January 20, 2015
GEI Project Number 140521-0

Eric Scott
Colorado Division of Mining, Reclamation, and Safety
1313 Sherman St., Room 215
Denver, CO 80203

Re: Geotechnical Stability Analysis for Martin Marietta Materials Three Bells Mine, M-1979-191, Larimer County, Colorado

Dear Mr. Scott,

This letter addresses the Geotechnical Stability Exhibit for the Martin Marietta Materials, Inc. (MMM) Three Bells Mine (M-1979-191) Reclamation Permit amendment, per Rule 6.5. The geotechnical stability exhibit is required in the event of unreturned Structure Agreement letters from owners of permanent structures within 200 feet of the mine boundary.

The Three Bells Mine is located in southeast quarter of Section 11, the southwest quarter of the southwest quarter of Section 12, the east half of the northwest quarter of Section 13, and the west half of the northeast quarter of Section 13 of Township 6 North, Range 68 West of the 6th Principle Meridian.

Permanent man-made structures within 200 feet of the proposed excavation limits include: East Larimer County Road 32E, parking lot, concrete path, various residential buildings, various agricultural buildings, an oil well and pipeline, utility power lines, sewer lines, municipal water station, weirs on the Cache la Poudre River, and bridges over the Cache la Poudre River (see full list on page 2).

Geologic Strata and Mining Conditions

The Three Bells Mine is located adjacent to the Cache la Poudre River in Windsor, Colorado. Mining will take place in the Three Bells Ditullio property in five phases. Phases 1, 3, and 4 will be lined with a compacted clay liner (CCL). Phase 4 will be partially backfilled and Phase 2 and 5 will be completely backfilled.

Veldman reclamation was completed in 2014.

Boring data gathered from boreholes advanced by others in 2013 (Figure 6 and 7), in addition to observations made within the mined pits, indicates that overburden is located at the surface of the mine, below which is a layer of pit run (sand and gravel), overlying bedrock. Overburden and pit run have variable depths, depending on locations in the mine and the mining phase. The bedrock underlying the mine is approximately 8-19 feet below

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existing ground surface. Boring data also indicates the groundwater surface is located approximately 2-9 feet below ground surface.

Proposed mine highwalls will be approximately 9-17 feet tall, and will be reclaimed at a 3:1 (H:V) slope. Highwalls will also be sealed with a low permeability barrier (LPB) constructed of overburden gathered from the Three Bells Mine. Existing reservoir slopes will become mine highwalls during operation and will be reclaimed to a Colorado SEO recognized stable slope after mining operations have been completed.

Slope Stability Monitoring Plan

During mining and reclamation, MM will observe the mine high-wall and native ground immediately adjacent to the areas under active mining or reclamation. This monitoring will be conducted by MM staff during normal mine related activities conducted on a day to day basis. If signs of global instability are observed (tension cracks, large scale slope movement or sloughing, etc.), MM will immediately contact the appropriate entities (DRMS, consulting engineers) and will take appropriate action to stabilize the area. Stabilization will include immediate and long term options.

Known Man-Made Structures within 200 feet of Mining Limits

Known man-made structures within 200 feet of the proposed operation are listed below and shown on **Figure 1 through 4**:

Supplied a structure agreement

Owner: Bayswater Exploration and Production, LLC

- 2 oil/gas wells

Owner: Larimer County

- E CR 32E
- Parking lot and concrete path

Did NOT supply a structure agreement

Owner: DCP Midstream

- Oil/gas pipeline

Owner: South Fort Collins Sanitation District

- Monitoring station
- Sewer line

Owner: John Graves

- 2 Bridges over the Greeley No. 2 Canal

Owner: William Graves

- 2 residential farming structures

Owner: Cache la Poudre Irrigation Company

- Weir on the Greeley Number 2 Canal
- Weir on the Cache la Poudre
- Residential building

Owner: Poudre Valley REA

- Power lines/power line poles

Stability Analyses

Stability analyses were performed in order to evaluate potential for damage to existing permanent structures due to mine highwall slope failures. Analyses were performed with Slope/W 2012 v. 8.12.3.7901 computer program. For each case we analyzed the most critical soil profiles based on exploratory boring data (i.e. tallest highwall, shortest highwall ledge, thickest overburden, etc.).

The stability analyses were run in accordance with accepted geotechnical standards and DRMS requirements for temporary pit slopes summarized as follows:

- Mine highwalls were modeled as vertical slopes
- Residual soil strength parameters used for the upper 2.5 feet of weathered bedrock
- Factor of Safety must be greater than 1.0

Groundwater levels on the profiles were modeled with anticipated maximum elevations to portray anticipated site conditions.

Laboratory strength tests were not performed on soils from the site. The soil strength parameters used were based on typical values from the anticipated soils and our experience working with DRMS at other sites. The input strength parameters are displayed in **Table 1**.

Table 1. Stability Analysis Strength Parameters

Material	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (deg)
Sand and gravