thirteen (13) standpipe piezometers proposed going forward for this facility at the locations shown on Figure 4. Some of the existing piezometers in various stages of operability. Some of the former piezometers will be replaced at new locations to better monitor the seepage patterns for this modified Facility. The table on Figure 14 denotes the status of each as new, restored, relocated or existing. All piezometers were restored or installed in the Summer of 2012 and functioning to ensure that adequate monitoring of the phreatic surface as well as the proper seepage levels in the embankment areas during construction and for long term stability analysis.

Piezometer P-1 will enable monitoring of the phreatic level in the zone between Site 2a (Impoundment #3) and Site 2b (Impoundment #4). There should be little or no seepage evident unless the 2b CCR level lags the 2a pool level significantly. Piezometer 1 can be abandoned once the CCR level in 2b is up to EL.730. Piezometers P-5, 6 & 7 on Cross Section K-K and piezometers B-12, P-8 & 9 on Cross Section D-D provide for redundancy for these important readings in the area of the upstream construction in Site 2a, Impoundment #3

VIBRATING WIRE (VW) PIEZOMETERS WILL BE INSTALLED PER FIGURES 4 & 14 AND SECTION 5.2 OF THE GUIDELINE TECHNICAL SPECIFICATIONS (GTS). MONITORING THE VW PIEZOMETERS WILL BE IN ACCORDANCE OF SECTION 3.1.1.3 OF THE GTS.

Trigger levels **(WATER LEVELS FOR NOTIFICATION)** for piezometer readings that would indicate an elevated phreatic surface and safety factor approaching the minimum MSHA values are also included in the table on Figure 14. Standpipe Piezometer installation details and extension details are provided on Figure 14, as well. **SECTION E OF APPENDIX C PROVIDES THE SLOPE STABILITY ANALYSES JUSTIFYING THE TRIGGER LEVELS.** A graphic display or tabulation of the 7-day MSHA impoundment inspection piezometer readings along with the trigger levels shall be kept file at the mine office for easy access and review.

V-notch weirs, at shown on Figure 14, will be provided to enable the 7-day monitoring of the internal drain outlet pipes. A graphic display or tabulation of the weir flows measured during the 7-day MSHA impoundment inspections shall also be kept at the mine office.

9.0 MONITORING AND MAINTENANCE [§ 77.216-2(A) (8 & 15)]

Coal Refuse Quantities

Records of coal refuse quantities disposed at the facility shall be maintained by OGR. These records allow for comparison with the quantities used for predicting the CCR and FCR facility disposal life and making modifications to the disposal plan, if necessary. The records shall be reviewed semi-annually.

General Observations

Observations of the embankment, its instrumantation and appurtenant equipment shall be made at intervals not exceeding 7 days and immediately following any unusual events such as floods, heavy rainfalls, heavy frost periods, abnormal structural behavior, etc. in accordance with MSHA impoundment inspection requirements ***BY AN MSHA CERTIFIED IMPOUNDMENT INSPECTOR***. Reports or records from field observations and testing results shall be maintained at the mine office. A report of the observations shall be reviewed at least semi-annually. Any unusual features shall be reported immediately to the Certifying Engineer. Items to be recorded by OGR and the Certifying Engineer include the following:

- Embankment Slopes - Any irregularities such as tension cracks, scarps, slumps, wet areas or vegetation disturbance shall be recorded.
- Working Disposal Surface - Irregularities shall be recorded.
- Bench and Perimeter Sediment Ditches - General condition of channels, soil erosion adjacent to or beneath riprap and seeded slopes, blockage by debris, etc., shall be recorded.
- Vicinity of the Embankment - General conditions throughout the area of the embankment shall be observed to note any changes, which could be associated with the behavior of the embankment and its foundation.

- Piezometer Readings and Impoundment Level - Piezometer readings and the impoundment level shall be recorded at intervals not exceeding seven days. Should the piezometers become damaged during operations they shall be replaced. To evaluate sensitivity of the piezometers pumping or bailing of water may be performed to determine the time to recharge/refill the piezometer. Adding water to the piezometers shall not be permitted.
- Internal Drain Flow – Weirs shall be installed at each underdrain outlet. Flow measurements at underdrain outlets shall be recorded at intervals not exceeding seven days. The weir detail is shown on Figure 14.
- Graphs- Graphs of the 7-day inspection results of the flows from each internal drain outlet and levels of each piezometer shall be prepared. The graphs will assist in identifying abnormal readings and dievations from trends. These graphs shall be kept with the 7-day inspection report information at the mine office.

Maintenance

The following maintenance activities shall be performed regularly:

- Routine Maintenance - Continuous maintenance, including replacement or patching of grouted riprap, reseeding of gutters, removal of debris from the ditches at the site, etc.
- Maintenance After Unusual Meteorological Events (Heavy Rainfall, Extreme Frost Periods, Severe Droughts, Floods, High Winds, Etc.) - The most important maintenance tasks, at these times, are the immediate backfilling of all scarps or slumps, repair of erosion rills or gullies and the repair and improvement of drainage systems and riprap lined ditches.
- Maintenance After Abnormal Changes in the Behavior of the Structure - If abnormal behavior of any portion of the embankment is observed, qualified persons knowledgeable of the facility design characteristics shall be advised immediately by the Certifying Engineer and any recommended maintenance measures undertaken.

Data Review

All facility performance data and maintenance data obtained during periodic inspections shall be reviewed by qualified persons knowledgeable of the facility construction. All performance data such as the relative compaction (or in-place dry density) of embankment fill materials, fill placement moisture content, filter fabric, underdrain stone, etc, must meet the requirements described within the Guideline Technical Specifications (Appendix B), the design recommendations presented in this Plan and the Almes, 1991 and PERC 2007 approved plans. If the required CCR fill material properties do not meet these specifications during construction of the refuse facility, the Certifying Engineer will determine if changes need to be made to the placement procedures or shall re-evaluate the stability of the upstream and downstream slopes and/or intermediate benches.

10.0 ABANDONMENT PLAN [§ 77.216-2(A) (16)]

The final reclamation of this facility will consist of the placement of the final soil cover material and applying the appropriate seed mixture according to the currently approved plans, Almes, 1991 and PERC, 2007.

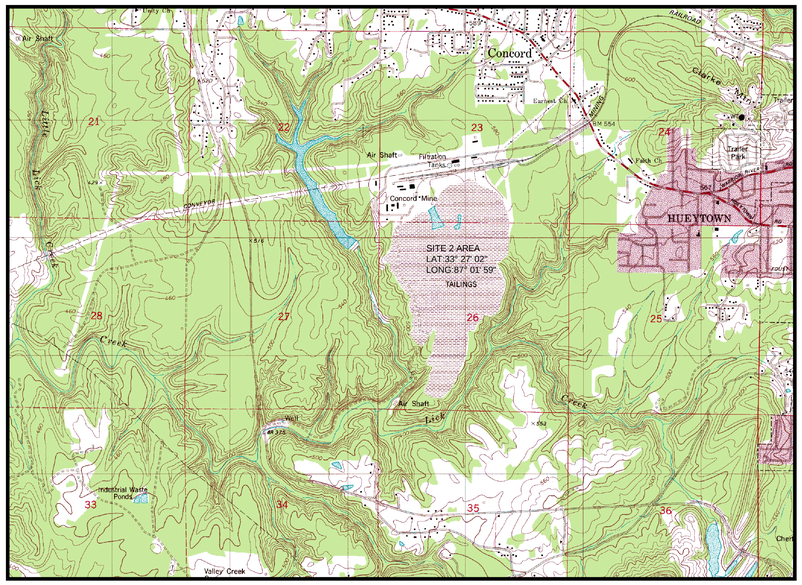
A tentative abandonment plan for capping and covering the slurry impoundment was included in the Almes, 1991 and PERC, 20007 plan approvals. However, other options may be implemented at the actual time of abandonment and a Final Abandonment Plan will be submitted to MSHA ***AND ASMC*** for approval prior to initiation of abandonment of the Facility. The Final Abandonment Plan for the slurry impoundments must eliminate any potential to impound water at the Facility. Options to eliminate the potential for impounding water at this Facility may include, but are not limited to, the following:

- Filling in the fine slurry area with coarse refuse generated from the plant while operating towards the closure date.
- Breaching one side of the embankment and placing cover material over the fine slurry area to create a positive drain towards the breach area.
- Lowering the entire embankment crest and placing this coarse refuse material over the fine slurry area to create a positive drainage area.
- Once the final abandonment of the slurry impoundment has started the impounding potential will be eliminated within two years.

The final reclamation surface will be graded such that a minimum 2-percent grade is provided to promote positive drainage toward the appropriate surface drainage control structures.

PROPOSED REFUSE DISPOSAL PLAN
CONCORD PREPARATION PLANT
CLIFFS NATURAL RESOURCES - OAK GROVE MINE
JEFFERSON COUNTY, ALABAMA

PREPARED FOR
CLIFFS NATURAL RESOURCES
OAK GROVE MINE
JEFFERSON COUNTY, ALABAMA



LOCATION MAP

SITE LOCATED ON PORTIONS OF USGS 7.5' CONCORD, ALABAMA QUADRANGLE

ALABAMA QUADRANGLE LOCATION

DRAWING LIST

FIGURE NO.		DESCRIPTION
1	2	TITLE SHEET, SITE LOCATION MAP, & DRAWING INDEX
2		EXISTING CONDITIONS - PLAN
3	2	KEY PLAN - REFUSE DISPOSAL AREAS
4	2	SUBSURFACE EXPLORATION & PIEZOMETER - PLAN
5	2	SITE 2 - PLAN
6		HAUL ROAD NO. 1 - PLAN, PROFILE, DETAILS
7		SITE 2a - INTERNAL DRAIN - PLAN
8		SITE 2a - INTERNAL DRAIN - PROFILES & DETAILS
9		FIGURE NOT USED
10		FIGURE NOT USED
11	2	CROSS SECTIONS A-A, B-B, C-C
12	2	CROSS SECTIONS D-D, E-E, K-K, L-L
13	2	CROSS SECTIONS M-M, N-N, Z-Z
13A	2	EXCAVATION CROSS SECTIONS EX-A, EX-B, EX-C
13B	2	EXCAVATION CROSS SECTIONS EX-D, EX-E
14	1	INSTRUMENTATION - DETAILS AND SCHEDULE
15	1	TYPICAL DITCH - SECTIONS AND DETAILS

I hereby certify that this document was prepared by me or under my direct personal supervision and is correct to the best of my knowledge and belief and that I am a duly licensed Professional Engineer under the laws of the State of ALABAMA.

William O Dickey Jr
(Signature)

Date: 2/24/15

ALABAMA LICENSED No. 31771 PROFESSIONAL ENGINEER WILLIAM O. DICKEY

State of West Virginia
County of Raleigh
Acknowledged before me, a Notary Public,
This 24 day of February, 2015
My commission expires 10/17/2017

NOTARY PUBLIC STATE OF WEST VIRGINIA STEPHANIE D. HILL 357 OAK GROVE ROAD BECKLEY, WV 25801 My commission expires October 17, 2017

REVISION	DATE	DESCRIPTION	P.M.
2	2/15	NEW FIGURES–MSHA APPROVED EXCAVATION OF EXISTING CCR	WOD
1	1/14	RESPONSE TO ASMC COMMENTS.	WOD

Prepared By:

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☐ Ashland, VA • ☐ Charleston, WV • ☐ Camp Hill, PA
☐ Kingsport, TN • ☐ Lenexa, KS • ☐ Bossier City, LA
☐ Cincinnati, OH • ■ Beckley, WV • ☐ Evansville, IN

FIGURE 1
TITLE SHEET, SITE LOCATION MAP, & DRAWING INDEX

OAK GROVE RESOURCES, LLC REFUSE FACILITY
CONCORD QUADRANGLE
MSHA DISTRICT 11 – BIRMINGHAM, ALABAMA
JEFFERSON COUNTY, ALABAMA
Prepared For:
CLIFFS NATURAL RESOURCES
OAK GROVE MINE, JEFFERSON COUNTY, ALABAMA

CAD BY	MTC	2/12
CHECKED BY	JRR	2/12
APPROVED BY	WOD	2/12

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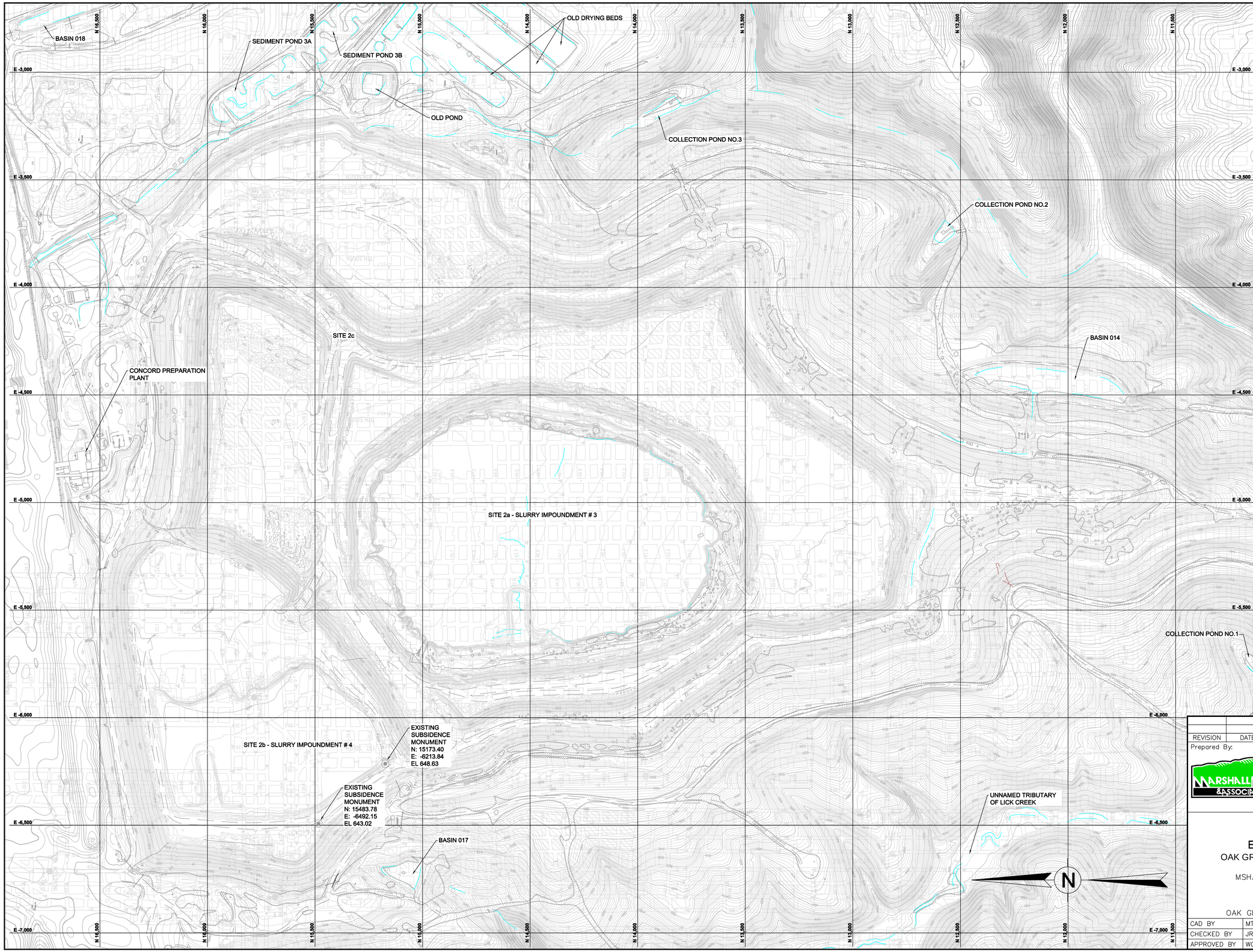

LEGEND

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DEPRESSION — 160 — 161

DRAINAGE

CULVERT
DROP INLET
BRIDGE
MARSH

ROADS

PRIMARY
SECONDARY
TRAIL
RAILROAD

OTHER FEATURES

BUILDING
VEGETATION
PROPERTY LINE
PROPERTY CORNER
FENCE
WALL
UTILITY POLE
LIGHT POLE
EXISTING UNDERGROUND MINEWORKS
EXISTING SUBSIDENCE MONUMENT

SOUTHERN RESOURCES MAPPING CORPORATION
2808-4 McFARLAND BOULEVARD
NORTHPORT, ALABAMA 35476
PHONE: (205) 333-9900
FAX: (205) 333-9915
Email: srmc@srmcmaps.com
Web Site: srmcmaps.com

N 33° 14' 31.41", W 87° 35' 11.85"
PHOTOGRAPHED: DECEMBER 23, 2010
COMPILED: FEBRUARY, 2011

I hereby certify that this document was prepared by me or under my direct personal supervision and is correct to the best of my knowledge and belief and that I am a duly licensed Professional Engineer under the laws of the State of ALABAMA.

William O. Delay II
(Signature)
Date: 2/22/12

ALABAMA LICENSED No. 34721 PROFESSIONAL ENGINEER WILLIAM O. DELAY II

State of WV
County of Raleigh
Acknowledged before me, a Notary Public, Michael S. Underwood.
This 22 day of FEB, 2012
My commission expires 2/6/2017

OFFICIAL SEAL
NOTARY PUBLIC
STATE OF WEST VIRGINIA
MICHAEL S. UNDERWOOD
821 BROAD STREET
MOUNT HOPE, WV 25880
My commission expires February 6, 2017

REVISION	DATE	DESCRIPTION	P.M.

Prepared By:

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☐ Kingsport, TN • ☐ Lenexa, KS • ☐ Bossier City, LA
☐ Cincinnati, OH • ■ Beckley, WV • ☐ Evansville, IN

FIGURE 2
EXISTING CONDITIONS - PLAN

OAK GROVE RESOURCES, LLC REFUSE FACILITY

CONCORD QUADRANGLE
MSHA DISTRICT 11 – BIRMINGHAM, ALABAMA
JEFFERSON COUNTY, ALABAMA
Prepared For:
CLIFFS NATURAL RESOURCES
OAK GROVE MINE, JEFFERSON COUNTY, ALABAMA

CAD BY	MTC	2/12
CHECKED BY	JRR	2/12
APPROVED BY	WOD	2/12

Scale in Feet
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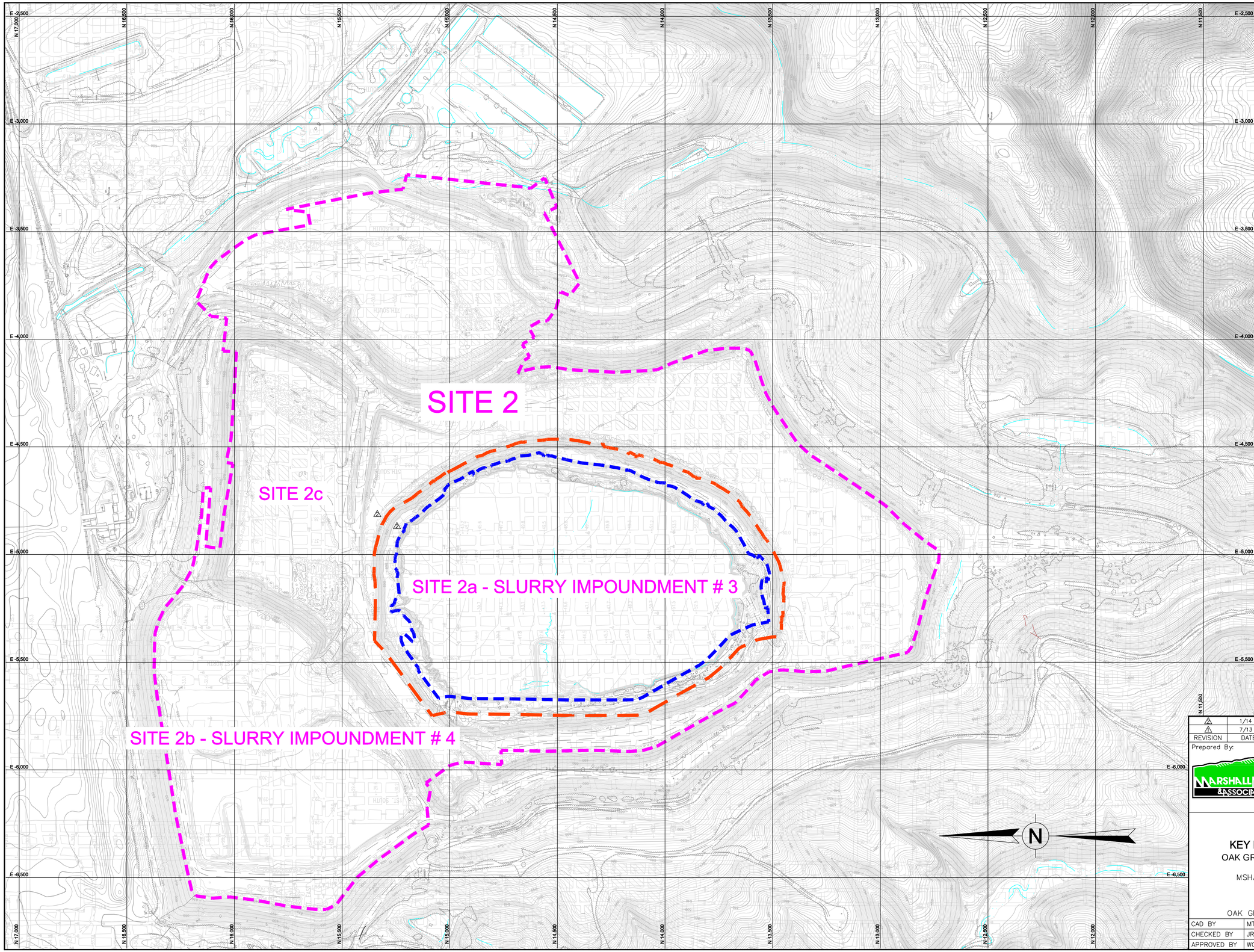


LEGEND

SITE 2 BOUNDARY - (EXISTING PERMIT BOUNDARY PROPOSED EXPANSION OF 2a - FCR POOL)

△2 EXISTING SLURRY ELEVATION 682.5

△2 FINAL SLURRY ELEVATION 718.0

EXISTING - UNDERGROUND MINEWORKS

NOTES:

△1. REFUSE IMPOUNDMENT IS CLASSIFIED AS A HIGH HAZARD POTENTIAL STRUCTURE.

I hereby certify that this document was prepared by me or under my direct personal supervision and is correct to the best of my knowledge and belief and that I am a duly licensed Professional Engineer under the laws of the State of ALABAMA.

William O Dickey III
(Signature)

Date: 1/20/14

State of West Virginia
County of Raleigh
Acknowledged before me, a Notary Public
This 20 day of Jan. 2014
My commission expires 10/17/17

ALABAMA LICENSED No. 31771 PROFESSIONAL ENGINEER WILLIAM O. DICKEY III

NOTARY PUBLIC
STATE OF WEST VIRGINIA
STEPHANIE D. HILL
357 OAK GROVE ROAD
BECKLEY, WV 25801
My commission expires October 17, 2017

REVISION	DATE	DESCRIPTION	P.M.
△2	1/14	RESPONSE TO ASMC COMMENTS.	WOD
△1	7/13	RESPONSE TO MSHA COMMENTS.	WOD

Prepared By:

Marshall Miller and Associates
Geology, Environmental Sciences & Engineering, Geophysics

☐ Bluefield, VA · ☐ Lexington, KY · ☐ Raleigh, NC
☐ Ashland, VA · ☐ Charleston, WV · ☐ Camp Hill, PA
☐ Kingsport, TN · ☐ Lenexa, KS · ☐ Bossier City, LA
☐ Cincinnati, OH · ■ Beckley, WV · ☐ Evansville, IN

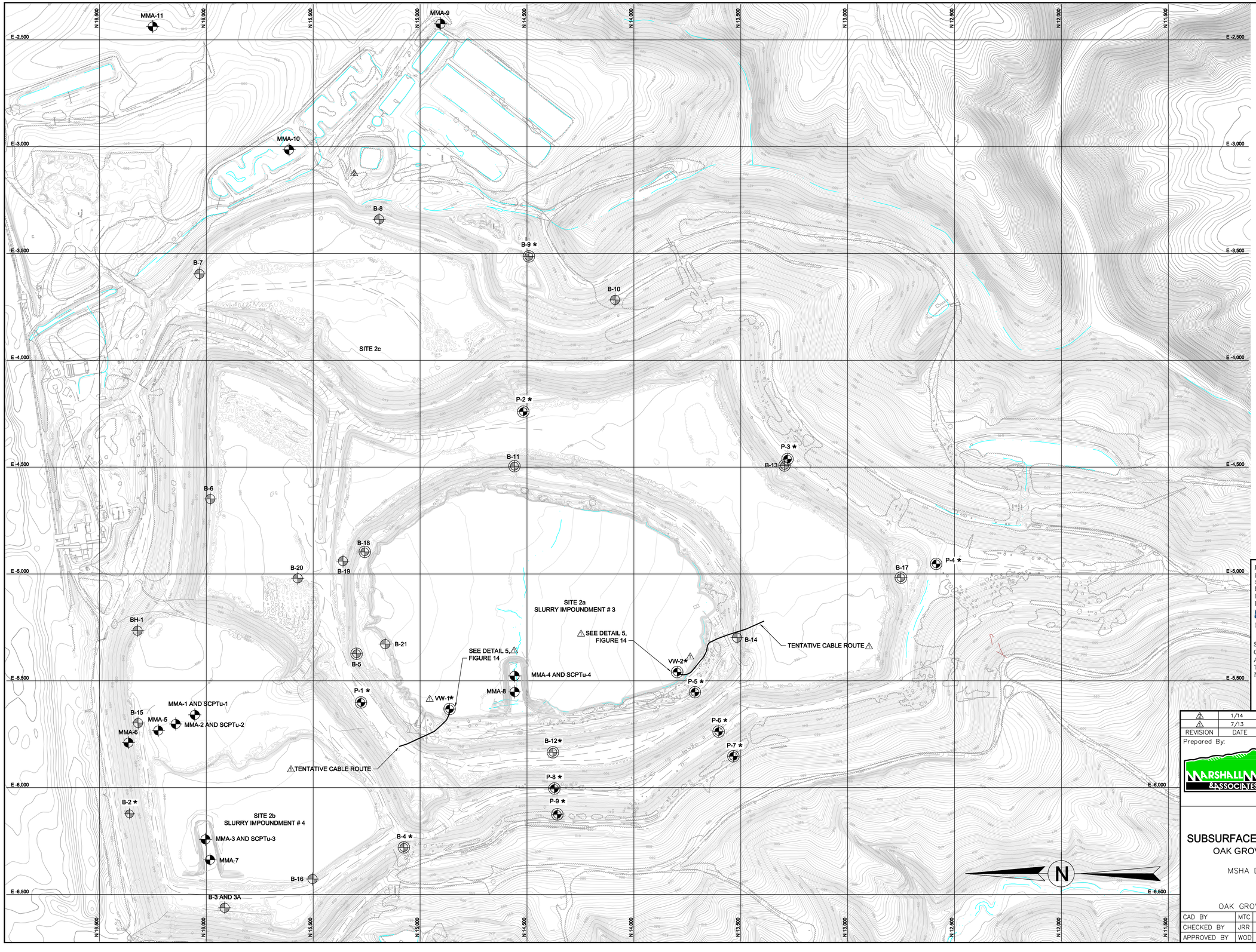
FIGURE 3
KEY PLAN - REFUSE DISPOSAL AREAS
OAK GROVE RESOURCES, LLC REFUSE FACILITY

CONCORD QUADRANGLE
MSHA DISTRICT 11 – BIRMINGHAM, ALABAMA
JEFFERSON COUNTY, ALABAMA

Prepared For:
CLIFFS NATURAL RESOURCES
OAK GROVE MINE, JEFFERSON COUNTY, ALABAMA

CAD BY	MTC	2/12
CHECKED BY	JRR	2/12
APPROVED BY	WOD	2/12

Scale in Feet
200 0 200 400



LEGEND

BOREHOLE / PIEZOMETER - APPOXIMATE LOCATIONS ALMES FEBRUARY, 1991	B-11
EXISTING BOREHOLE - APPOXIMATE LOCATIONS ALMES FEBRUARY, 1991	B-5
MMA BOREHOLE AND SCPTu - LOCATIONS	MMA-1
△1 PIEZOMETER INSTALLED - JULY-AUGUST 2012 AS-BUILT LOCATIONS	P-5
△1 PROPOSED VIRBRATING - WIRE PIEZOMETERS APPROXIMATE LOCATIONS	VW-1
ACTIVE PIEZOMETERS - GOING FORWARD	*

NOTES:

1.) FOR PIEZOMETER DETAILS SEE FIGURE 14.

I hereby certify that this document was prepared by me or under my direct personal supervision and is correct to the best of my knowledge and belief and that I am a duly licensed Professional Engineer under the laws of the State of ALABAMA.

William O. Dickett
(Signature)

Date: 1/20/14

State of West Virginia
County of Raleigh
Acknowledged before me, a Notary Public
This 20 day of Jan. 2014
My commission expires 10/17/17

ALABAMA LICENSED No. 31771 PROFESSIONAL ENGINEER WILLIAM O. DICKETT

NOTARY PUBLIC
STATE OF WEST VIRGINIA
STEPHANIE D. HILL
357 OAK GROVE ROAD
BECKLEY, WV 25801
My commission expires October 17, 2017

REVISION	DATE	DESCRIPTION	P.M.
2	1/14	RESPONSE TO ASMC COMMENTS.	WOD
1	7/13	RESPONSE TO MSHA COMMENTS.	WOD

Prepared By:

Marshall Miller and Associates

Geology, Environmental Sciences & Engineering, Geophysics

☐ Bluefield, VA • ☐ Lexington, KY • ☐ Raleigh, NC
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☐ Kingsport, TN • ☐ Lenexa, KS • ☐ Bossier City, LA
☐ Cincinnati, OH • ■ Beckley, WV • ☐ Evansville, IN

FIGURE 4
SUBSURFACE EXPLORATION & PIEZOMETER - PLAN

OAK GROVE RESOURCES, LLC REFUSE FACILITY

CONCORD QUADRANGLE
MSHA DISTRICT 11 – BIRMINGHAM, ALABAMA
JEFFERSON COUNTY, ALABAMA

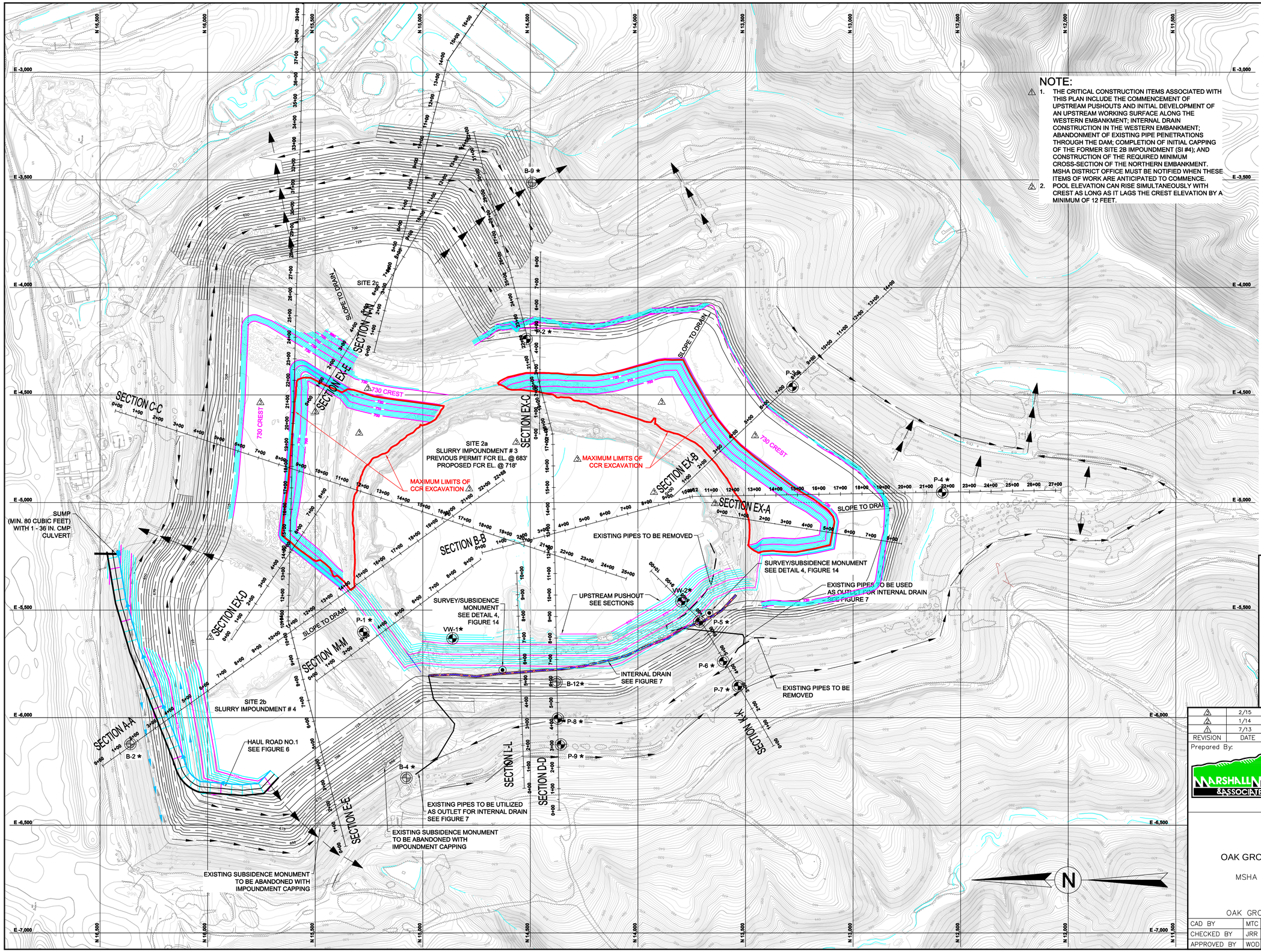
Prepared For:

CLIFFS NATURAL RESOURCES
OAK GROVE MINE, JEFFERSON COUNTY, ALABAMA

CAD BY	MTC	2/12
CHECKED BY	JRR	2/12
APPROVED BY	WOD	2/12

Scale in Feet

200 0 200 400



NOTE:

1. THE CRITICAL CONSTRUCTION ITEMS ASSOCIATED WITH THIS PLAN INCLUDE THE COMMENCEMENT OF UPSTREAM PUSHOUTS AND INITIAL DEVELOPMENT OF AN UPSTREAM WORKING SURFACE ALONG THE WESTERN EMBANKMENT; INTERNAL DRAIN CONSTRUCTION IN THE WESTERN EMBANKMENT; ABANDONMENT OF EXISTING PIPE PENETRATIONS THROUGH THE DAM; COMPLETION OF INITIAL CAPPING OF THE FORMER SITE 2B IMPOUNDMENT (SI #4); AND CONSTRUCTION OF THE REQUIRED MINIMUM CROSS-SECTION OF THE NORTHERN EMBANKMENT. MSHA DISTRICT OFFICE MUST BE NOTIFIED WHEN THESE ITEMS OF WORK ARE ANTICIPATED TO COMMENCE.
2. POOL ELEVATION CAN RISE SIMULTANEOUSLY WITH CREST AS LONG AS IT LAGS THE CREST ELEVATION BY A MINIMUM OF 12 FEET.

LEGEND

CONTOURS

PREVIOUS PERMIT - (INDEX CONTOURS) — 160

PREVIOUS PERMIT - (INTERMEDIATE CONTOURS)

PROPOSED INDEX CONTOURS - 160

PROPOSED INTERMEDIATE - CONTOURS

DRAINS

PREVIOUS PERMIT - (DOWN DRAINS)

PREVIOUS PERMIT - (SLOPE BENCH DRAINS)

PROPOSED ROAD DITCH -

PROPOSED SLOPE BENCH DRAIN -

PIEZOMETERS

BOREHOLE / PIEZOMETER - APPOXIMATE LOCATIONS ALMES FEBRUARY, 1991 — B-11

PIEZOMETER INSTALLED- JULY-AUGUST 2012 AS-BUILT LOCATIONS — P-5

PROPOSED VIRBRATING - WIRE PIEZOMETERS APPROXIMATE LOCATIONS — VW-1

ACTIVE PIEZOMETERS - GOING FORWARD — *

SECTIONS

SECTIONS A-A THROUGH E-E ARE THE SAME AS ALMES, 1991. SECTION E-E HAS BEEN EXTENDED TO THE EAST.

MONUMENTS

EXISTING SUBSIDENCE MONUMENT-

PROPOSED- SURVEY/SUBSIDENCE MONUMENT-

PROPOSED SURVEY/SUBSIDENCE MONUMENTS ARE NOT INTENDED FOR SEVEN DAY INSPECTIONS. THEY SHOULD BE MONITORED QUARTERLY DURING THEIR FIRST YEAR OF EXISTENCE AND ANNUALLY THEREAFTER.

I hereby certify that this document was prepared by me or under my direct personal supervision and is correct to the best of my knowledge and belief and that I am a duly licensed Professional Engineer under the laws of the State of ALABAMA.

William O. Dickey Jr. (Signature)

Date: 2/24/15

ALABAMA LICENSED No. 31771 PROFESSIONAL ENGINEER WILLIAM O. DICKEY

State of West Virginia
County of Raleigh
Acknowledged before me, a Notary Public,
This 24 day of February, 2015
My commission expires 10/17/2017

NOTARY PUBLIC STATE OF WEST VIRGINIA STEPHANIE D. HILL 357 OAK GROVE ROAD BECKLEY, WV 25801 My commission expires October 17, 2017

REVISION	DATE	DESCRIPTION	P.M.
3	2/15	ADDED MSHA APPROVED EXCAVATION OF EXISTING CCR	WOD
2	1/14	RESPONSE TO ASMC COMMENTS.	WOD
1	7/13	RESPONSE TO MSHA COMMENTS.	WOD

Prepared By:

Marshall Miller and Associates

Geology, Environmental Sciences & Engineering, Geophysics

☐ Bluefield, VA • ☐ Lexington, KY • ☐ Raleigh, NC
☐ Ashland, VA • ☐ Charleston, WV • ☐ Camp Hill, PA
☐ Kingsport, TN • ☐ Lenexa, KS • ☐ Bossier City, LA
☐ Cincinnati, OH • ■ Beckley, WV • ☐ Evansville, IN

FIGURE 5
SITE 2 - PLAN

OAK GROVE RESOURCES, LLC REFUSE FACILITY

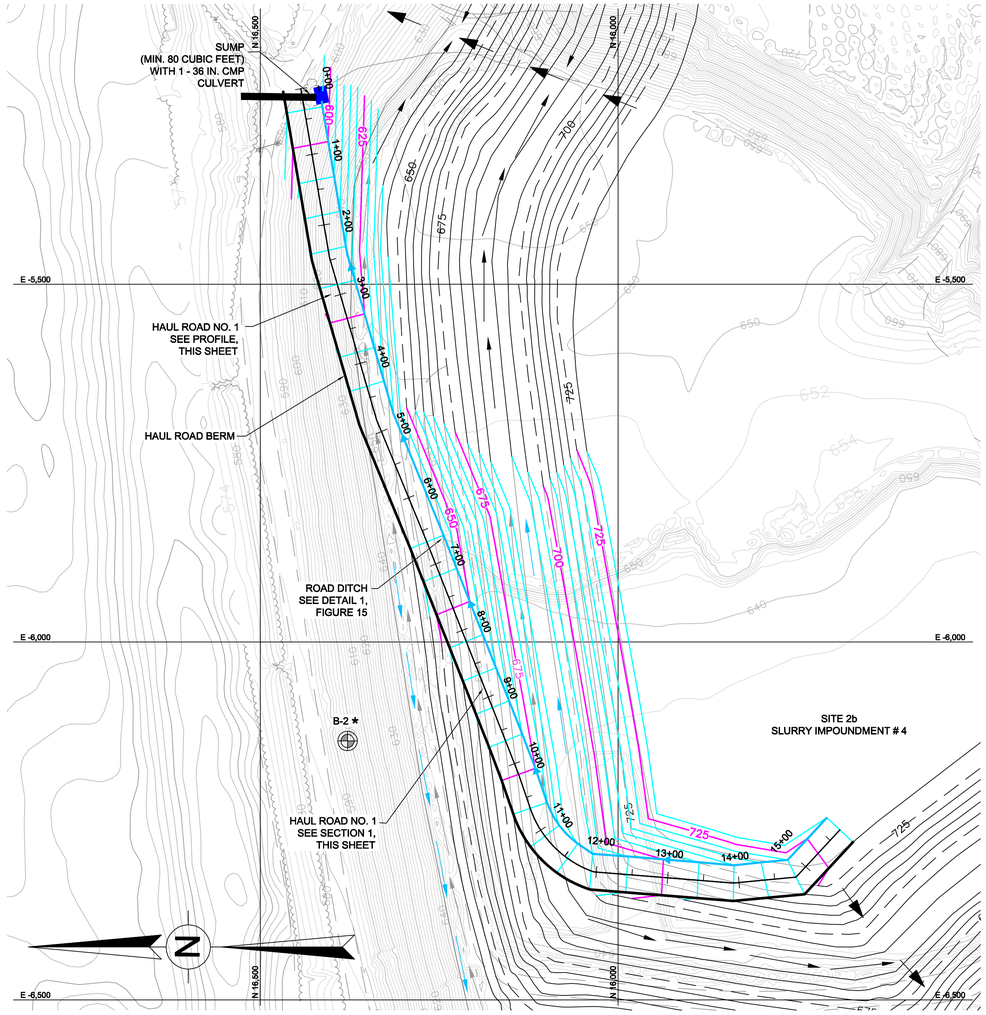
CONCORD QUADRANGLE
MSHA DISTRICT 11 – BIRMINGHAM, ALABAMA
JEFFERSON COUNTY, ALABAMA

Prepared For:

CLIFFS NATURAL RESOURCES
OAK GROVE MINE, JEFFERSON COUNTY, ALABAMA

CAD BY	MTC	2/12
CHECKED BY	JRR	2/12
APPROVED BY	WOD	2/12

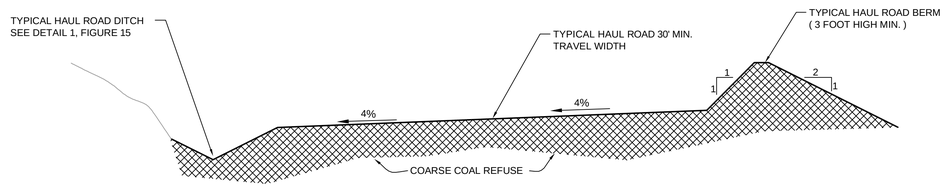
Scale in Feet: 200 0 200 400



HAUL ROAD NO.1 PLAN

SCALE: 1" = 100'

100 0 100 200



1/6 TYPICAL HAUL ROAD SECTION - LOOKING UP GRADE

N.T.S.

LEGEND

CONTOURS

PREVIOUS PERMIT - (INDEX CONTOURS) — 160

PREVIOUS PERMIT - (INTERMEDIATE CONTOURS)

PROPOSED INDEX CONTOURS - 160

PROPOSED INTERMEDIATE - CONTOURS

DRAINS

PREVIOUS PERMIT - (DOWN DRAINS)

PREVIOUS PERMIT - (SLOPE BENCH DRAINS)

PROPOSED ROAD DITCH -

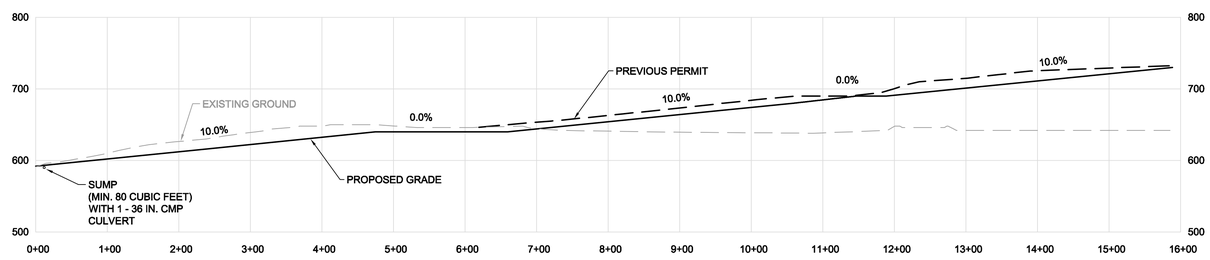
PROPOSED SLOPE BENCH DRAIN -

PIEZOMETERS

BOREHOLE / PIEZOMETER - APPOXIMATE LOCATIONS ALMES FEBRUARY, 1991 — B-11

PROPOSED PIEZOMETER - APPOXIMATE LOCATIONS — P-5

ACTIVE PIEZOMETERS - GOING FORWARD — *



HAUL ROAD NO.1 - PROFILE

SCALE: 1" = 100'

100 0 100 200

I hereby certify that this document was prepared by me or under my direct personal supervision and is correct to the best of my knowledge and belief and that I am a duly licensed Professional Engineer under the laws of the State of ALABAMA.

William O Beckley II
(Signature)

Date: 2/22/12

ALABAMA LICENSED No. 24271 PROFESSIONAL ENGINEER WILLIAM O. BECKLEY II

State of WV
County of Raleigh
Acknowledged before me, a Notary Public, Michael S. Underwood.
This 22 day of Feb, 2012
My commission expires 2/6/2017

OFFICIAL SEAL
NOTARY PUBLIC
STATE OF WEST VIRGINIA
MICHAEL S. UNDERWOOD
821 BROAD STREET
MOUNT HOPE, WV 25880
My commission expires February 6, 2017

REVISION	DATE	DESCRIPTION	P.M.

Prepared By:

Marshall Miller and Associates

Geology, Environmental Sciences & Engineering, Geophysics

☐ Bluefield, VA · ☐ Lexington, KY · ☐ Raleigh, NC
☐ Ashland, VA · ☐ Charleston, WV · ☐ Camp Hill, PA
☐ Kingsport, TN · ☐ Lenexa, KS · ☐ Bossier City, LA
☐ Cincinnati, OH · ■ Beckley, WV · ☐ Evansville, IN

FIGURE 6
HAUL ROAD NO. 1 - PLAN, PROFILES, DETAILS

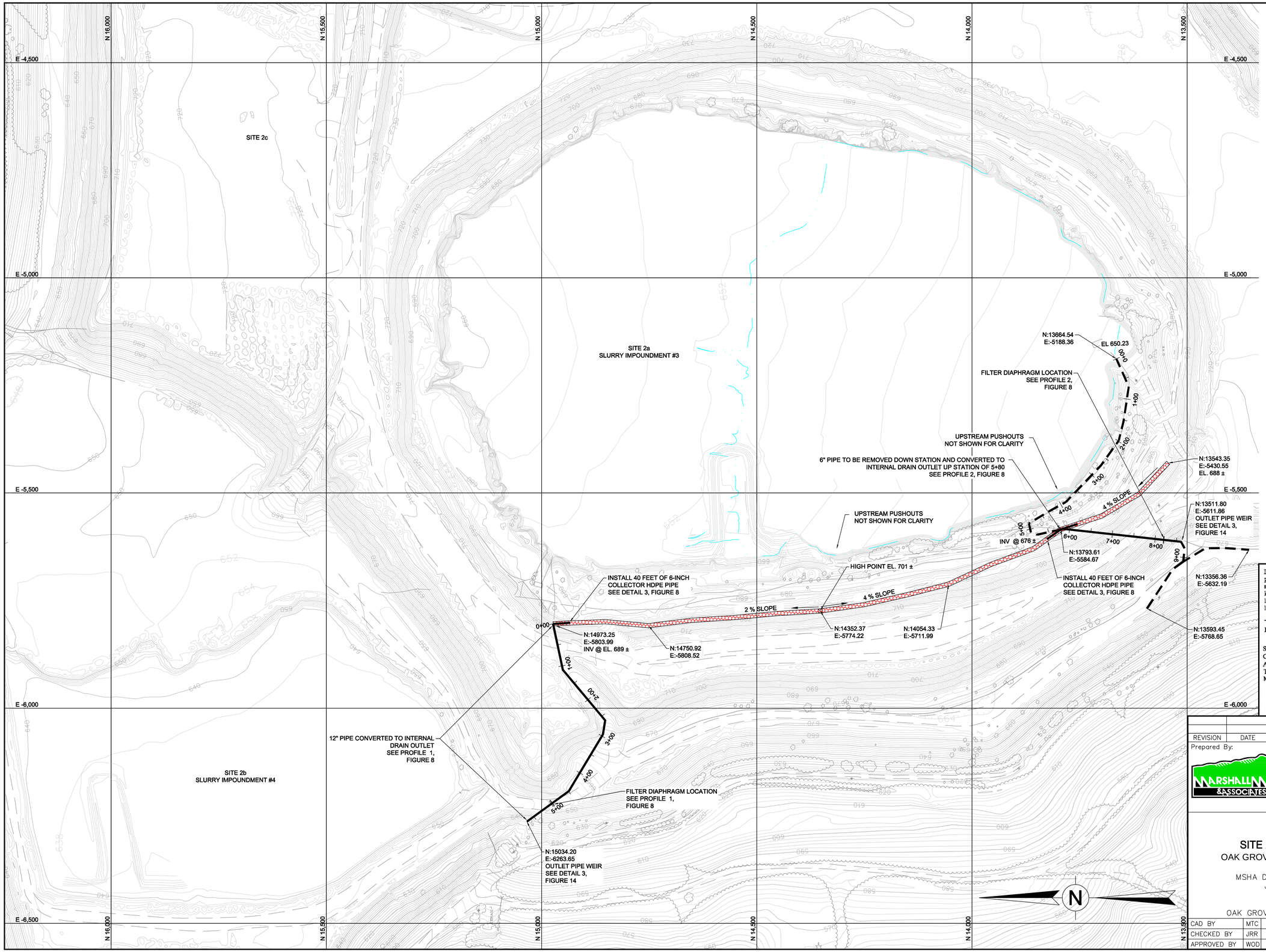
OAK GROVE RESOURCES, LLC REFUSE FACILITY

CONCORD QUADRANGLE
MSHA DISTRICT 11 – BIRMINGHAM, ALABAMA
JEFFERSON COUNTY, ALABAMA

Prepared For:

CLIFFS NATURAL RESOURCES
OAK GROVE MINE, JEFFERSON COUNTY, ALABAMA

CAD BY	MTC	2/12	Scale as Noted
CHECKED BY	JRR	2/12	
APPROVED BY	WOD	2/12	



LEGEND

INTERNAL DRAIN AND PIPING

INTERNAL DRAIN -

PIPES CONVERTED TO INTERNAL DRAIN OUTLETS -

EXISTING PIPES TO BE REMOVED -

I hereby certify that this document was prepared by me or under my direct personal supervision and is correct to the best of my knowledge and belief and that I am a duly licensed Professional Engineer under the laws of the State of ALABAMA.

William O. Dickey Jr.
(Signature)

Date: 2/22/12

ALABAMA LICENSED No. 24271 PROFESSIONAL ENGINEER WILLIAM O. DICKEY JR.

State of WV
County of Raleigh
Acknowledged before me, a Notary Public, Michael S. Underwood
This 22 day of Feb, 2012
My commission expires 2/6/2017

OFFICIAL SEAL
NOTARY PUBLIC
STATE OF WEST VIRGINIA
MICHAEL S. UNDERWOOD
821 BROAD STREET
MOUNT HOPE, WV 25880
My commission expires February 6, 2017

REVISION	DATE	DESCRIPTION	P.M.

Prepared By:

Marshall Miller and Associates

Geology, Environmental Sciences & Engineering, Geophysics

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☐ Ashland, VA · ☐ Charleston, WV · ☐ Camp Hill, PA
☐ Kingsport, TN · ☐ Lenexa, KS · ☐ Bossier City, LA
☐ Cincinnati, OH · ■ Beckley, WV · ☐ Evansville, IN

FIGURE 7
SITE 2a - INTERNAL DRAIN - PLAN

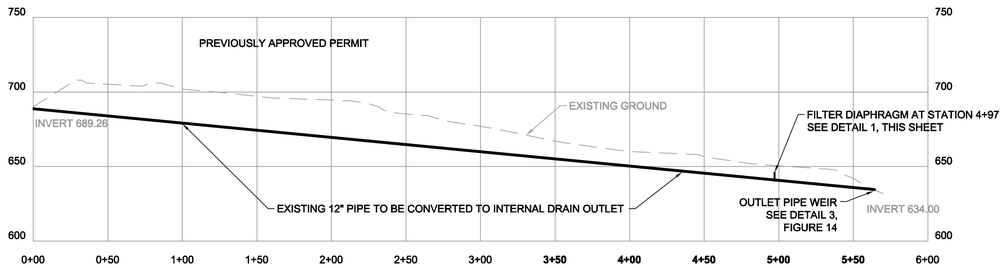
OAK GROVE RESOURCES, LLC REFUSE FACILITY

CONCORD QUADRANGLE
MSHA DISTRICT 11 – BIRMINGHAM, ALABAMA
JEFFERSON COUNTY, ALABAMA

Prepared For:
CLIFFS NATURAL RESOURCES
OAK GROVE MINE, JEFFERSON COUNTY, ALABAMA

CAD BY	MTC	2/12
CHECKED BY	JRR	2/12
APPROVED BY	WOD	2/12

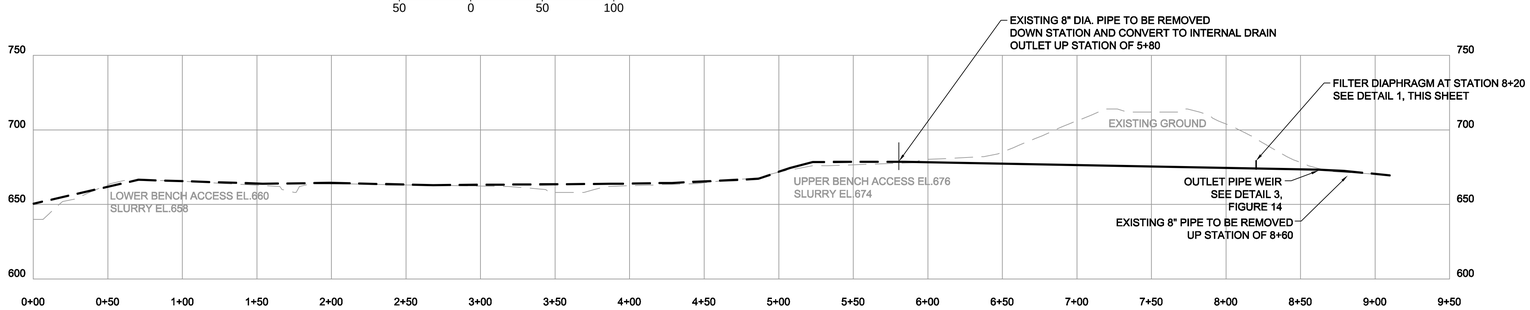
Scale in Feet
100 0 100 200



INTERNAL DRAIN OUTLET PROFILE 1

SCALE: 1" = 50'

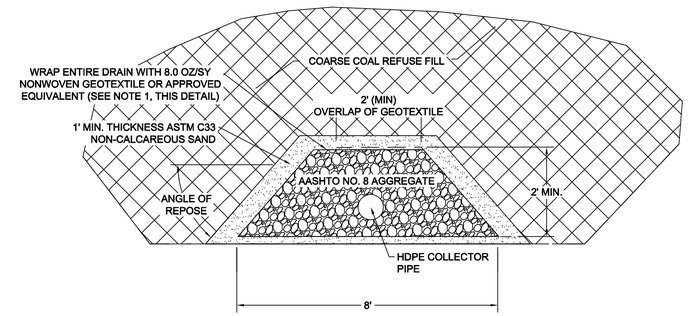
50 0 50 100



INTERNAL DRAIN OUTLET PROFILE 2

SCALE: 1" = 50'

50 0 50 100

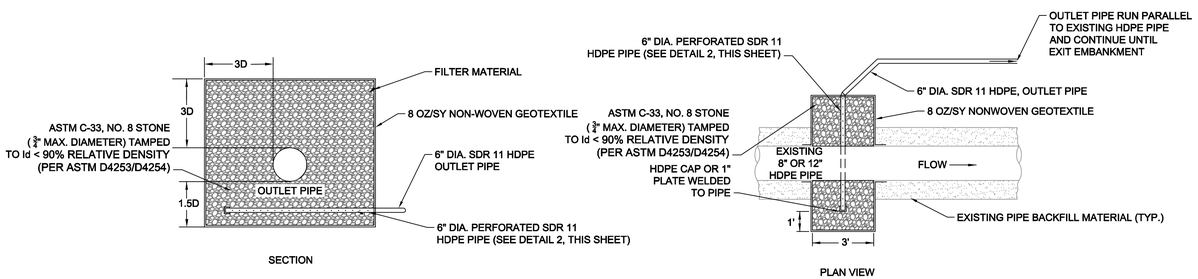


INTERNAL DRAIN INSTALLATION REQUIREMENTS:

1. WHERE 8 OZ/SY NONWOVEN GEOTEXTILE OVERLAPS ARE REQUIRED, A 24-INCH (MIN) OVERLAP SHALL BE PROVIDED. SEE THE SPECIFICATIONS FOR GEOTEXTILE MATERIAL M.A.R.V. REQUIREMENTS.
2. INTERNAL DRAIN CONFIGURATION CAN BE MODIFIED TO ACCOMMODATE FIELD CONDITIONS, PROVIDED THE MINIMUM CROSS-SECTIONAL AREA OF 12 SQ.FT. IS ACHIEVED. THE PERIMETER AND LATERAL INTERNAL DRAIN HEIGHTS SHALL NOT BE SMALLER THAN NOTED AND SHALL HAVE SLOPE AS DEPICTED ON PLAN (FIG.7).
3. THE AASHTO NO. 8 STONE SHALL BE USED IN THE INTERNAL DRAIN CONSTRUCTION SHALL BE DURABLE SANDSTONE SHALL HAVE A D_{50} OF 6 INCHES AND SHALL CONTAIN LESS THAN 5 PERCENT PASSING THE NUMBER 200 SIEVE. LARGE VOIDS ENCOUNTERED AT THE TOP OF THE UNDERDRAIN MAY BE FILLED WITH SMALLER STONES OR LARGE STONES SHALL BE REMOVED TO MINIMIZE TEARING OF THE GEOTEXTILE.
4. A 1' (MIN.) LAYER OF FREE DRAINING ASTM NON-CALCAREOUS SAND WILL BE PLACED IMMEDIATELY ABOVE THE INTERNAL DRAIN GEOTEXTILE TO PREVENT DEGRADATION FROM UV LIGHT.

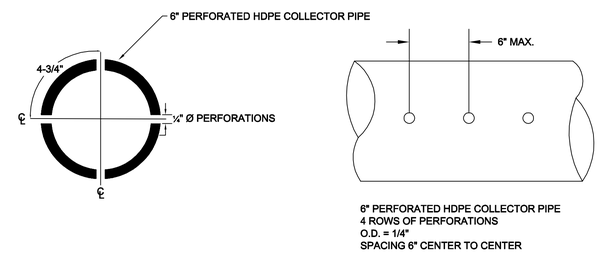
3/8 INTERNAL DRAIN DETAIL OF HDPE COLLECTOR PIPE

N.T.S.



1/8 FILTER DRAINAGE DIAPHRAGM DETAIL

N.T.S.



2/8 6" Ø PERFORATED HDPE COLLECTOR PIPE

N.T.S.

I hereby certify that this document was prepared by me or under my direct personal supervision and is correct to the best of my knowledge and belief and that I am a duly licensed Professional Engineer under the laws of the State of ALABAMA.

(Signature)

Date: 2/22/12

State of WV
County of Raleigh
Acknowledged before me, a Notary Public, Michael S. Underwood
This 22 day of FEB, 2012
My commission expires 2/6/2017

ALABAMA LICENSED No. 24721 PROFESSIONAL ENGINEER WILLIAM O. DELAY II

OFFICIAL SEAL
NOTARY PUBLIC
STATE OF WEST VIRGINIA
MICHAEL S. UNDERWOOD
821 BROAD STREET
MOUNT HOPE, WV 25880
My commission expires February 6, 2017

REVISION	DATE	DESCRIPTION	P.M.

Prepared By:

Marshall Miller and Associates

Geology, Environmental Sciences & Engineering, Geophysics

☐ Bluefield, VA · ☐ Lexington, KY · ☐ Raleigh, NC
☐ Ashland, VA · ☐ Charleston, WV · ☐ Camp Hill, PA
☐ Kingsport, TN · ☐ Lenexa, KS · ☐ Bossier City, LA
☐ Cincinnati, OH · ■ Beckley, WV · ☐ Evansville, IN

FIGURE 8
SITE 2a - INTERNAL DRAIN PROFILES & DETAILS

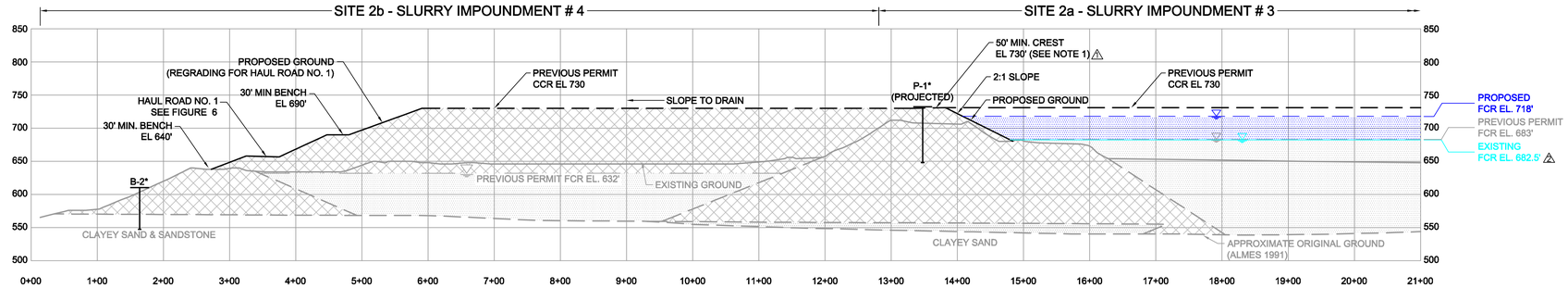
OAK GROVE RESOURCES, LLC REFUSE FACILITY

CONCORD QUADRANGLE
MSHA DISTRICT 11 – BIRMINGHAM, ALABAMA
JEFFERSON COUNTY, ALABAMA

Prepared For:

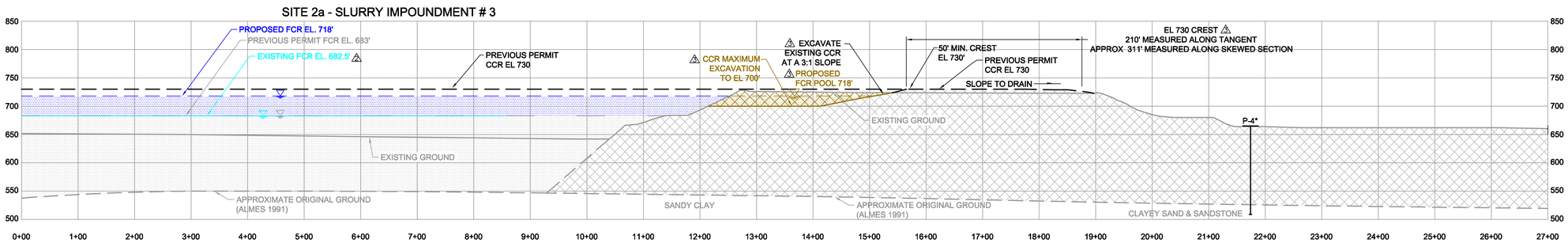
CLIFFS NATURAL RESOURCES
OAK GROVE MINE, JEFFERSON COUNTY, ALABAMA

CAD BY	MTC	2/12	Scale as Noted
CHECKED BY	JRR	2/12	
APPROVED BY	WOD	2/12	



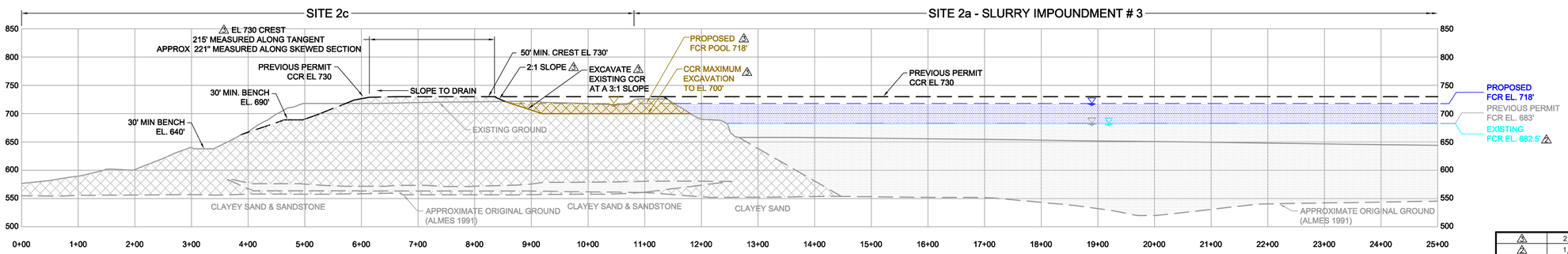
SECTION A-A

SCALE: 1" = 100'



SECTION B-B

SCALE: 1" = 100'



SECTION C-C

SCALE: 1" = 100'

LEGEND

COAL REFUSE

- PREVIOUS PERMIT CCR -
- PREVIOUS PERMIT FCR -
- PROPOSED CCR -
- PROPOSED FCR -
- △3 CCR TO BE EXCAVATED -
- △3 FCR TO BE PLACED- RESULTING FROM CCR EXCAVATION

PIEZOMETERS

- ACTIVE PIEZOMETERS - GOING FORWARD — P-1*

NOTES:

△1. MAINTAIN 50' MINIMUM CREST WIDTH AS 2b IS BROUGHT UP TO EL 730. SEE FOOTNOTE (3) TO PIEZOMETER TABLE OF FIGURE 14.

I hereby certify that this document was prepared by me or under my direct personal supervision and is correct to the best of my knowledge and belief and that I am a duly licensed Professional Engineer under the laws of the State of ALABAMA.

William O. Dickey Jr. (Signature)

Date: 2/24/15

State of West Virginia
County of Raleigh
Acknowledged before me, a Notary Public, This 24 day of February, 2015
My commission expires 10/17/2017

Notary Public
STATE OF WEST VIRGINIA
STEPHANIE D. HILL
357 OAK GROVE ROAD
BECKLEY, WV 25801
My commission expires October 17, 2017

ALABAMA LICENSED No. 31771 PROFESSIONAL ENGINEER WILLIAM O. DICKEY

REVISION	DATE	DESCRIPTION	P.M.
△3	2/15	ADDED MSHA APPROVED EXCAVATION OF EXISTING CCR	WOD
△2	1/14	RESPONSE TO ASMC COMMENTS.	WOD
△1	7/13	RESPONSE TO MSHA COMMENTS.	WOD

Prepared By:

Marshall Miller and Associates
Geology, Environmental Sciences & Engineering, Geophysics

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☐ Kingsport, TN • ☐ Lenexa, KS • ☐ Bossier City, LA
☐ Cincinnati, OH • ■ Beckley, WV • ☐ Evansville, IN

FIGURE 11
CROSS SECTIONS A-A, B-B, C-C

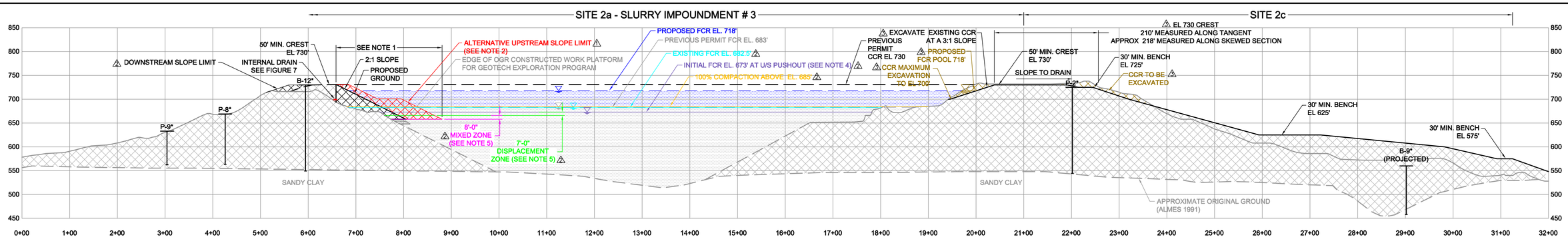
OAK GROVE RESOURCES, LLC REFUSE FACILITY

CONCORD QUADRANGLE
MSHA DISTRICT 11 – BIRMINGHAM, ALABAMA
JEFFERSON COUNTY, ALABAMA

Prepared For:
CLIFFS NATURAL RESOURCES
OAK GROVE MINE, JEFFERSON COUNTY, ALABAMA

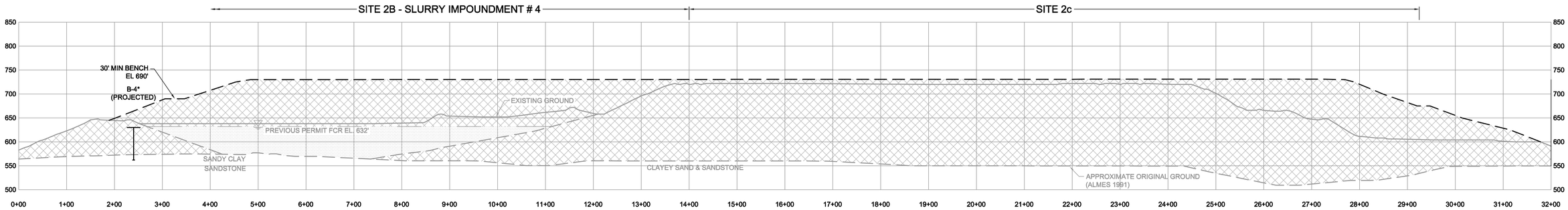
CAD BY	MTC	2/12
CHECKED BY	JRR	2/12
APPROVED BY	WOD	2/12

Scale in Feet: 100 0 100 200



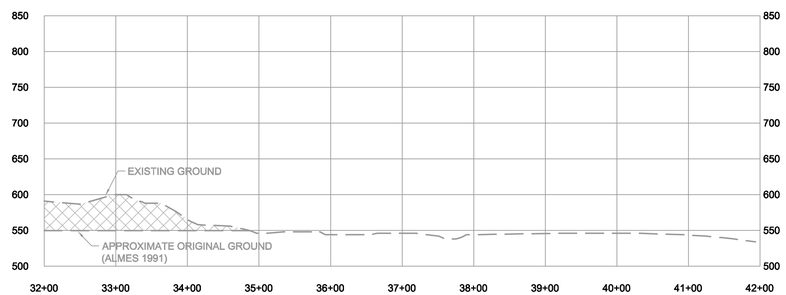
SECTION D-D

SCALE: 1" = 100'



SECTION E-E

SCALE: 1" = 100'



SECTION E-E (CONTINUED)

SCALE: 1" = 100'

LEGEND

COAL REFUSE

PREVIOUS PERMIT CCR -

PREVIOUS PERMIT FCR -

PROPOSED CCR -

PROPOSED FCR -

PROPOSED CCR - (ALTERNATIVE SLOPE LIMITS) SEE NOTE 2

CCR TO BE EXCAVATED-

FCR TO BE PLACED- RESULTING FROM CCR EXCAVATION

PIEZOMETERS

ACTIVE PIEZOMETERS - GOING FORWARD

NOTES:

1. PROPOSED UPSTREAM CONSTRUCTION IS WITHIN PREVIOUS PERMIT CCR LIMIT BUT SHOWN AS PROPOSED GROUND TO HIGHLIGHT PROPOSED UPSTREAM CONSTRUCTION. 100% COMPACTION IS REQUIRED FOR THE UPSTREAM CONSTRUCTION ABOVE EL 685.
2. THESE ADJUSTMENTS DO NOT INVOLVE ANY EMBANKMENT CONSTRUCTION ABOVE THE CURRENTLY PROPOSED CREST EL 730 STAGE AND ARE OVERALL POSITIVE WITH REGARD TO DAM STABILITY AND CONTAINMENT OF THE IMPOUNDMENT. THEY ARE PROPOSED NOW PURELY FOR THE PURPOSE OF HAVING A BROADER BASE IN CASE OGR DESIRES TO SUBMIT A FUTURE PROPOSAL TO RAISE THE CREST ABOVE EL 730.
3. EXISTING CONDITIONS ELEVATIONS ARE FROM JANUARY 6, 2014.
4. INITIAL FCR ELEVATION IS BASED ON SURVEY BY MEC.
5. FCR DISPLACEMENT AND MIXED ZONES ARE BASED ON MM&A PRE-DESIGN EXPLORATION FROM UPSTREAM (U/S) DRILLING PLATFORMS AND MEC OBSERVATIONS OF U/S PUSHOUT.

I hereby certify that this document was prepared by me or under my direct personal supervision and is correct to the best of my knowledge and belief and that I am a duly licensed Professional Engineer under the lawy of the State of ALABAMA.

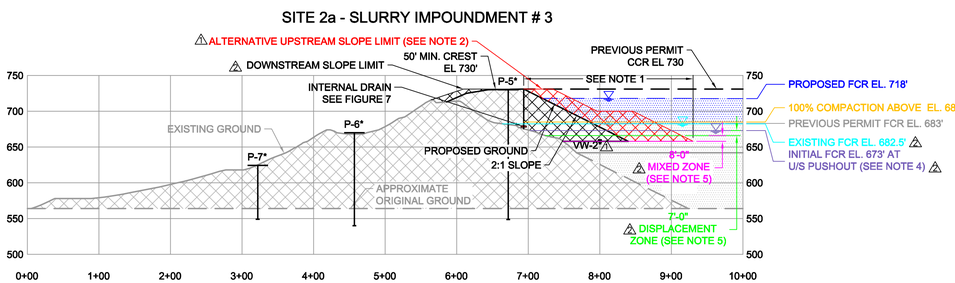
William O Dickey Jr
(Signature)

Date: 2/24/15

State of West Virginia
County of Raleigh
Acknowledged before me, a Notary Public,
This 24 day of February 2015.
My commission expires 10/17/2017

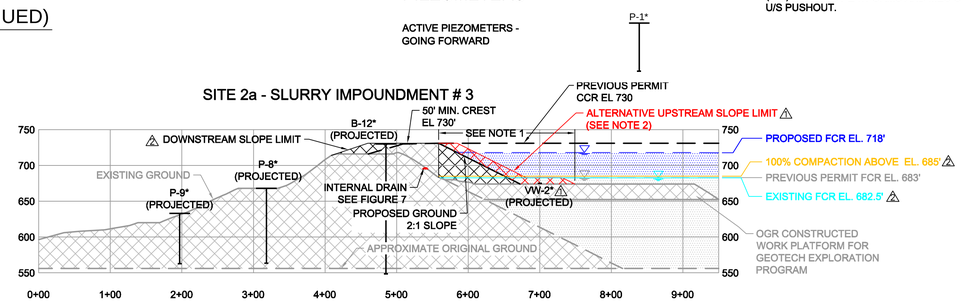
ALABAMA LICENSED No. 31771 PROFESSIONAL ENGINEER WILLIAM O. DICKEY

OFFICIAL SEAL NOTARY PUBLIC STATE OF WEST VIRGINIA STEPHANIE D. HILL 357 OAK GROVE ROAD BECKLEY, WV 25801 My commission expires October 17, 2017



SECTION K-K

SCALE: 1" = 100'



SECTION L-L

SCALE: 1" = 100'

REVISION	DATE	DESCRIPTION	P.M.
3	2/15	ADDED MSHA APPROVED EXCAVATION OF EXISTING CCR	WOD
2	1/14	RESPONSE TO ASMC COMMENTS.	WOD
1	7/13	RESPONSE TO MSHA COMMENTS.	WOD

Prepared By:

Marshall Miller and Associates

Geology, Environmental Sciences & Engineering, Geophysics

☐ Bluefield, VA • ☐ Lexington, KY • ☐ Raleigh, NC
☐ Ashland, VA • ☐ Charleston, WV • ☐ Camp Hill, PA
☐ Kingsport, TN • ☐ Lenexa, KS • ☐ Bossier City, LA
☐ Cincinnati, OH • ■ Beckley, WV • ☐ Evansville, IN

FIGURE 12
CROSS SECTIONS D-D, E-E, K-K, L-L

OAK GROVE RESOURCES, LLC REFUSE FACILITY

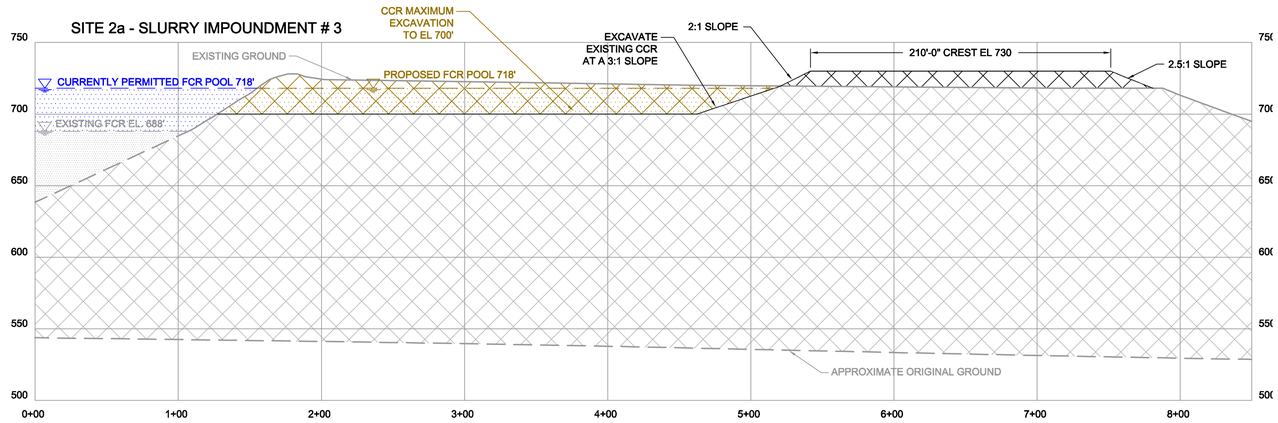
CONCORD QUADRANGLE
MSHA DISTRICT 11 – BIRMINGHAM, ALABAMA
JEFFERSON COUNTY, ALABAMA

Prepared For:

CLIFFS NATURAL RESOURCES
OAK GROVE MINE, JEFFERSON COUNTY, ALABAMA

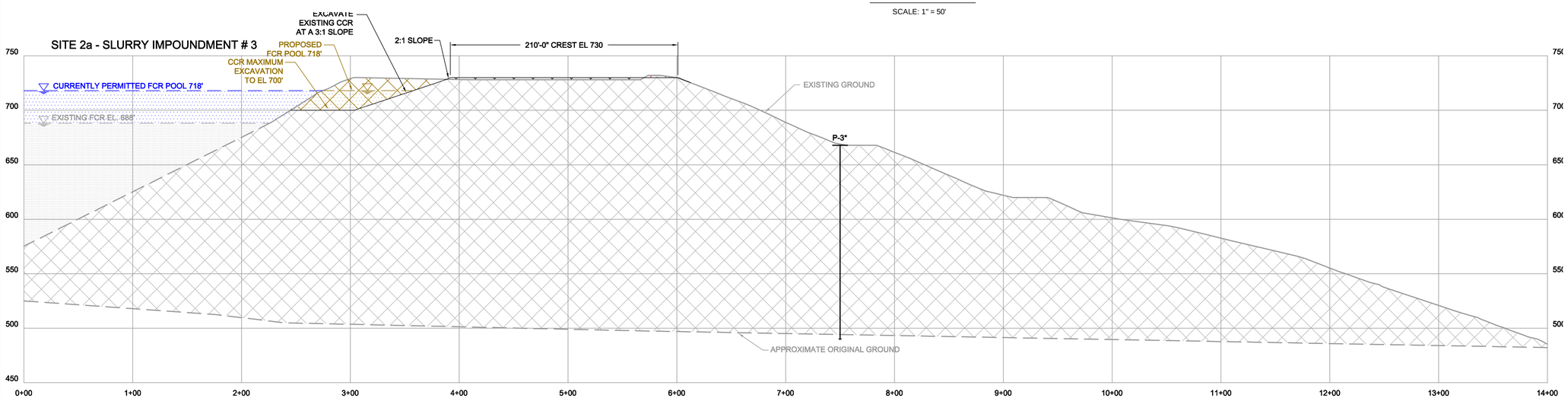
CAD BY	MTC	2/12
CHECKED BY	JRR	2/12
APPROVED BY	WOD	2/12

Scale in Feet: 100 0 100 200



SECTION EX-A

SCALE: 1" = 50'



SECTION EX-B

SCALE: 1" = 50'

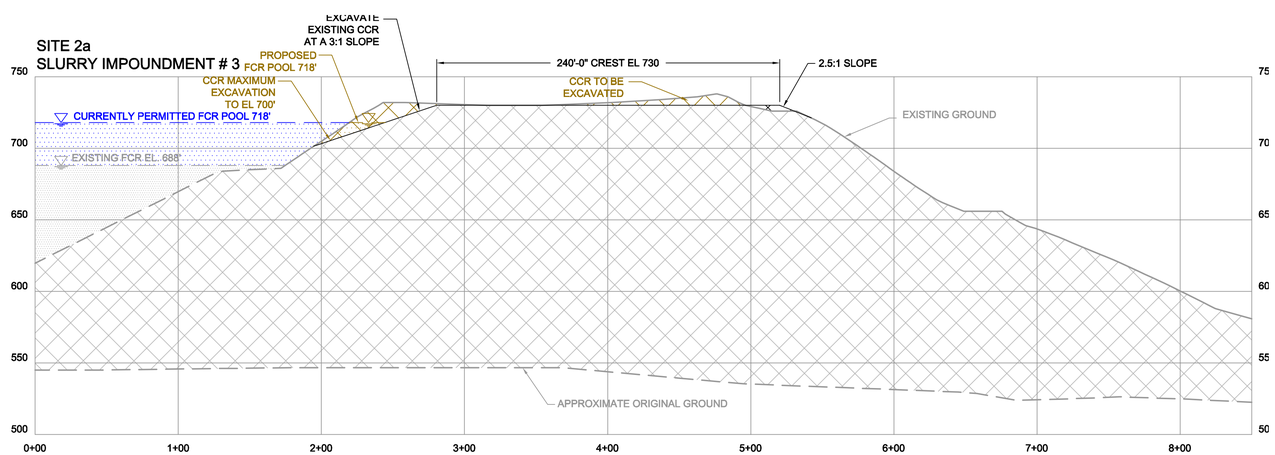
LEGEND

COAL REFUSE

- EXISTING CCR -
- EXISTING FCR -
- FCR TO BE PLACED UNDER CURRENT PERMIT -
- CCR TO BE PLACED UNDER CURRENT PERMIT -
- CCR TO BE EXCAVED -
- FCR TO BE PLACED- RESULTING FROM CCR EXCAVATION

PIEZOMETERS

- ACTIVE PIEZOMETERS - GOING FORWARD — P-1*



SECTION EX-C

SCALE: 1" = 50'

I hereby certify that this document was prepared by me or under my direct personal supervision and is correct to the best of my knowledge and belief and that I am a duly licensed Professional Engineer under the laws of the State of ALABAMA.

William O. Dickey Jr. (Signature)

Date: 2/24/15

ALABAMA LICENSED No. 31771 PROFESSIONAL ENGINEER WILLIAM O. DICKEY

State of West Virginia
County of Raleigh
Acknowledged before me, a Notary Public,
This 24 day of February, 2015
My commission expires 10/17/2017

OFFICIAL NOTARY PUBLIC STATE OF WEST VIRGINIA STEPHANIE D. HILL 357 OAK GROVE ROAD BECKLEY, WV 25801 My commission expires October 17, 2017

REVISION	DATE	DESCRIPTION	P.M.
1	2/15	NEW FIGURE–MSHA APPROVED EXCAVATION OF EXISTING CCR	WOD

Prepared By:

Marshall Miller and Associates

Geology, Environmental Sciences & Engineering, Geophysics

☐ Bluefield, VA · ☐ Lexington, KY · ☐ Raleigh, NC
☐ Ashland, VA · ☐ Charleston, WV · ☐ Camp Hill, PA
☐ Kingsport, TN · ☐ Lenexa, KS · ☐ Bossier City, LA
☐ Cincinnati, OH · ■ Beckley, WV · ☐ Evansville, IN

FIGURE 13A
EXCAVATION CROSS SECTIONS EX-A, EX-B,EX-C

OAK GROVE RESOURCES, LLC REFUSE FACILITY

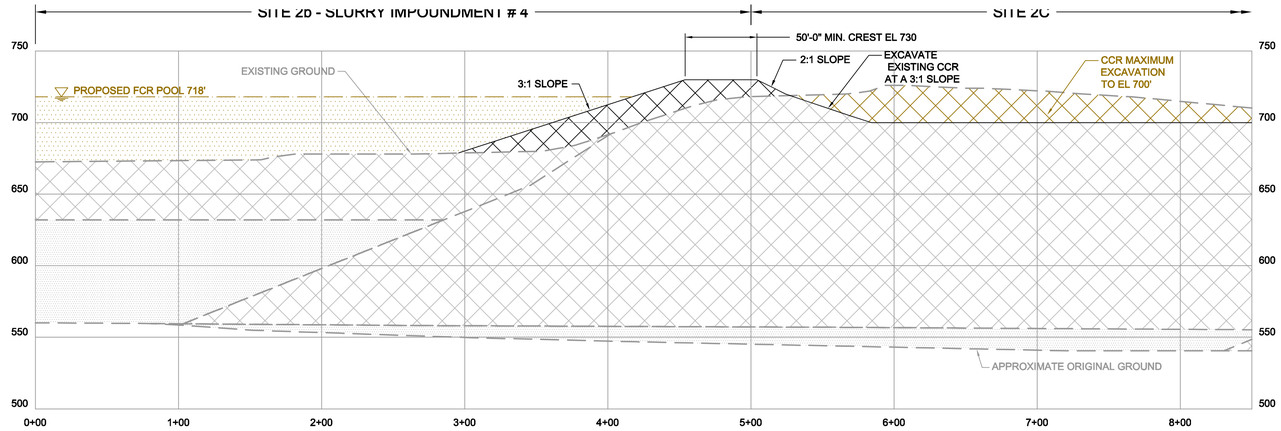
CONCORD QUADRANGLE
MSHA DISTRICT 11 – BIRMINGHAM, ALABAMA
JEFFERSON COUNTY, ALABAMA

Prepared For:

CLIFFS NATURAL RESOURCES
OAK GROVE MINE, JEFFERSON COUNTY, ALABAMA

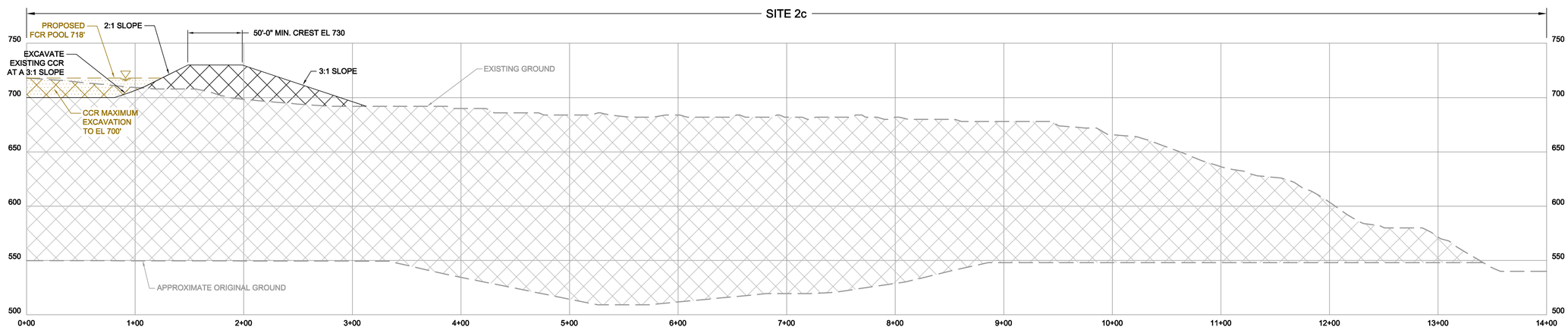
CAD BY	JRR	2/15
CHECKED BY	BCP	2/15
APPROVED BY	WOD	2/15

Scale in Feet: 50 0 50 100



SECTION EX-D

SCALE: 1" = 50'



SECTION EX-E

SCALE: 1" = 50'

LEGEND

COAL REFUSE

- EXISTING CCR -
- EXISTING FCR -
- FCR TO BE PLACED UNDER CURRENT PERMIT -
- CCR TO BE PLACED UNDER CURRENT PERMIT -
- CCR TO BE EXCAVED -
- FCR TO BE PLACED- RESULTING FROM CCR EXCAVATION

PIEZOMETERS

- ACTIVE PIEZOMETERS - GOING FORWARD — P-1*

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REVISION	DATE	DESCRIPTION	P.M.
1	2/15	NEW FIGURE–MSHA APPROVED EXCAVATION OF EXISTING CCR	WOD

Prepared By:

Marshall Miller and Associates

Geology, Environmental Sciences & Engineering, Geophysics

☐ Bluefield, VA • ☐ Lexington, KY • ☐ Raleigh, NC
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☐ Kingsport, TN • ☐ Lenexa, KS • ☐ Bossier City, LA
☐ Cincinnati, OH • ■ Beckley, WV • ☐ Evansville, IN

FIGURE 13B
EXCAVATION CROSS SECTIONS EX-D, EX-E

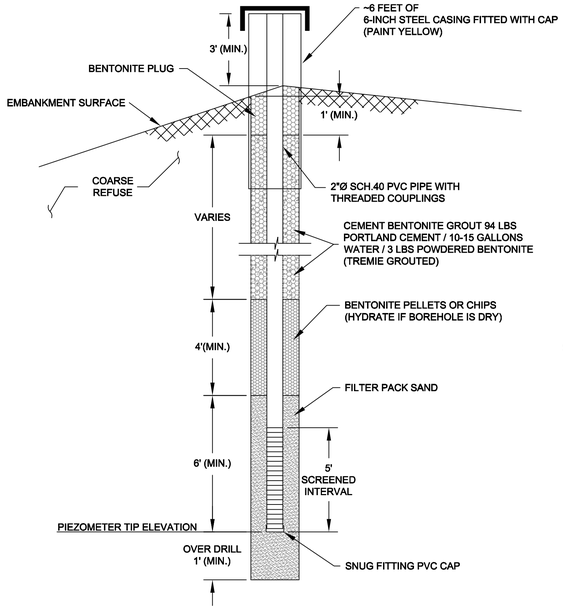
OAK GROVE RESOURCES, LLC REFUSE FACILITY

CONCORD QUADRANGLE
MSHA DISTRICT 11 – BIRMINGHAM, ALABAMA
JEFFERSON COUNTY, ALABAMA

Prepared For:
CLIFFS NATURAL RESOURCES
OAK GROVE MINE, JEFFERSON COUNTY, ALABAMA

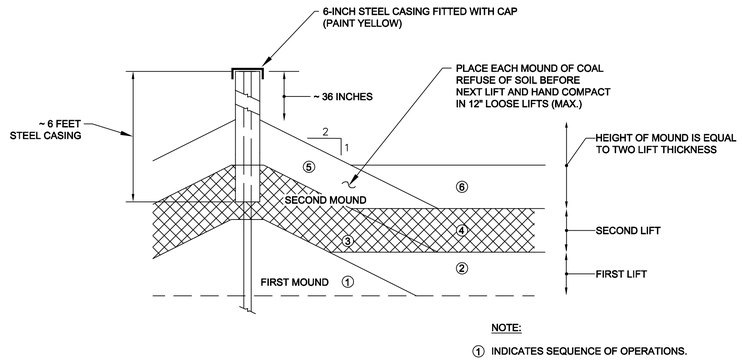
CAD BY	JRR	2/15
CHECKED BY	BCP	2/15
APPROVED BY	WOD	2/15

Scale in Feet: 50 0 50 100



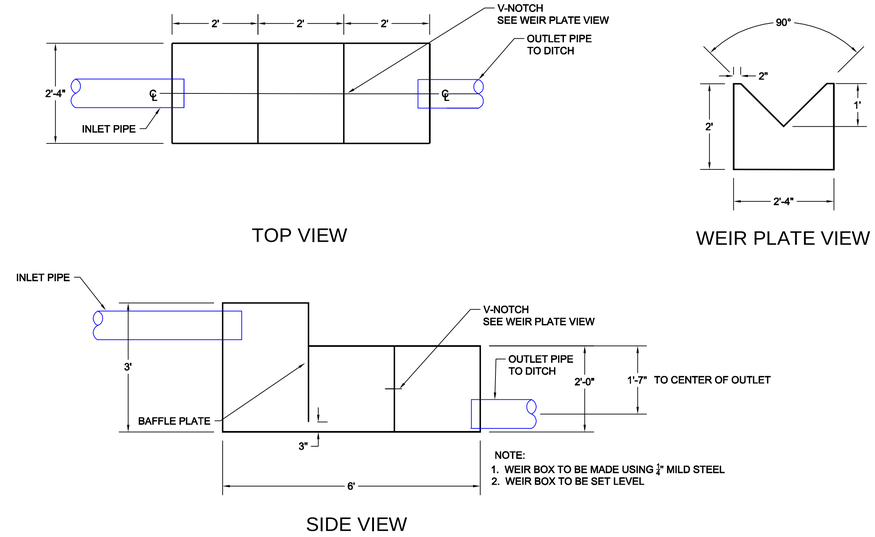
1/14 PIEZOMETER INSTALLATION

N.T.S.



2/14 PIEZOMETER EXTENSION PROCEDURE

N.T.S.



3/14 OUTLET WEIR DETAILS

N.T.S.

NOTES:
1. PIEZOMETERS ARE TO BE INSTALLED AT THE PLANNED LOCATION IN THE SPRING OF 2012.
2. A 6"±Ø HOLE TO BE DRILLED WITH HOLLOW STEM AUGERS, OR PROTECT THE HOLE WITH CASING.
3. PLACE 1/4-INCH TO 3/8-INCH PEA GRAVEL OR SAND AT THE BOTTOM TO SPECIFED 1-FOOT DEPTH.
4. PLACE 2-INCH DIA. PVC PIPE WITH 5-FOOT LONG SCREEN IN CASING TO SPECIFIED TIP ELEVATION. IF PEA GRAVEL IS USED AS BACKFILL, WRAP THE SCREENED INTERVAL WITH 6 OZ.SY NON-WOVEN GEOTEXTILE. USE PLASTIC ELECTRICAL ZIP TIES, AT 6" SPACING, TO HOLD THE GEOTEXTILE IN PLACE.
5. BACKFILL AROUND TIP WITH 1/4-INCH TO 3/8-INCH PEA GRAVEL OR SAND TO SPECIFIED 1 FOOT ABOVE SLOTTED ZONE.
6. PLACE 4-FOOT THICK (MIN.) BENTONITE SEAL PLUG.
7. BACKFILL ABOVE HYDRATED BENTONITE SEAL WITH CEMENT BENTONITE GROUT.
8. PLACE 12-INCH (MIN.) BENTONITE PLUG NEAR EXISTING GROUND SURFACE.
9. PNEUMATIC PIEZOMETERS MAY BE SUBSTITUTED FOR STAND PIPE PIEZOMETERS UPON REQUEST OF THE SITE OPERATOR.
10. IF PIEZOMETERS ARE DAMAGED DURING CONSTRUCTION OF THE REFUSE FILL, THEN THE REPLACEMENT PIEZOMETER DEPTH AND LOCATION SHALL BE DETERMINED BY THE DESIGN ENGINEER, AT THE TIME OF REPLACEMENT.

PIEZOMETER NO.	FORMER BORING NO.	CATEGORY	NORTHING	EASTING	ESTIMATED GROUND ELEV.	ESTIMATED TIP ELEV.	WATER LEVEL FOR NOTIFICATION
P-1 (3)	B-5	RELOCATED	15306 ±	-5629 ±	730 ±	645 ±	(3)
P-2	B-11	RELOCATED	14517 ±	-4213 ±	725 ±	535 ±	675 (1)
P-3	B-13	RELOCATED	13276 ±	-4452 ±	668 ±	490 ±	550 (1)
P-4	B-17	RELOCATED	12587 ±	-4950 ±	718 ±	520 ±	550 (1)
P-5		NEW	13696 ±	-5568 ±	692 ±	555 ±	711 ⚠
P-6		NEW	13585 ±	-5759 ±	670 ±	555 ±	648 ⚠
P-7		NEW	13520 ±	-5871 ±	620 ±	555 ±	609 ⚠
P-8		NEW	14372 ±	-6013 ±	668 ±	555 ±	662 ⚠
P-9		NEW	14369 ±	-6183 ±	620 ±	555 ±	630 ⚠
B-2		EXISTING	16376 ±	-6138 ±	593 ±	547 ±	575 (1)
B-4		EXISTING	15084 ±	-6280 ±	630 ±	562 ±	575 (1)
B-9		EXISTING	14507 ±	-3556 ±	560 ±	458 ±	485 (1)
B-12	B-12	RESTORED	14377 ±	-5837 ±	700 ±	547 ±	700 ⚠
⚠ VW-1		NEW	14861±	-5632±	XX	XX	XX
⚠ VW-2		NEW	13797±	-5459±	XX	XX	XX

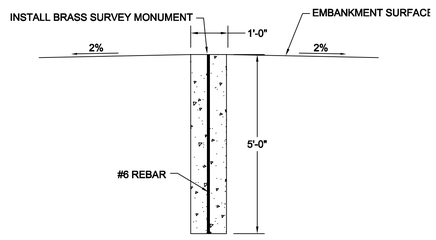
(1) FROM ALMES, 1991.

(2) SEE FIGURE 4 FOR PIEZOMETER PLAN.

(3) P-1 CAN BE REMOVED ONCE SITE 2b IS UP TO EL 730. MONITOR DURING CONSTRUCTION FOR CONSISTENCY OF PHREATIC SURFACE. NOTIFY IF LEVEL INCREASES FASTER THAN THE 2a POOL ELEVATION.

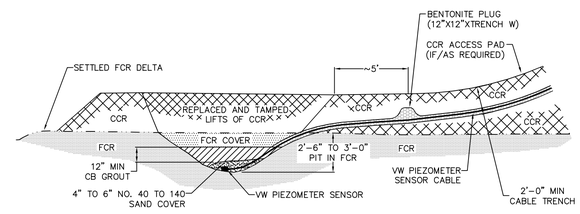
⚠ (4) VW-1 AND VW-2 ARE VIBRATING WIRE PIEZOMETERS.

⚠ (5) DESIGN ENGINEER SHOULD BE NOTIFIED IF THE WATER ELEVATIONS IN PIEZOMETERS REACH THE TRIGGER LEVELS (WATER LEVEL FOR NOTIFICATION).



4/14 SURVEY/SUBSIDENCE MONUMENT

N.T.S.



NOTES:
1. USE LOW-PRESSURE VW PIEZOMETERS (25 PSI FULL OUTPUT LIMIT) AS SUPPLIED BY SLOPE INDICATOR HTTP://WWW.SLOPEINDICATOR.COM/INSTRUMENTS/PIEZO-INTRO.HTML, OR EQUIVALENT. PROCURE AT LEAST TWO (2) VW PIEZOMETERS, AND THE NUMBER OF EXTRA/RESERVE VW PIEZOMETERS (IF ANY) DIRECTED BY OGR. ORDER THE VW PIEZOMETERS WITH SUFFICIENT, EXCESS CABLE LENGTH TO COMPENSATE FOR SETTLEMENT AND OTHER MOVEMENTS, AND FOR ROUTING THE CABLES TO THE LOCATIONS SELECTED BY OGR WITHOUT SPLICING. THE CABLE SHALL BE SHIELDED/INSULATED FROM EXTRANEOUS CURRENT AND RATED FOR DIRECT BURIAL.
2. AT THE READOUT LOCATIONS, TERMINATE THE CABLES IN WEATHER/WATER-PROOF HOUSINGS ABOVE GROUND, AND CLEARLY MARK EACH LOCATION AND PROTECT IT FROM EQUIPMENT TRAFFIC.
3. PROCURE A COMPATIBLE PORTABLE READOUT UNIT FOR OWNERSHIP AND USE BY OGR.
4. REVIEW THE ENTIRE SLOPE INDICATOR (I.E., MANUFACTURER/SUPPLIER) VW PIEZOMETER MANUAL FOR INSTRUMENT PREPARATION (INCLUDING PRE-INSTALLATION SENSOR SATURATION AND TESTING) AND HANDLING REQUIREMENTS, AS WELL AS RECOMMENDED INSTALLATION PRACTICES. THE "EMBANKMENT INSTALLATION" SECTION PROVIDES GUIDELINES MOST APPLICABLE TO THE INSTALLATION DETAIL THAT IS SHOWN, BUT THE UNIVERSAL RECOMMENDATIONS SHALL ALSO BE ADHERED TO. A BOREHOLE INSTALLATION PROCEDURE MAY BE USED IN LIEU OF THE DETAIL SHOWN. FOR A BOREHOLE INSTALLATION, INSTALL EACH VW PIEZOMETER SENSOR IN A PVC-CASED PILOT HOLE THROUGH ANY CCR ACCESS PAD AND 7-FEET TO 15-FEET INTO FCR.
5. SHORTLY BEFORE INSTALLATION, SATURATE THE PIEZOMETER FILTERS AS RECOMMENDED BY THE MANUFACTURER/SUPPLIER AND TEST THE PIEZOMETERS. KEEP THE SENSOR SUBMERGED IN WATER THEREAFTER, UNTIL INSTALLATION.
6. USE THE "GROUT MIX FOR SOFT SOILS" UNDER "BOREHOLE INSTALLATION (GROUT-IN METHOD)" PER THE SLOPE INDICATOR MANUAL.
7. LOOSELY BUNDLE THE CABLES, "SNAKE" THEM ALONG THE TRENCH, AND COVER THE CABLES WITH BENTONITE POWDER BEFORE BACKFILLING THE TRENCH. THE BEDDING AND IMMEDIATE (INITIAL 4 TO 6 INCHES) COVER OVER THE CABLES SHALL BE FREE OF ROCK FRAGMENTS, SHARP OBJECTS, GRAVEL-SIZE OR LARGER PARTICLES, AND OTHER MATERIALS THAT COULD DAMAGE THE CABLES OR THEIR INSULATION. USE FINE-GRAINED SOIL OR REFUSE BEDDING AND IMMEDIATE BACKFILL (IN ADDITION TO BENTONITE) TO PROTECT THE CABLES IF AND WHERE NECESSARY.
8. PLACE AND COMPACT A PROMINENT MOUND OF CCR OVER THE INSTALLATION PITS AND ALONG THE CABLE TRENCHES TO DIVERT SURFACE RUNOFF AWAY FROM THE INSTALLATIONS AND ALERT EQUIPMENT OPERATORS TO THEIR PRESENCE. FOR ENHANCED PROTECTION, IF DIRECTED BY OGR, FIRST PLACE A MARKER LAYER OF GEOTEXTILE (GEOTEX®) OR ORANGE PLASTIC CONSTRUCTION MESH OVER THE INSTALLATION PITS AND CABLE TRENCHES (BENEATH THE MOUNDED MATERIAL).
9. AFTER COMPLETING EACH VW PIEZOMETER INSTALLATION, TAKE AN INITIAL READING AND REPORT THE FINDINGS TO OGR. DAILY BASELINE READINGS SHOULD BE OBTAINED FOR AS LONG AS THE PIEZOMETER INSTALLATION OR OVERSIGHT PERSONNEL ARE AT THE SITE.

⚠ 5/14 VW PIEZOMETER TYPICAL DETAIL

N.T.S.

I hereby certify that this document was prepared by me or under my direct personal supervision and is correct to the best of my knowledge and belief and that I am a duly licensed Professional Engineer under the laws of the State of ALABAMA.

William O. Dickey Jr.
(Signature)
Date: July 11, 2013

ALABAMA LICENSED No. 31971 PROFESSIONAL ENGINEER WILLIAM O. DICKEY

State of West Virginia
County of Raleigh
Acknowledged before me, a Notary Public
This 11 day of July, 2013
My commission expires 10/17/2017

OFFICIAL SEAL
NOTARY PUBLIC
STATE OF WEST VIRGINIA
STEPHANIE D. HILL
357 OAK GROVE ROAD
BECKLEY, WV 25801
My commission expires October 17, 2017

REVISION	DATE	DESCRIPTION	P.M.
⚠	7/13	RESPONSE TO MSHA COMMENTS.	WOD

Prepared By:

Marshall Miller and Associates
Geology, Environmental Sciences & Engineering, Geophysics
☐ Bluefield, VA • ☐ Lexington, KY • ☐ Raleigh, NC
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☐ Kingsport, TN • ☐ Lenexa, KS • ☐ Bossier City, LA
☐ Cincinnati, OH • ■ Beckley, WV • ☐ Evansville, IN

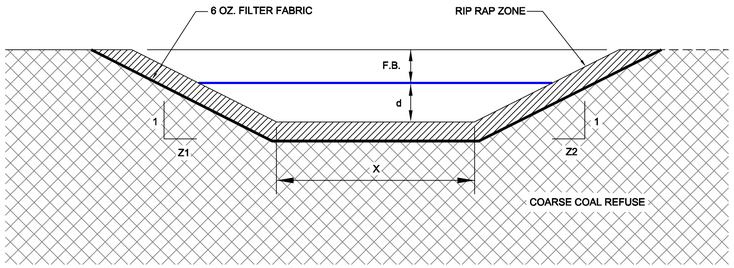
FIGURE 14
INSTRUMENTATION - DETAILS AND SCHEDULE

OAK GROVE RESOURCES, LLC REFUSE FACILITY

CONCORD QUADRANGLE
MSHA DISTRICT 11 – BIRMINGHAM, ALABAMA
JEFFERSON COUNTY, ALABAMA
Prepared For:
CLIFFS NATURAL RESOURCES
OAK GROVE MINE, JEFFERSON COUNTY, ALABAMA

CAD BY	MTC	2/12
CHECKED BY	JRR	2/12
APPROVED BY	WOD	2/12

Scale As Noted



SITE 2b		Z1	Z2		X			d		F.B.	
Structure Name	Slope (%)			Channel Lining	Bottom Width (ft.)	Design Flow (cfs)	Calculated Velocity (ft/sec)	Flow Depth (ft)	Design Depth (ft)	$FB=1+0.025(vd)^{1/2}$ (ft)	D50 dia. stone (inches)
HAUL ROAD NO. 1 DITCH											
Road Dtch - Minimum Slope Section	1	2	2	Rip Rap	0.00	23.68	4.23	1.67	**2.80**	1.13	18
Road Ditch - Maximum Slope Section	10	2	2	Rip Rap	0.00	23.68	7.10	1.29	**2.49**	1.20	18

The highlighted dimensions are recommended for construction.

NOTES: DITCH SUMMARY

1) ALL DITCH DIMENSIONS WERE BASED ON THE WORST CASE FLOW CALCULATION FOR EACH STRUCTURE.

2) D50 ROCK SIZING CALCULATIONS AND CHANNEL SIZING WERE PERFORMED USING THE SEDCAD 4.0 SOFTWARE CHANNEL DESIGN FUNCTION.

3) THE ROCK RIP SHALL HAVE A MINIMUM OF 75 - PERCENT OF THE MATERIAL GREATER THAN OR EQUAL TO 18 INCHES IN DIAMETER AND 25 - PERCENT OF MATERIAL OF SUFFICIENT SIZE TO FILL THE VOIDS.

4) THE RIP RAP ZONE SHALL BE 2 FT. THICK.

⚠ 1/15 TYPICAL HAUL ROAD DITCH DETAIL

N.T.S.

⚠ REMOVED DETAIL 2

I hereby certify that this document was prepared by me or under my direct personal supervision and is correct to the best of my knowledge and belief and that I am a duly licensed Professional Engineer under the laws of the State of ALABAMA.

William O. Dickey
(Signature)

Date: 1/20/14

ALABAMA LICENSED No. 31771 PROFESSIONAL ENGINEER WILLIAM O. DICKEY

State of West Virginia
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NOTARY PUBLIC STATE OF WEST VIRGINIA STEPHANIE D. HILL 357 OAK GROVE ROAD BECKLEY, WV 25801 My commission expires October 17, 2017

REVISION	DATE	DESCRIPTION	P.M.
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Prepared By:

Marshall Miller and Associates

Geology, Environmental Sciences & Engineering, Geophysics

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☐ Kingsport, TN · ☐ Lenexa, KS · ☐ Bossier City, LA
☐ Cincinnati, OH · ■ Beckley, WV · ☐ Evansville, IN

FIGURE 15
TYPICAL DITCH - SECTIONS AND DETAILS

OAK GROVE RESOURCES, LLC REFUSE FACILITY

CONCORD QUADRANGLE
MSHA DISTRICT 11 – BIRMINGHAM, ALABAMA
JEFFERSON COUNTY, ALABAMA

Prepared For:

CLIFFS NATURAL RESOURCES
OAK GROVE MINE, JEFFERSON COUNTY, ALABAMA

CAD BY	MTC	2/12
CHECKED BY	JRR	2/12
APPROVED BY	WOD	2/12

Scale as Noted

APPENDIX B - GUIDELINE TECHNICAL SPECIFICATIONS

PROPOSED COAL REFUSE DISPOSAL PLAN

COAL REFUSE DISPOSAL AREAS
CONCORD PREPARATION PLANT
CLIFFS NATURAL RESOURCES – OAK GROVE MINE
JEFFERSON COUNTY, ALABAMA

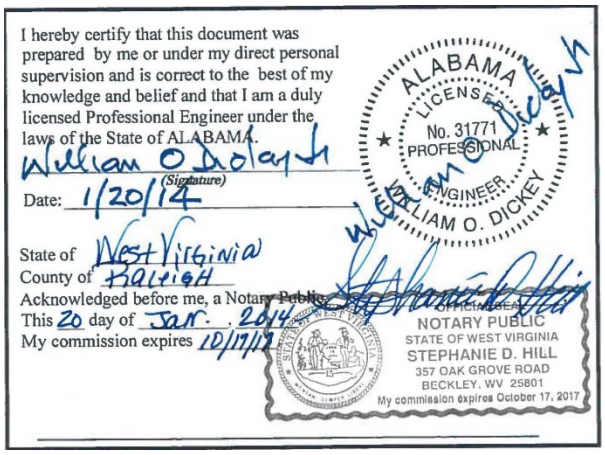
POOL RAISING OF IMPOUNDMENT #3 (SITE 2a) FOR FCR DISPOSAL

FACILITY ID No. 01-00329
MSHA ID 1211-AL11-00043-02 (Site 2c - CCR Disposal)
MSHA ID 1211-AL11-00093-01 (Impoundment #3, Site 2a)
MSHA ID 1211-AL11-00093-02 (Impoundment #4, Site 2b)

February 22, 2012

Revsion 1, July 15, 2013
(Per MSHA Comments Dated: April 19, 2013)

Revsion 2, January 20, 2014
(Per ASMC Comments; January, 2014)
(REVISIONS APPEAR IN THIS FONT)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William O Dickey
(Signature)
Date: 1/20/14
State of West Virginia
County of Raleigh
Acknowledged before me, a Notary Public
This 20 day of Jan. 2014
My commission expires 10/17/17
ALABAMA LICENSED No. 31771 PROFESSIONAL ENGINEER WILLIAM O. DICKEY
NOTARY PUBLIC
STATE OF WEST VIRGINIA
STEPHANIE D. HILL
357 OAK GROVE ROAD
BECKLEY, WV 25801
My commission expires October 17, 2017

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1.0 INTRODUCTION

Miller & Associates Marshall Miller and Associates (MMA) has prepared a proposed plan (Plan) for modifications to Slurry Impoundment #3 (Site 2a) for ***Fine*** Coal Refuse disposal at the Oak Grove Resources LLC (OGR) Concord Preparation Plant in Jefferson County, Alabama. These Guideline Technical Specifications (GTS) are part of that Plan. Unless modified herein, all conditions and requirements of the existing permits, Almes, 1991 and PERC, 2007 are still valid. Two specific modifications are provided as needed for placing CCR in an upstream configuration over FCR and for excavation to competent material and special placement of back fill at the proposed toe of the Site 3a buttress toe.

The Engineering Report, of which this GTS is Appendix A, provides other important information on the Facility and the Plan. MMA is responsible for the design of the proposed Plan and OGR is responsible for placing CCR and FCR and for construction of the Facility to the requirements of the Plan including these Guideline Technical Specifications. Additionally, OGR shall retain the services of a Certifying Engineer to prepare Construction Monitoring Reports, (with test results and photographs) per applicable regulations. The Certifying Engineer is to be a qualified Registered Professional Engineer or a specialist chosen to represent the Engineer that is knowledgeable of these design documents and operational requirements and is responsible for certifying the disposal of coal refuse in the proposed Facility expansion.

The frequency of site visits in the regulations is a minimum and additional regular site visits may be required at the discretion of the Certifying Engineer. The Plan with these GTS is intended to be of sufficient detail for OGR to complete the work required to construct the proposed Facility expansion. However, if this work were to be sub-contracted by OGR, additional contract documents would be required.

2.0 SITE PREPARATION – *NOT REQUIRED FOR REVISION 2*

3.0 COARSE COAL REFUSE DISPOSAL

3.1 GENERAL

The CCR disposal at Site 2a of this Facility should under this Plan adhere to the following. The "100 Percent Compaction Zone" requirements herein are applicable to the Site 2a dam/embankment ***UPSTREAM*** construction under this Plan, excluding the initial upstream fill construction (initial "push out") to the extent required to develop a starting upstream working surface of CCR. ***THE SMALL AMOUNT OF NEW DOWNSTREAM CCR PLACEMENT SHALL FOLLOW THE COMPACTION REQUIREMENTS OF SECTION 3.2.4.2, NON-STRUCTURAL ZONE.*** Other locations for CCR placement in this Plan are already approved under Almes, 1991 and/or PERC 2007.

3.1.1 CRITICAL CONSTRUCTION ITEMS

Per the MSHA COAL MINE IMPOUNDMENT INSPECTION AND PLAN REVIEW HANDBOOK (Handbook Number PH07-V-1 (1)). The following activities are considered to be "Critical construction" for this project and the mine operator should notify MSHA in advance of their start:

1. Construction of drains, filters, and placement of geo-fabrics and geo-grids.
2. Initial push-out of an embankment using upstream construction.

3.2 COARSE COAL REFUSE PLACEMENT AND CONSTRUCTION (NON-UPSTREAM CONSTRUCTION)

3.2.1 LINES AND GRADES

Refuse shall be placed to the lines and grades shown on the drawings. Control for placement can be established from the control points and coordinate system provided on the drawings.

3.2.2 MATERIAL

Run-of-plant coarse coal refuse produced at the coal preparation plant shall be used for construction of the Site 2a dam/embankment.

3.2.3 PLACEMENT

Coarse coal refuse shall be spread in nearly horizontal lifts using a bulldozer or other earth-moving equipment. The maximum lift thickness shall not exceed 12 inches in the 100 percent compaction zone and structural zone of the impounding embankment and not more than 2 feet in the non-structural zone. The 100 percent compaction shall be followed for Site 2a dam/ embankment upstream construction ***ABOVE THE INITIAL PUSHOUT WORKING SURFACE.*** All lifts shall be placed parallel to the longitudinal axis of the embankment in continuous nearly horizontal lifts with each lift extending to its full length and width prior to the placement of subsequent lifts. The refuse shall be placed in the central portion of the embankment, away from the slopes during wet weather or when drainage is insufficient and near the inside or outside slopes during drier periods.

3.2.4 COMPACTION

3.2.4.1 100 PERCENT COMPACTION ZONE

The coarse coal refuse material within the 100 percent compaction zone of the impounding embankments shall be compacted to a density greater than or equal to 100 percent of the maximum dry density, within -2 to +3 percent of the optimum water content, as determined by the Standard Proctor compaction test (ASTM D698).

A field density testing program shall be established during disposal operations to determine the actual dry density being achieved in the 100 percent compaction zone and structural zone. The number of passes by the compaction equipment shall be based on the densities obtained in relation to the minimum required density. If the density achieved is not consistent with these plans and specifications, modifications to the compaction procedure or to the disposal plan may be required. Field density tests shall

be perfonned on each lift of coarse coal refuse placed and compacted in the structural zone of the impounding embankment. A field density test shall be perfonned for every 2.000 cubic yards placed. As a minimum, density testing shall be performed on each lift placed. Additional field density tests should be conducted any time there is a suspicion of the effectiveness of compaction. A supplementary Standard Proctor laboratory compaction test (ASTM D698) shall be performed for every 20 field density tests (approximately every 40,000 cubic yards).

Field tests shall be perfonned at random locations in the fill. Records of the test results, as well as the test locations, shall be kept at the mine.

Any time there is reason to suspect that the characteristics of the construction material have changed, reasons such as a change in preparation plant processing or unusual compaction test results, the material shall be further investigated. Grain-size compaction, shear-strength, and other tests shall be performed as warranted.

3.2.4.2 NON-STRUCTURAL ZONE

The coarse coal refuse material placed in the non-structural zone shall be compacted to a density greater than or equal to 90 percent maximum dry density, as determined by the Standard Proctor compaction test (ASTM D698).

A field density testing program shall be established during disposal operations to determine the actual dry density being achieved. The number of passes by the compaction equipment shall be based on the densities obtained in relation to the minimum required density. If the density achieved is not consistent with these plans and specifications, modifications to the compaction procedure or to the disposal plan may be required. Field density tests shall be performed on each lift of coarse coal refuse placed and compacted in the structural zone of the impounding embankment. A density test shall be performed for every 10,000 cubic yards placed. As a minimum, density testing shall be performed on each lift placed.

3.2.5 COMPACTION REQUIREMENTS

The coal refuse shall advance upward in nearly horizontal layers throughout the entire disposal area. To minimize infiltration of precipitation the coal refuse surface shall be sloped, backbladed and compacted as it is spread.Surface material too wet to support consouction equipment must be removed to expose drier material prior to placement of the next coal refuse layer. After drying, these wet materials can be reused in the embankment. As the level of the embankment is raised, it shall be graded smoothly to the contours shown on the plans.

3.3 CCR PLACEMENT OVER SETTLED FINE COAL REFUSE (UPSTREAM CONSTRUCTION)

Placement of coarse coal refuse and/or breaker rock over settled fine coal refuse (FCR) (commonly referred to as push-out or upstream construction) for development of upstream portions of embankments and/or for backfilling/capping the impoundment shall adhere to the special requirements provided herein. Please note that upstream dam construction is only proposed along the western perimeter of Site 2a, Impoundment #3.

3.3.1 UPSTREAM CONSTRUCTION SAFETY CONSIDERATIONS

3.3.1.1 TRAINING:

1. Safety meetings shall be conducted and procedures discussed on a weekly basis.
2. Equipment operators shall be made aware of the proper procedures for advancing the push-out.
3. Equipment operators working on or near the impoundment area shall be given additional hazard training. These safety precautions with regards to upstream construction shall be reviewed, along with material handling safety policies, and designated storage areas for safety equipment.

4. Task-specific training shall be provided to personnel performing and monitoring upstream construction. Instructions shall be provided to operators regarding operations involved in developing access to push-out areas, along with specific construction methods required to perform upstream construction.
5. Information concerning risks associated with upstream construction and features that are indicative of unstable working surfaces shall be provided to operators and other mine personnel who will be in the vicinity of the upstream construction.
6. Training records shall be maintained at the mine office.
7. ***Training to be provided by an MSHA certified impoundment inspector.***

3.3.1.2 Equipment:

1. Only low ground pressure (LGP) track dozers shall be utilized.
2. Dozers shall not contain a "submarine kit," thick break resistant windows, or brush guards over the windows.
3. Dozers shall be equipped with life jackets during construction of the push-out.
4. For safety purposes, a minimum of two dozers shall be used during the construction of a push-out. The dozer operators shall sequence their push patterns, such that only one operator is near the upstream edge of the push-out during fill placement. The dozer operators shall be in visual sight of each other at all times.
5. Two-way radios or similar devices shall be used by equipment operators during construction, so that if potential hazards are observed they can be quickly communicated to other operators.
6. A work skiff with oars and life jackets shall be maintained near the push-out area.
7. A flotation ring attached to a rope, a throw bag or other similar device shall be maintained near the push-out area.
8. ***OGR will be responsible for assuring that the listed equipment is used for the upstream construction.***

3.3.1.3 GENERAL PRECAUTIONS:

1. Alternate between upstream and downstream construction when possible to allow excess pore pressures to dissipate. The rate of placement for advancing push-out material is critical;
   - Rapid placement of push-out material during construction of the upstream push-out results in excess pore pressures.
   - Excessive pore pressure reduces the residual strength between the particles of the push-out material.
   - Loss of strength decreases stability and can result in instability.
2. Pump the water level down as much as possible, for as long as possible, to expose the slurry delta, prior to initiating push-outs.
3. Monitor pore pressures using the planned vibrating wire piezometers. Read and record the VW piezometers before and at the end of each shift when upstream construction might be performed.
4. The coarse refuse placement procedures shall proceed in a systematic manner.
5. Only conduct upstream construction during daylight hours, unless ample artificial lighting is provided and a written plan to conduct upstream construction under artificial lighting is specifically approved by MSHA.
6. Grade controls shall be maintained at all times.
7. Do not conduct upstream construction during ***SIGNIFICANT*** precipitation events or within ***8 TO*** 16 hours thereafter ***OR AS WEATHER PERMITS TO ACHIEVE THE REQUIRED COMPACTION.***
8. Equipment operators shall always exercise caution during upstream construction, especially when a new push-out is started. They should be cognizant that the initial pad of a push-out will likely contain soft areas, and that differential settlement or other movements could cause the subgrade to become unstable. Accordingly, equipment operators shall continually examine the work area for unsafe conditions.

9. Oversight by knowledgeable personnel – preferably a person who is familiar with mechanics of upstream construction and can recognize and immediately correct unsafe work practices and conditions.
10. Use equipment operators who are experienced in this type of work. Required initial push-out lift thickness is not intuitive. Inexperienced equipment operators, especially contractors who are used to working in other settings, sometimes think thicker lifts are better, and may not understand that excessively thick lifts can result in cracking and rapid sinking of the push-out into the impoundment.
11. Equipment operators shall continually check for cracks in the push-out area. If a crack is detected, the operator shall not proceed past the crack for any reason. Cracking of the push-out material is a sign of movement and potential instability. Push-out areas shall be allowed time to settle before additional coarse coal refuse is gradually worked out over the cracked area.
12. Dozer tracks shall be offset when returning back to stockpile.
13. Preferably the operator should overbuild the upstream zone by extending the upstream pushout further upstream than the minimum limits shown on the figures (and allow the upstream slope to conform to its angle of repose) such that the design cross section shown on the figures is encompassed within the overbuild cross section.
14. Equipment shall operate perpendicular to the impoundment periphery and the push-out activities shall be sequenced so that haul trucks will not travel within 50-feet of the advancing upstream crest of the push-out working surface. In general, the upstream construction shall be advanced out over the settled FCR in approximately 25-foot increments over long segments of the impoundment periphery to avoid isolated “fingers” or peninsulas of CCR jutting out into the impoundment.
15. Before the resumption of upstream construction each day, a MSHA-qualified impoundment inspector shall visibly inspect the area of the upstream construction. The inspection shall focus on identifying the following suspect conditions:
    - Open cracks in the vicinity of the push-out area;

- Vertical offset between areas of the push-out working surface;
- Substantial bulging or displacement of FCR near the push-out area;
- Sloughing, more significant slippage, and/or sinking of push-out fill (e.g., coarse coal refuse, breaker reject) into the impoundment;
- Ponded water or bolis;
- Widespread pumping under equipment traffic;
- During the preceding shift, there was a substantial increase in the piezometric level at either VW piezometer from the beginning to the end of the shift.
- The measured piezometric level in either VW piezometer at the beginning of a shift has not decreased substantially ("substantially" relative to the increase in piezometric level observed during the preceding shift) compared to the preceding end-of-shift reading.
- The VW piezometers shall be monitored until the western embankment is raised to the level of the existing crest, and sufficient readingshave been accumulated to show that the piezometric levels are falling and nearing (or below) the prevailing impoundment pool level.
- Unstable or wet areas on the push-out surface; and
- Multiple, coinciding features among those described above

  If any of the above-listed conditions are observed, immediately relocate equipment and personnel to a stable area, until the suspect conditions can be more thoroughly reviewed by personnel experienced in upstream construction and the potential problem area(s) are corrected or allowed sufficient time to stabilize. The results of these required inspections shall be recorded in mine records at the mine office.

3.3.1.4 Initial Push-Out Precautions:

1. The thickness of the initial lift of coarse coal refuse placed over settled fine refuse should be at least 5 feet, or somewhat greater (possibly up to 8 feet) if required to

provide a stable working platform for the equipment. Generally, the top of the established uptream fill surface should be maintained at least ***3 TO*** 5 feet above the pool level.

2. Material for the initial lift shall be dumped 25 feet from the edge of the impoundment or settled fines and then shall be pushed out over the fine refuse using low ground contact pressure equipment.
3. If practical, an outslope of 2H:1V or flatter should be maintained as the lift is pushed out over the fine refuse; however, equipment should generally not be operated on the upstream outslope merely to establish a flatter grade and not until a stable working platform is developed.
4. Use a spotter to watch for settlement cracks and slumps.
5. Equipment shall not travel or dump near the edge of an upstream push-out because the refuse may give way. Trucks shall dump a safe distance back from the edge and the material shall be pushed toward the pool by a dozer. Develop an exclusion zone for trucks, scrapers, and compactors until a firm base is established.
   - Maintain an exclusion zone, wherein only low ground pressure shall be permitted to operate, 50 to 100 feet back from leading edge of the push-out.
   - Clearly mark the exclusion zone with cones, stakes, or barrels.
6. The dozer shall not push a full blade of material completely out over fine refuse or into the impoundment area; the blade should be “double loaded.” A berm of coarse refuse material, approximately 3 to 6 feet high, measured on the same plane that the dozer is pushing, shall be left in place on the front edge of the lift leading into the impoundment area to insure that the dozer has sufficient refuse beneath it for support. Subsequent dozer pushes into the impoundment area shall advance the existing berm into the impoundment, leaving a berm in its place, lessening the chance of the operator getting the dozer too close to the impoundment pool.
7. Spread construction out across full length or width of the push-out. Do not concentrate placement in one area.

8. All push-outs shall begin from solid ground or embankment surface outside the boundary of impounded material.

4.0 NOTIFICATION

The design engineer should be notified if the water level for notification is reached, shown in the table below for each piezometer.

Piezometer NO.	Water Level For Notification (ft. el.)
P-1 (3)	*(3)*
P-2	675 (1)
P-3	550 (1)
P-4	550 (1)
P-5	711
P-6	648
P-7	609
P-8	662
P-9	630
B-2	575 (1)
B-4	575 (1)
B-9	485 (1)
B-12	700

(1) From Almes 1991.
(2) See Figure 4 For Piezometer Plan.
(3) P-1 can be removed once Site 2b is up to El. 730. Monitor During construction for consistncy of Phreatic Surface. Notify if level increases faster than the 2a pool elevation.

5.0 OPERATION AND INSTRUMENTATION

5.1 PUMPS

Pumping shall be considered if areas of pending upstream construction are submerged, and the water quality, clarified depth of water, and pool volume are conducive for pumping.

5.2 VIBRATING WIRE PIEZOMETERS

Two vibrating wire piezometers will be provided as described below and shown in Fig. 14 & 4.

1. Use low-pressure VW piezometers (25 psi full output limit) as supplied by Slope Indicator http://www.slopeindicator.com/instruments/piezo-intro.html, or equivalent. Procure at least two (2) VW piezometers, and the number of extra/reserve VW piezometers (if any) directed by OGR. Order the VW

piezometers with sufficient, excess cable length to compensate for settlement and other movements, and for routing the cables to the locations selected by OGR without splicing. The cable shall be shielded/insulated from extraneous current and rated for direct burial.

2. At the readout locations, terminate the cables in weather/water-proof housings above ground, and clearly mark each location and protect it from equipment traffic.
3. Readings will be accomplished by OGR using a compatible portable readout unit.
4. Review the entire Slope Indicator (i.e., Manufacturer/Supplier) VW Piezometer Manual (http://www.slopeindicator.com/pdf/manuals/vw-piezometer-manual.pdf) (considered part of these specs.) for instrument preparation (including pre-installation sensor saturation and testing) and handling requirements, as well as recommended installation practices. The "Embankment Installation" section provides guidelines most applicable to the installation detail that is shown, but the universal recommendations shall also be adhered to.

5. Shortly before installation, saturate the piezometer filters as recommended by the Manufacturer/Supplier and test the piezometers. Keep the sensor submerged in water thereafter, until installation.
6. Use the "Grout Mix for Soft Soils" under "Borehole Installation (Grout-in Method)" per the Slope Indicator Manual.
7. Loosely bundle the cables, "snake" them along the trench, and cover the cables with bentonite powder before backfilling the trench. The bedding and immediate (initial 4 to 6 inches) cover over the cables shall be free of rock fragments, sharp objects, gravel-size or larger particles, and other materials that could damage the cables or their insulation. Use fine-grained soil or refuse bedding and immediate backfill (in addition to bentonite) to protect the cables if and where necessary.

8. Place and compact a prominent mound of CCR over the installation pits and along the cable trenches to divert surface runoff away from the installations and alert

equipment operators to their presence. For enhanced protection, if directed by OGR, first place a marker layer of geotextile (Geotex®) or orange plastic construction mesh over the installation pits and cable trenches (beneath the mounded material).

9. After completing each VW piezometer installation, take an initial reading and report the findings to OGR. Daily baseline readings should be obtained for as long as the piezometer installation or oversight personnel are at the site

6.0 GEOTEXTILE

A geotextile will be applied in the construction of an internal drain as shown in Fig.8.

a. Non-woven Geotextile - The non-woven geotextile shall be ProPex 4553 manufactured by Amoco Fabrics and Fibers Company, 180N manufactured by Mirafi Construction Products, or an Engineer approved equivalent that meets the Minimum Average Roll Values for geotextile products presented below in the table. Geotextile fabrics shall be furnished in an un-torn, un-stretched condition, free of defects that alter the drainage and filtering capability of the geotextile. The geotextile shall be stored in the manufacturer protective covering until ready to install.

Minimum Average Roll Values (MARV)
For Non-woven Geotextile Fabrics

Properties	**Test Method**	**Unit**	**Minimum Average Roll Values**
			8 oz./ sy
Mass Per Unit Area	ASTM D3776	$oz./yd^2$	7.8
Grab Tensile Strength	ASTM D4632	lbs	205
Grab Elongation	ASTM D4632	%	50
Puncture Resistance	ASTM D4833	lbs	110
Trapezoidal Tear Strength	ASTM D4533	lbs	80
Permittivity	ASTM D4491	sec^{-1}	1.05
Apparent Opening Size	ASTM D4751	sieve size	70-100
UV Resistance (at 500 Hours)	ASTM D4355	% Strength Retained	70

b. Installation - A detail of the internal drain is shown on Figure 8. The AASHTO No. 8 drain is wrapped entirely in filter cloth with a minimum two (2) foot overlap and totally enclosed in a 1' minimum thickness ASTM C33 non-calcareous sand. A two (2) foot overlap shall be provided between sections of geotextile.

Upon installation, the underdrain geotextile shall be immediately covered with at least one foot of free draining ASTM C33 non-calcareous sand to prevent UV degradation. The underdrain shall be placed with a near uniform slope, without any depressions or flat areas where fines and water would settle or collect.

APPENDIX C

Calculation Brief

I hereby certify that this document was prepared by me or under my direct personal supervision and is correct to the best of my knowledge and belief and that I am a duly licensed Professional Engineer under the laws of the State of ALABAMA.

William O Dickey Jr.
(Signature)

Date: 2/24/15

State of West Virginia
County of Raleigh
Acknowledged before me, a Notary Public,
This 24 day of February 2015
My commission expires 10/17/2017

ALABAMA LICENSED No. 31771 PROFESSIONAL ENGINEER WILLIAM O. DICKEY

OFFICIAL SEAL
NOTARY PUBLIC
STATE OF WEST VIRGINIA
STEPHANIE D. HILL
357 OAK GROVE ROAD
BECKLEY, WV 25801
My commission expires October 17, 2017

OBJECTIVE:

Evaluate the slope stability of the existing area and proposed expansion of Site 2a, Impoundment #3(Figure 10) of the OGR Concord Preparation Plant in Jefferson County, Alabama. Compare the global slope stability minimum Factors of Safety (FoS) with the FoS values required by ***ASMC***:

CASE/CONDITION	REQUIRED FoS
Static/Steady-State Seepage	1.5
End-of-Construction with No Pool	1.3
Rapid Drawdown	1.3
Seismic (or ***PSEUDO STATIC***)	1.2

METHODOLOGY:

The slope stability computer software program, SLIDE 6.0 (Reference 1) was used to evaluate the Site 2a, Impoundment #3 embankment/dam at cross-sections K-K (Figure 7) and J-J (Calc Brief Figures E-1.1 and E-1.3). Section K-K is representative of the western embankment perimeter where some limited upstream construction is planned out into the slurry impoundment. (NOTE: Section K-K is geometrically similar to or more critical than Section L-L.) Section J-J lies on a portion of Impoundment #3 with proposed downstream construction.

As is customary, sliver and sloughing-type failure surfaces were excluded from the analyses, as such failures are inconsequential and not representative of the global stability of the embankment. The slope stability analyses adopt a conservative phreatic surface, which is elevated and more extensive than the phreatic surface predicted from the seepage analyses presented in Section E-2 of the Calc Brief (Figures E-2.1 ~ E-2.3). The phreatic surface used was based on maximum normal pool level of EL. 721, recognizing that higher pool levels (i.e., storm surcharge pool levels) sustained for relatively short durations have a negligible effect on the phreatic surface through the main body of the dam.

Upstream slopes were evaluated where upstream construction is proposed (Section K-K), which presents the most critical configuration for upstream stability under static and ***PSEUDO-STATIC*** conditions. ***PSEUDO-STATIC***, upstream slope stability analyses were performed based on ***THE*** steady-state undrained shear strength of the FCR (refer to Sections B and C of Calc Brief) ***AND AN ACCELERATION OF 0.1G. A TOTAL OF 5 CASES WERE INVESTIGATED AND 4 CASES ANALYZED (RAPID DRAW-DOWN WAS FOUND TO BE N/A) ON THE UPSTREAM SLOPE OF SECTION K-K.***

THESE ANALYSES WERE PERFORMED ON THE UPSTREAM SLOPE OF CROSS-SECTION KK USING CURRENT GEOMETRY. THE UNIT WEIGHT OF THE PUSHOUT CCR IS CONFIRMED BY

RECENT TEST DATA BY MEC. THE SLIDE ANALYSES (CASES 1,2,4,AND 5) ARE NOTED AS FIGURES E-3.5.A, E-3.5.B, E-3.6.A, AND E-3.6.B. CASES 1-5 ARE SUMMARIZED AS FOLLOWS WITH RAPID DRAW-DOWN BEING PRECLUDED FROM ANALYSIS:

1) ***END-OF-CONSTRUCTION ANALYSIS OF THE ANTICIPATED FINAL WEST EMBANKMENT (UPSTREAM ANALYSIS) WITH LOW POOL AND SETTLED FCR LEVELS. THIS CASE WILL USE, CREST EL 730; POOL EL 687; SETTLED FCR EL 685. FIGURE E-3.5.A***

2) ***STATIC/STEADY-STATE ANALYSIS OF THE ANTICIPATED FINAL WEST EMBANKMENT CONFIGURATION (UPSTREAM ANALYSIS) THAT WILL DEMONSTRATE CONFORMANCE WITH THEIR STATIC STABILITY FACTOR OF SAFETY OF 1.5 MINIMUM. THIS CASE WILL USE POOL EL 721 AND AVERAGE SETTLED FCR EL 718. FIGURE E-3.5.B***

3) ***RAPID DRAW-DOWN-A RAPID DRAWDOWN SCENARIO WAS DETERMINED NOT APPLICABLE AND WAS NOT EVALUATED. AS STATED IN THE REPORT: RAPID DRAWDOWN IS PRECLUDED BY MAINTAINING THE POOL LEVEL IN CLOSE PROXIMITY TO THE SETTLED FCR LEVEL, AND BY THE LIMITED CAPACITY OF THE OPERATOR'S PUMPING SYSTEM TO ARTIFICIALLY CREATE A RAPID DRAWDOWN SITUATION. ADDITIONALLY, THE FACILITY DOES NOT INCLUDE OUTLET WORKS THAT COULD PROMOTE RAPID UNWATERING AND CCR IS NOT TYPICALLY PRONE TO RAPID DRAWDOWN FAILURE BECAUSE OF ITS DRAINAGE CHARACTERISTICS.***

4) ***PSEUDO-STATIC ANALYSIS (EARTHQUAKE HORIZONTAL ACCELERATION, A = 0.1G) OF THE ANTICIPATED FINAL WEST EMBANKMENT CONFIGURATION (CREST EL 730) TO DEMONSTRATE CONFORMANCE WITH THE ASMC'S SEISMIC STABILITY FACTOR OF SAFETY OF 1.2 MINIMUM. THIS CASE WILL USE POOL EL 721 AND AVERAGE SETTLED FCR EL 718. FIGURE E-3.6.A***

5) ***"INTERIM" STATIC/STEADY-STATE ANALYSIS OF THE WEST EMBANKMENT <u>WORKING SURFACE</u> AT AN INTERMEDIATE LEVEL (WORKING SURFACE EL 705). THIS CASE WILL USE, WORKING SURFACE EL 705; POOL EL 687; SETTLED FCR EL 685. FIGURE E-3.6.B***

Global failure surfaces were searched for the three sections. In addition, more constrained search limits were employed to target a lower slope portion where the phreatic surface is assumed proximal to the embankment surface (i.e., toe seepage scenario). In general, two types of failures were analyzed, circular and block.

The overall slope stability of the proposed coal refuse slopes depends on the material unit weight and shear strength properties , as well as the properties of the underlying foundation soils and, where upstream construction is anticipated, FCR. Design values were adopted from the results of geotechnical (Section B) and seismic (Section C) data analyses. **Table 1** presents the unit weights and shear strength properties used in the slope stability analyses.

Trigger levels were determined for cross-Sections K-K and L-L as follows; the simplified phreatic surface for the maximum normal pool condition was modified, bringing it closer to the outslope until the factor of safety approached 1.5. The "Water Level For Notification" column in the table in Figure 14 contains these elevations.

Table 1

Material Properties				
Material Name	**Unit Weight (lbs/ft^3)**	**Cohesion (psf)**	**Friction angle (deg)**	***PSUEDO STATIC* Friction angle (deg)**
Bedrock	165	2000	40	40
Native Foundation Soil/ Layer	125	0	31	31
FCR	85	0	29	**25**
CCR (Existing)	120	0	36	36
100% STRUCTURAL CCR	***120***	***0***	***36***	***36***
Mix	105	0	33	***29***
PUSHOUT CCR	***120***	***0***	***33***	***33***

REFERENCES:

1.SLIDE 6.0, ROCSCIENCE INC., Toronto, Ontario, Canada, 1998-2012

CALCULATION:

SLIDE conducted a vertical slice limit equilibrium analyses utilizing the Spencer method. A thorough search of the minimum FoS was executed for circular and block surfaces.

For a circular surface an extensive search grid generated circular slip centers and evaluated numerous circular surfaces between the minimum and maximum radii. If a global minimum was located on the perimeter of a search grid, the grid was shifted ensuring the search encompassed the surface with the lowest FoS.

For a block search a multitude of ‘block’ and optimized ‘line’ searches were conducted until the lowest FoS was determined. Then using the ‘Monte Carlo’ technique within SLIDE, the minimum was optimized to obtain a refined, lower minimum FoS for each analysis case.

RESULTS:

Graphical SLIDE results displaying global minimum FoS (Figures E-3.0.a~E-3.10) follow the input data summary for each analysis case. **Table 2** summarizes the slope stability cases analyzed and their corresponding minimum FoS. The embankment/dam stability was determined to be acceptable in all cases.

Table 2 – Site 2a Slurry Impoundment Embankment/Dam

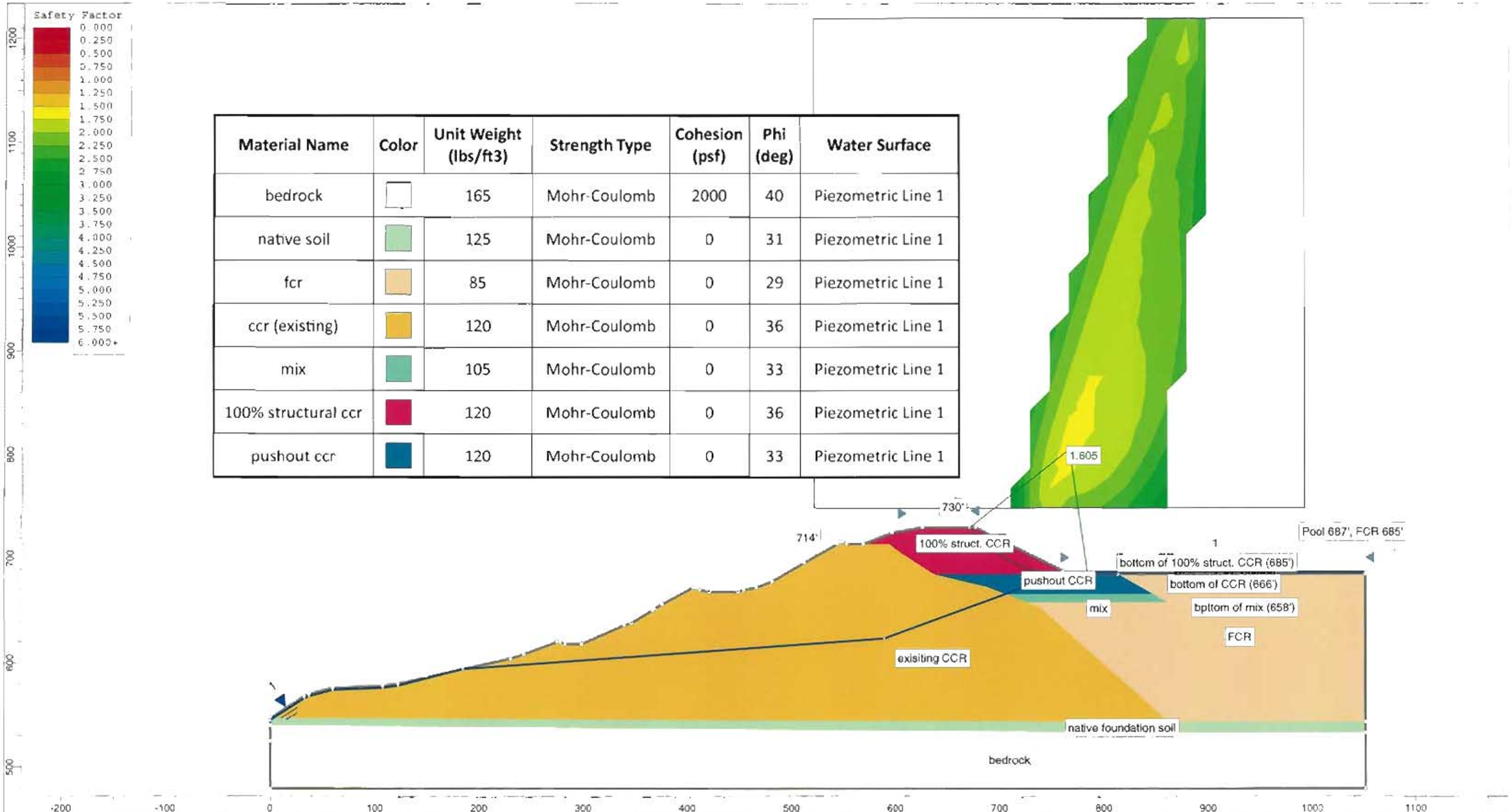
Figure	Cross-Section	Slope Side	Slope Region	Failure type	Condition	*ACTUAL* FoS
E-3.0.a	2aKK	Downstream	Entire	Circular	Static	1.52
E-3.0.b	2aKK	Downstream	Entire	Block	Static	1.56
E-3.0.c	2aLL	Downstream	Entire	Circular	Static	1.54
E-3.0.d	2aLL	Downstream	Entire	Block	Static	1.52
E-3.1	2aKK	Downstream	Entire	Circular	Static	1.92
E-3.2	2aKK	Downstream	Entire	Block	Static	1.82
E-3.3	2aKK	Downstream	Lower	Circular	Static	1.85
E-3.4	2aKK	Downstream	Lower	Block	Static	1.70
E-3.5.A	***2aKK***	***UPSTREAM***	***ENTIRE***	***CIRCULAR***	***STATIC***	*1.6*
E-3.5.B	***2aKK***	***UPSTREAM***	***ENTIRE***	***CIRCULAR***	***STATIC***	*1.7*
E-3.6.A	***2aKK***	***UPSTREAM***	***ENTIRE***	***CIRCULAR***	***PSEUDO-STATIC***	*1.2*
E-3.6.B	***2aKK***	***UPSTREAM***	***ENTIRE***	***CIRCULAR***	***STATIC***	*1.8*
E-3.7	2aJJ	Downstream	Entire	Circular	Static	2.36
E-3.8	2aJJ	Downstream	Entire	Block	Static	2.11
E-3.9	2aJJ	Downstream	Lower	Circular	Static	1.54
E-3.10	2aJJ	Downstream	Lower	Block	Static	1.52

NOTE: ANALYSES WHICH ARE SCREENED IN THE TABLE ARE UNCHANGED AND CAN BE FOUND IN REVISION 1.

Conclusions:

The global minimum FoS from the analyses met the minimum requirements for slope stability. These results combined with additional safeguards including: an internal drain located in the western dam section, a conservative operational procedure for the impoundment, and a thorough monitoring program, as presented in this Plan and summarized in the Engineering Report, develop an adequate dam and impoundment design for Site 2a, Impoundment #3.

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
bedrock		165	Mohr-Coulomb	2000	40	Piezometric Line 1
native soil		125	Mohr-Coulomb	0	31	Piezometric Line 1
fcr		85	Mohr-Coulomb	0	29	Piezometric Line 1
ccr (existing)		120	Mohr-Coulomb	0	36	Piezometric Line 1
mix		105	Mohr-Coulomb	0	33	Piezometric Line 1
100% structural ccr		120	Mohr-Coulomb	0	36	Piezometric Line 1
pushout ccr		120	Mohr-Coulomb	0	33	Piezometric Line 1



Prepared By:

MARSHALL MILLER & ASSOCIATES

SLIDEINTERPRET 6.024

Project	OGR Concord SI Final West Embk Section K-K
Analysis Description	Fig. E-3.5.A_Case 1 U/S Static End-of-Construction, Final Config w/ Fines at 685
Drawn By	Ben
Scale	1:1050
Company	MM&A
Date	1/10/2014
File Name	Case 1-KK-US-Anticipated-EndOfConstruction-P687 F685 with labels.slim

Slide Analysis Information

OGR Concord SI Final West Embk Section K-K

Project Summary

File Name: Case 1-KK-US-Anticipated-EndOfConstruction-P687 F685 with labels.slim
Last saved with Slide version: 6.024
Project Title: OGR Concord SI Final West Embk Section K-K
Analysis: Fig. E-3.5 A_Case 1 U/S Static End-of-Construction, Final Config w/ Fines at 685
Author: Ben
Company: MM&A
Date Created: 1/10/2014
Comments:

Pool EL 685, FCR EL 684, FCR Initial Delta EL 673 (assume 7-ft displacement)
Structural CCR Above EL 685, Non-Structural CCR EL 666 to EL 685
Mixed CCR FCR EL 658 to 666, Undisturbed FCR Fnd EL 658
ASMC Criteria

General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3
Advanced Groundwater Method: None

Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius Increment: 10
Composite Surfaces: Enabled
Reverse Curvature: Invalid Surfaces
Minimum Elevation: Not Defined
Minimum Depth: 15

Material Properties

Property	bedrock	native soil	fcr	ccr (existing)	mix	100% structural ccr	pushout ccr
Color							
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	165	125	85	120	105	120	120
Cohesion [psf]	2000	0	0	0	0	0	0
Friction Angle [deg]	40	31	29	36	33	36	33
Water Surface	Piezometric Line 1	Piezometric Line 1	Piezometric Line 1	Piezometric Line 1	Piezometric Line 1	Piezometric Line 1	Piezometric Line 1
Hu Value	1	1	Automatically Calculated	1	1	1	1

List Of Coordinates

Piezoline

X	Y
0	545
32.65	566
37.039	568
59.587	574
107.563	576
121.966	578
184.506	594
588.947	623.326

763.059	687
1051.21	687

External Boundary

X	Y
767.084	685
761.044	688.001
694.63	721
677.059	730
671.777	730
625.888	730
596.968	725
569.028	714
553.111	714
549.521	716
547.15	716
544.265	714
512.305	696
481.519	678
466.28	672
454.178	670
448.876	668
421.111	668
411.711	670
409.044	672
405.437	672
375.591	656
369.073	652
366.617	650.338
346.16	638
339.164	636
298.385	618
282.535	618
277.745	620
274.803	620
242.796	608
230.311	604
184.506	594
149.432	586
121.966	580
107.563	578
59.5871	576
37.0388	570
32.6504	568
0	547

0	545
0	540
0	525.009
0	479.396
1051.16	479.396
1051.16	533
1051.16	543.25
1051.22	685
813.285	685

Material Boundary

X	Y
0	547
826.634	543.25
862.369	543.25
1051.16	543.25

Material Boundary

X	Y
0	540
8.17331	540
826.54	533
1051.16	533

Material Boundary

X	Y
569.028	714
586.409	714
593.915	714
596.694	712
599.304	710
601.792	708
604.386	706
607.327	704
610.43	702
613.545	700
616.641	698
619.731	696
622.823	694
625.92	692
629.017	690
632.114	688
635.221	686

637.418	685
687.724	673
705.621	666.001
726.077	658.001
739.096	652.91
743.511	648.628
747.604	645
862.369	543.25

Material Boundary

X	Y
705.621	666.001
846.803	666.001

Material Boundary

X	Y
366.617	650.338
640	648.5
743.511	648.628

Material Boundary

X	Y
637.418	685
738.227	685
767.084	685

Material Boundary

X	Y
726.077	658.001
860.915	658.001

Material Boundary

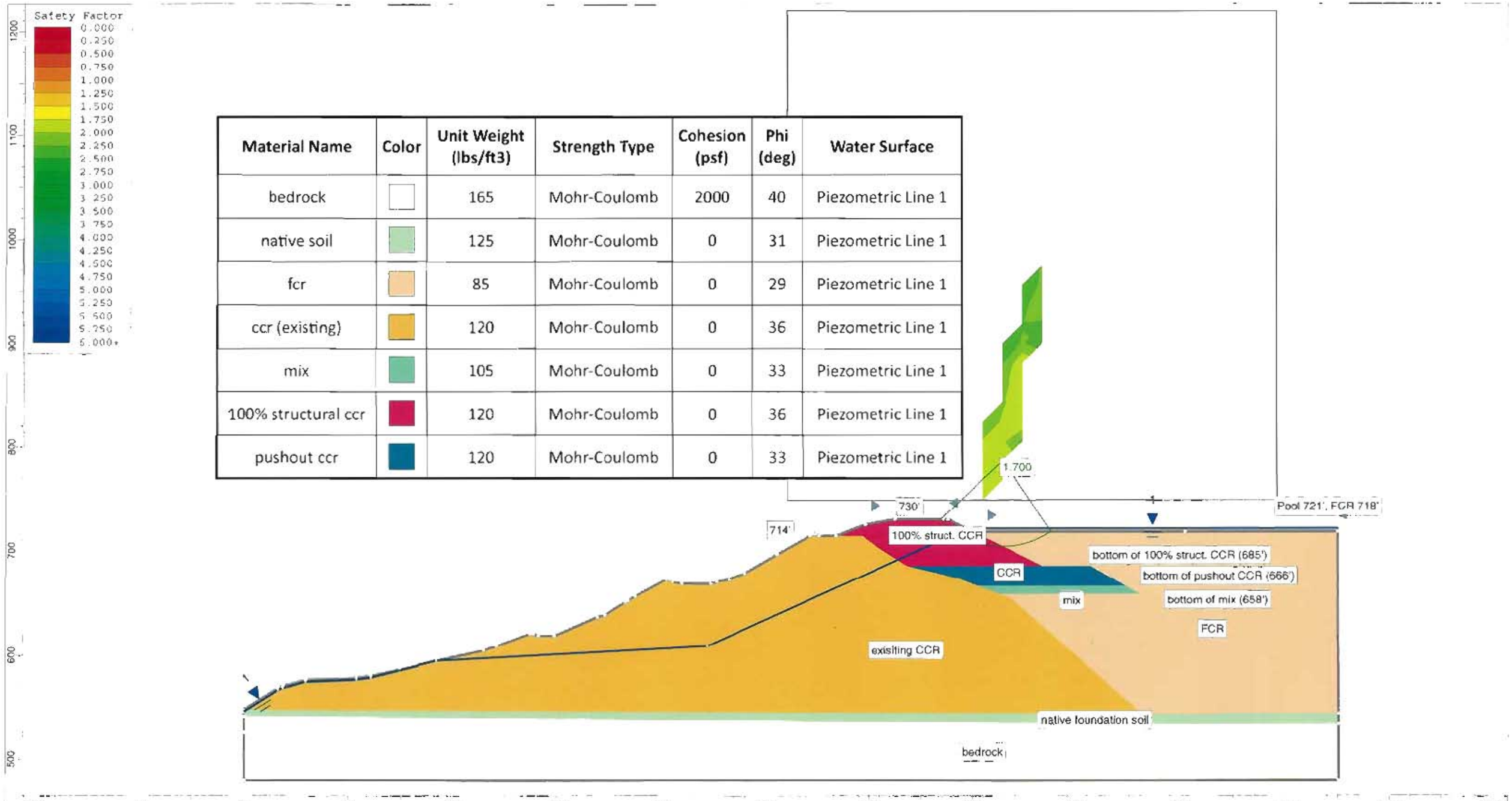
X	Y
846.803	666.001
860.915	658.001

Material Boundary

X	Y
813.285	685
825.38	678.178

846.803 666 001

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
bedrock		165	Mohr-Coulomb	2000	40	Piezometric Line 1
native soil		125	Mohr-Coulomb	0	31	Piezometric Line 1
fcr		85	Mohr-Coulomb	0	29	Piezometric Line 1
ccr (existing)		120	Mohr-Coulomb	0	36	Piezometric Line 1
mix		105	Mohr-Coulomb	0	33	Piezometric Line 1
100% structural ccr		120	Mohr-Coulomb	0	36	Piezometric Line 1
pushout ccr		120	Mohr-Coulomb	0	33	Piezometric Line 1



Prepared By:

MARSHALL MILLER & ASSOCIATES

Project	OGR Concord SI Final West Embk Section K-K
Analysis Description	Fig. E-3.5.B_Case 2 U/S Static Anticipated Final Config, Fines at 718
Drawn By: Ben	Scale: 1:1050
Company	MM&A
Date	1/10/2014
File Name	Case 2-KK-US-AnticipatedFinal Config Static-P721 F718 with labels.slim

Slide Analysis Information

OGR Concord SI Final West Embk Section K-K

Project Summary

File Name: Case 2-KK-US-AnticipatedFinal Config Static-P721 F718 with labels slim
Last saved with Slide version 6.024
Project Title: OGR Concord SI Final West Embk Section K-K
Analysis: Fig. E-3.5.B_Case 2 U/S Static Anticipated Final Config, Fines at 718
Author: Ben
Company: MM&A
Date Created 1/10/2014
Comments

Pool EL 721, FCR EL 718, FCR Initial Delta EL 673 (assume 7-ft displacement)
Structural CCR Above EL 685, Non-Structural CCR EL 666 to EL 685
Mixed CCR.FCR EL 658 to 666, Undisturbed FCR Fnd EL 658
ASMC Criteria

General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Minimum lambda (Spencer, GLE): 0.1
Discard data for surfaces with FS below: 0.75
Discard data for surfaces with FS above: 2.5
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3
Advanced Groundwater Method: None

Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius Increment: 10
Composite Surfaces: Enabled
Reverse Curvature: Invalid Surfaces
Minimum Elevation: Not Defined
Minimum Depth: 10

Material Properties

Property	bedrock	native soil	fcr	ccr (existing)	mix	100% structural ccr	pushout ccr
Color							
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	165	125	85	120	105	120	120
Cohesion [psf]	2000	0	0	0	0	0	0
Friction Angle [deg]	40	31	29	36	33	36	33
Water Surface	Piezometric Line 1	Piezometric Line 1	Piezometric Line 1	Piezometric Line 1	Piezometric Line 1	Piezometric Line 1	Piezometric Line 1
Hu Value	1	1	Automatically Calculated	1	1	1	1

List Of Coordinates

Piezoline

X	Y
0	545
32.65	566
37.039	568
59.587	574
107.563	576

121.966	578
184.506	594
445.046	608
694.63	721
1052.11	721

External Boundary

X	Y
0	525.009
0	479.396
1051.16	479.396
1051.16	533
1051.16	543.25
1051.16	718
904.697	718
700.413	718
694.63	721
677.059	730
671.777	730
625.888	730
596.968	725
569.028	714
553.111	714
549.521	716
547.15	716
544.265	714
512.305	696
481.519	678
466.28	672
454.178	670
448.876	668
421.111	668
411.711	670
409.044	672
405.437	672
375.591	656
369.073	652
366.617	650.338
346.16	638
339.164	636
298.385	618
282.535	618
277.745	620
274.803	620
242.796	608

230.311	604
184.506	594
149.432	586
121.966	580
107.563	578
59.5871	576
37.0388	570
32.6504	568
0	547
0	545
0	540

Material Boundary

X	Y
0	547
826.634	543.25
862.369	543.25
1051.16	543.25

Material Boundary

X	Y
0	540
8.17331	540
826.54	533
1051.16	533

Material Boundary

X	Y
569.028	714
586.409	714
593.915	714
596.694	712
599.304	710
601.792	708
604.386	706
607.327	704
610.43	702
613.545	700
616.641	698
619.731	696
622.823	694
625.92	692
629.017	690

632.114	688
635.221	686
637.418	685
687.724	673
705.621	666.001
726.077	658.001
739.096	652.91
743.511	648.628
747.604	645
862.369	543.25

Material Boundary

X	Y
700.413	718
743.088	697
767.084	685

Material Boundary

X	Y
705.621	666.001
846.803	666.001

Material Boundary

X	Y
366.617	650.338
640	648.5
743.511	648.628

Material Boundary

X	Y
637.418	685
738.227	685
767.084	685
813.285	685
825.38	678.178
846.803	666.001

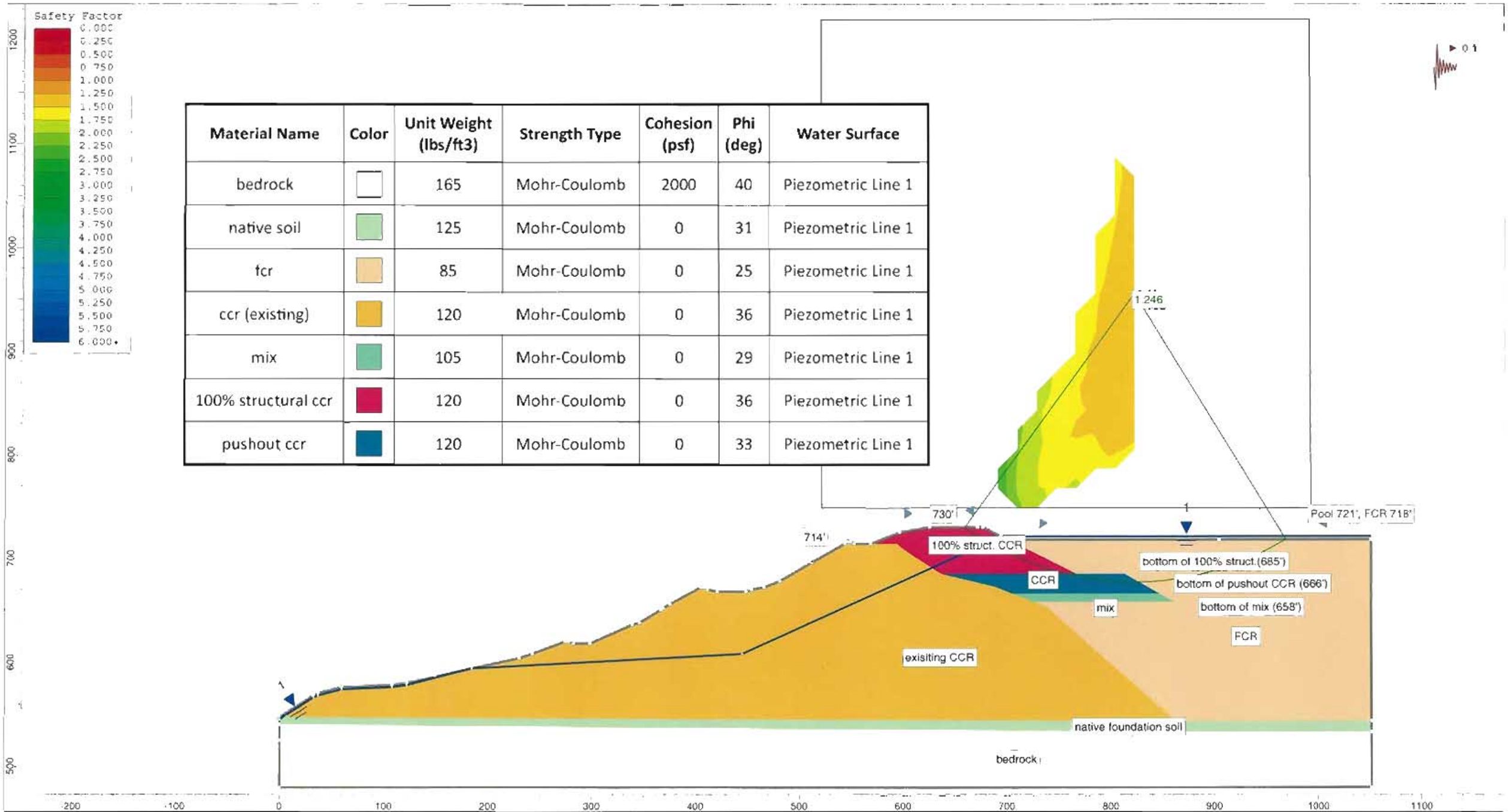
Material Boundary

X	Y
726.077	658.001
860.915	658.001

Material Boundary

X	Y
846.803	666.001
860.915	658.001

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
bedrock		165	Mohr-Coulomb	2000	40	Piezometric Line 1
native soil		125	Mohr-Coulomb	0	31	Piezometric Line 1
fcr		85	Mohr-Coulomb	0	25	Piezometric Line 1
ccr (existing)		120	Mohr-Coulomb	0	36	Piezometric Line 1
mix		105	Mohr-Coulomb	0	29	Piezometric Line 1
100% structural ccr		120	Mohr-Coulomb	0	36	Piezometric Line 1
pushout ccr		120	Mohr-Coulomb	0	33	Piezometric Line 1



Prepared By:

MARSHALL MILLER & ASSOCIATES

Project	OGR Concord SI Final West Embk Section K-K
Analysis Description	Fig. 3.6.A_Case 4 U/S Pseudo-Static EQ PGA 0.1g
Drawn By: Ben	Scale: 1:1050
Company: MM&A	
Date: 1/10/2014	File Name: Case 4-KK-US-Anticipated-Final Config PseudoStatic-P721 F718 25to29deg EQ0.1g with labels.slm

SLIDEINTERPRET 6.02

Slide Analysis Information

OGR Concord SI Final West Embk Section K-K

Project Summary

File Name: Case 4-KK-US-Anticipated-Final Config PseudoStatic-P721 F718 25to29deg EQ0.1g with labels.slim
Last saved with Slide version: 6.024
Project Title: OGR Concord SI Final West Embk Section K-K
Analysis: Fig. 3.6.A_Case 4 U/S Pseudo-Static EQ PGA 0.1g
Author: Ben
Company: MM&A
Date Created: 1/10/2014
Comments:

Pool EL 721, FCR EL 718, FCR Initial Delta EL 673 (assume 7-ft displacement)
Structural CCR Above EL 685, Non-Structural CCR EL 666 to EL 685
Mixed CCR/FCR EL 658 to 666, Undisturbed FCR Fnd EL 658
ASMC Criteria

General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function: Half Sine
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Minimum lambda (Spencer, GLE): -0.1
Discard data for surfaces with FS below: 0.75
Discard data for surfaces with FS above: 2.5
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3
Advanced Groundwater Method: None

Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v 3

Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius Increment: 10
Composite Surfaces: Enabled
Reverse Curvature: Invalid Surfaces
Minimum Elevation: Not Defined
Minimum Depth: 40

Loading

Seismic Load Coefficient (Horizontal): 0.1

Material Properties

Property	bedrock	native soil	fcr	ccr (existing)	mix	100% structural ccr	pushout ccr
Color							
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	165	125	85	120	105	120	120
Cohesion [psf]	2000	0	0	0	0	0	0
Friction Angle [deg]	40	31	25	36	29	36	33
Water Surface	Piezometric Line 1	Piezometric Line 1	Piezometric Line 1	Piezometric Line 1	Piezometric Line 1	Piezometric Line 1	Piezometric Line 1
Hu Value	1	1	Automatically Calculated	1	1	1	1

List Of Coordinates

Piezoline

X	Y
0	545

32.65	566
37.039	568
59.587	574
107.563	576
121.966	578
184.506	594
445.046	608
694.63	721
1052.11	721

External Boundary

X	Y
0	525.009
0	479.396
1051.16	479.396
1051.16	533
1051.16	543.25
1051.16	718
904.697	718
700.413	718
694.63	721
677.059	730
671.777	730
625.888	730
596.968	725
569.028	714
553.111	714
549.521	716
547.15	716
544.265	714
512.305	696
481.519	678
466.28	672
454.178	670
448.876	668
421.111	668
411.711	670
409.044	672
405.437	672
375.591	656
369.073	652
366.617	650.338
346.16	638
339.164	636
298.385	618

282.535	618
277.745	620
274.803	620
242.796	608
230.311	604
184.506	594
149.432	586
121.966	580
107.563	578
59.5871	576
37.0388	570
32.6504	568
0	547
0	545
0	540

Material Boundary

X	Y
0	547
826.634	543.25
862.369	543.25
1051.16	543.25

Material Boundary

X	Y
0	540
8.17331	540
826.54	533
1051.16	533

Material Boundary

X	Y
569.028	714
586.409	714
593.915	714
596.694	712
599.304	710
601.792	708
604.386	706
607.327	704
610.43	702
613.545	700
616.641	698

619.731	696
622.823	694
625.92	692
629.017	690
632.114	688
635.221	686
637.418	685
687.724	673
705.621	666.001
726.077	658.001
739.096	652.91
743.511	648.628
747.604	645
862.369	543.25

Material Boundary

X	Y
700.413	718
743.088	697
767.084	685

Material Boundary

X	Y
705.621	666.001
846.803	666.001

Material Boundary

X	Y
366.617	650.338
640	648.5
743.511	648.628

Material Boundary

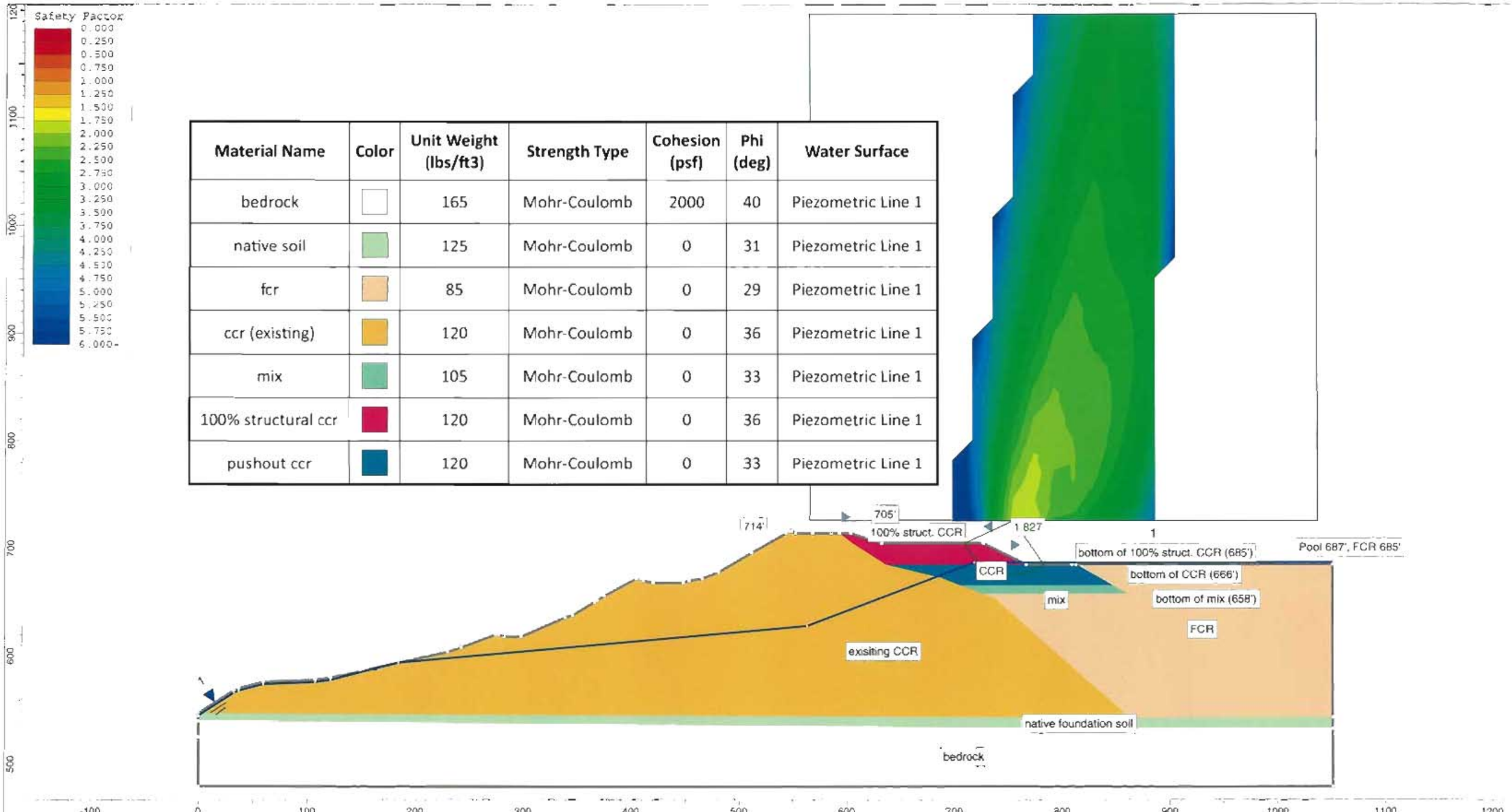
X	Y
637.418	685
738.227	685
767.084	685
813.285	685
825.38	678.178
846.803	666.001

Material Boundary

X	Y
726.077	658.001
860.915	658.001

Material Boundary

X	Y
846.803	666.001
860.915	658.001



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
bedrock		165	Mohr-Coulomb	2000	40	Piezometric Line 1
native soil		125	Mohr-Coulomb	0	31	Piezometric Line 1
fcr		85	Mohr-Coulomb	0	29	Piezometric Line 1
ccr (existing)		120	Mohr-Coulomb	0	36	Piezometric Line 1
mix		105	Mohr-Coulomb	0	33	Piezometric Line 1
100% structural ccr		120	Mohr-Coulomb	0	36	Piezometric Line 1
pushout ccr		120	Mohr-Coulomb	0	33	Piezometric Line 1

Prepared By:

MARSHALL MILLER & ASSOCIATES

Project	OGR Concord SI Interim West Embk Section K-K
Analysis Description	Fig. E-3.6.B_Case 5 U/S Static Interim Working Surface Config, Fines at 685
Drawn By	Ben
Scale	1:1017
Company	MM&A
Date	1/10/2014
File Name	Case 5-KK-US-Anticipated-Interim Config Static-P687 F685 with labels.slim

Slide Analysis Information

OGR Concord SI Interim West Embk Section K-K

Project Summary

File Name: Case 5 KK-US-Anticipated-Interim Config Static P687 F685 with labels.slim
Last saved with Slide version: 6.024
Project Title: OGR Concord SI Interim West Embk Section K-K
Analysis: Fig. E-3.6.B_Case 5 U/S Static Interim Working Surface Config, Fines at 685
Author: Ben
Company: MM&A
Date Created: 1/10/2014
Comments

Pool EL 691.5, FCR EL 682.5, FCR Initial Delta EL 673 (assume 7-ft displacement)
Structural CCR Above EL 685, Non-Structural CCR EL 666 to EL 685
Mixed CCR:FCR EL 658 to 666, Undisturbed FCR Fnd EL 658
Working Surface at EL 705 (upstream crest)
ASMC Criteria

General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Left to Right
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50
Check malpha < 0.2: Yes
Minimum lambda (Spencer, GLE): -0.1
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces

Pore Fluid Unit Weight: 62.4 lbs/ft3
Advanced Groundwater Method: None

Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius Increment: 10
Composite Surfaces: Enabled
Reverse Curvature: Invalid Surfaces
Minimum Elevation: Not Defined
Minimum Depth: 10

Material Properties

Property	bedrock	native soil	fcr	ccr (existing)	mix	100% structural ccr	pushout ccr
Color							
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	165	125	85	120	105	120	120
Cohesion [psf]	2000	0	0	0	0	0	0
Friction Angle [deg]	40	31	29	36	33	36	33
Water Surface	Piezometric Line 1	Piezometric Line 1	Piezometric Line 1	Piezometric Line 1	Piezometric Line 1	Piezometric Line 1	Piezometric Line 1
Hu Value	Automatically Calculated	Automatically Calculated	Automatically Calculated	Automatically Calculated	Automatically Calculated	Automatically Calculated	Automatically Calculated

List Of Coordinates

Piezoline

X	Y
0	545
32.65	566
37.039	568
59.587	574
107.563	576

121.966	578
184.506	594
563.65	628.151
718.663	687
1051.8	687

External Boundary

X	Y
0	525.009
0	479.396
1051.16	479.396
1051.16	533
1051.16	543.25
1051.16	685
813.149	685
809.455	685
767.084	685
727.084	705
632.956	705
604.495	714
593.915	714
586.409	714
569.028	714
553.111	714
549.521	716
547.15	716
544.265	714
512.305	696
481.519	678
466.28	672
454.178	670
448.876	668
421.111	668
411.711	670
409.044	672
405.437	672
375.591	656
369.073	652
366.617	650.338
346.16	638
339.164	636
298.385	618
282.535	618
277.745	620
274.803	620

242.796	608
230.311	604
184.506	594
149.432	586
121.966	580
107.563	578
59.5871	576
37.0388	570
32.6504	568
0	547
0	545
0	540

Material Boundary

X	Y
0	547
826.634	543.25
862.369	543.25
1051.16	543.25

Material Boundary

X	Y
0	540
8.17331	540
826.54	533
1051.16	533

Material Boundary

X	Y
593.915	714
596.694	712
599.304	710
601.792	708
604.386	706
607.327	704
610.43	702
613.545	700
616.641	698
619.731	696
622.823	694
625.92	692
629.017	690
632.114	688

635.221	686
637.418	685
687.724	673
705.621	666.001
726.077	658.001
739.096	652.91
743.511	648.628
747.604	645
862.369	543.25

Material Boundary

X	Y
705.621	666.001
846.803	666.001

Material Boundary

X	Y
366.617	650.338
640	648.5
743.511	648.628

Material Boundary

X	Y
637.418	685
767.084	685

Material Boundary

X	Y
726.077	658.001
860.915	658.001

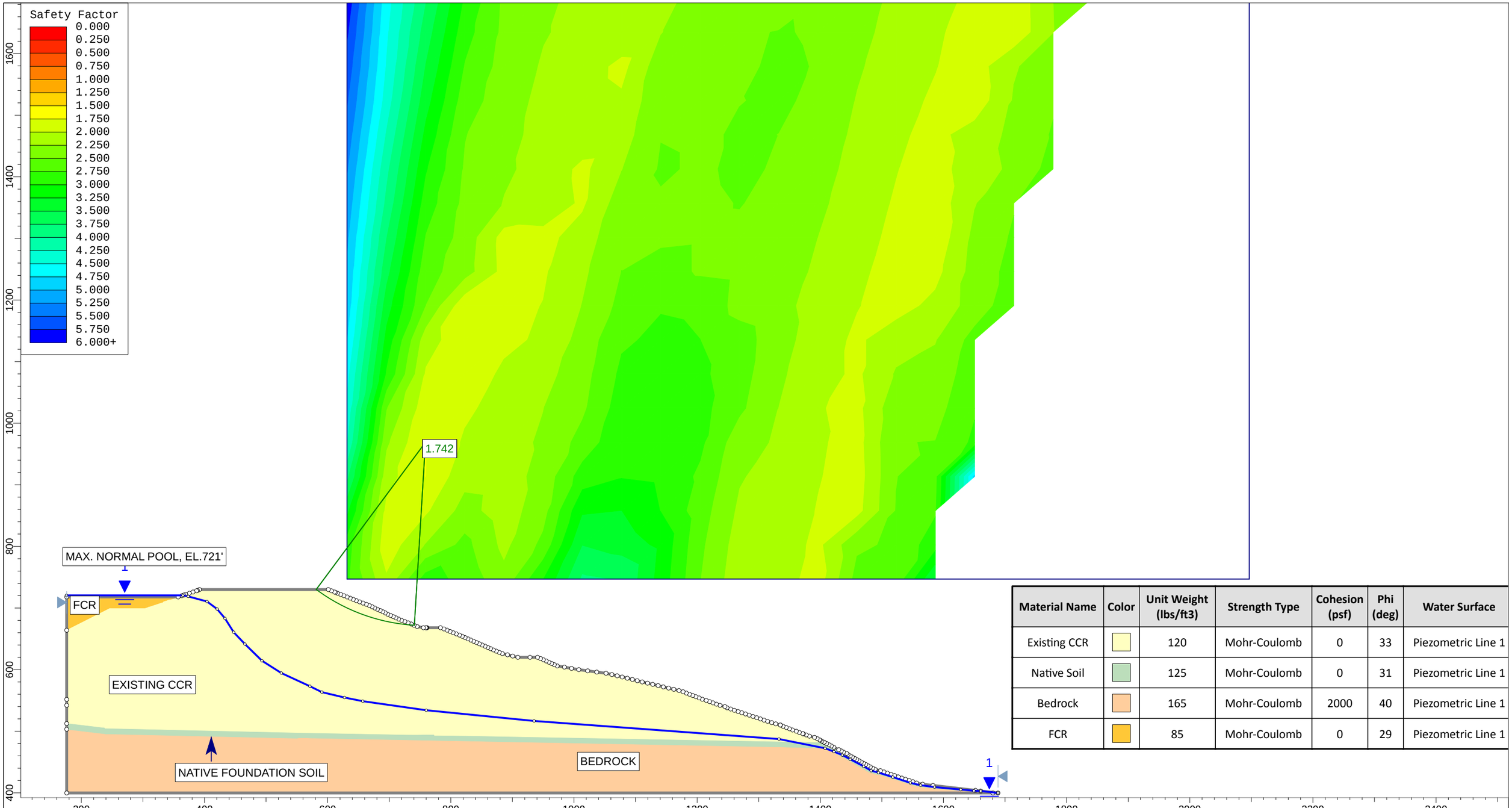
Material Boundary

X	Y
846.803	666.001
860.915	658.001

Material Boundary

X	Y
813.149	685
825.38	678.178

846.803 666.001



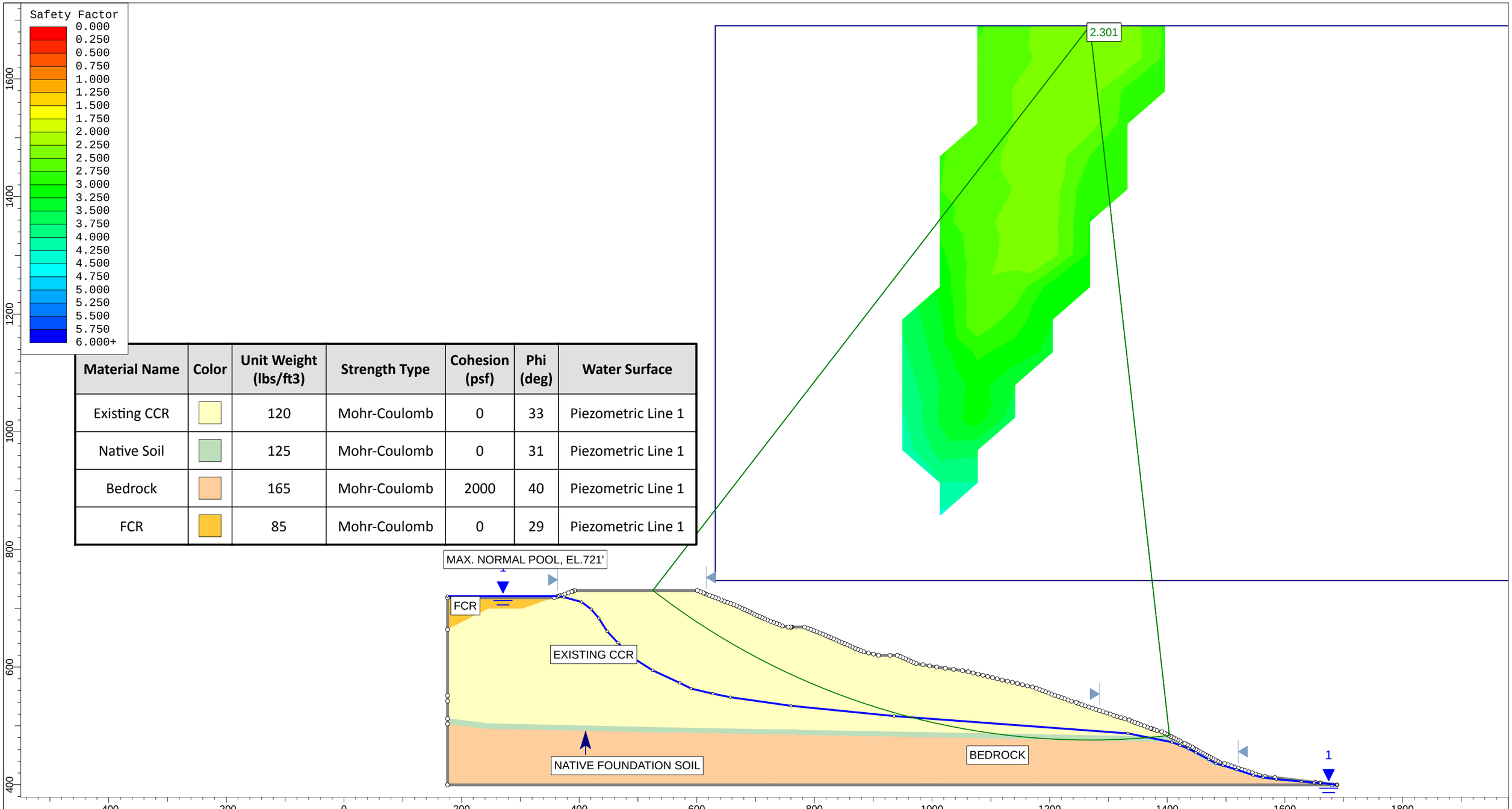
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
Existing CCR		120	Mohr-Coulomb	0	33	Piezometric Line 1
Native Soil		125	Mohr-Coulomb	0	31	Piezometric Line 1
Bedrock		165	Mohr-Coulomb	2000	40	Piezometric Line 1
FCR		85	Mohr-Coulomb	0	29	Piezometric Line 1

Prepared By:

MARSHALL MILLER & ASSOCIATES®

SLIDEINTERPRET 6.029

Project	SLIDE - An Interactive Slope Stability Program		
Analysis Description	Stability_SI#3 Eastern Excavation_MM&A Section EX-B_Entire		
Drawn By	BCP	Scale	1:1777
Company	MM&A		
Date	5/15/2014	File Name	2a excavation_section EX-B_entire stability, 33 for CCR_MM&A_721_ 5-29-14.slim



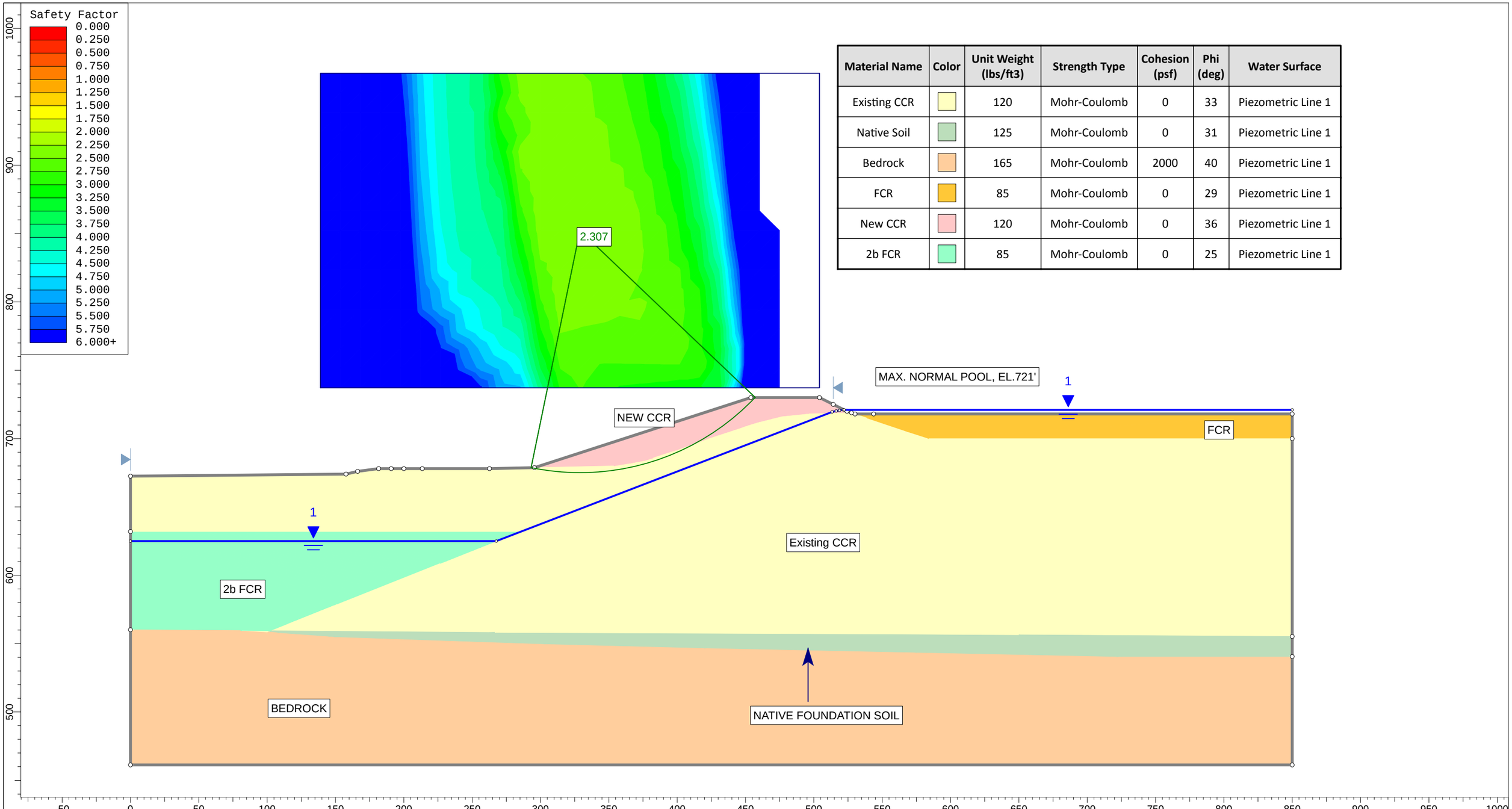
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
Existing CCR		120	Mohr-Coulomb	0	33	Piezometric Line 1
Native Soil		125	Mohr-Coulomb	0	31	Piezometric Line 1
Bedrock		165	Mohr-Coulomb	2000	40	Piezometric Line 1
FCR		85	Mohr-Coulomb	0	29	Piezometric Line 1

Prepared By:

MARSHALL MILLER & ASSOCIATES®

SLIDEINTERPRET 6.029

Project	SLIDE - An Interactive Slope Stability Program		
Analysis Description	Stability_SI#3 Eastern Excavation_MM&A Section EX-B_Crest to Toe		
Drawn By	BCP	Scale 1:1861	Company MM&A
Date	5/15/2014		File Name 2a excavation_section EX-B_crest stability, 33 for CCR_MM&A_721_ 5-29-14.slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
Existing CCR		120	Mohr-Coulomb	0	33	Piezometric Line 1
Native Soil		125	Mohr-Coulomb	0	31	Piezometric Line 1
Bedrock		165	Mohr-Coulomb	2000	40	Piezometric Line 1
FCR		85	Mohr-Coulomb	0	29	Piezometric Line 1
New CCR		120	Mohr-Coulomb	0	36	Piezometric Line 1
2b FCR		85	Mohr-Coulomb	0	25	Piezometric Line 1

Prepared By:

MARSHALL MILLER & ASSOCIATES®

SLIDEINTERPRET 6.029

Project	SLIDE - An Interactive Slope Stability Program		
Analysis Description	Stability_SI#3 Northern Excavation_MM&A Section EX-D_Entire		
Drawn By	BCP	Scale	1:801
Company	MM&A		
Date	6/12/2014	File Name	EX-D.slim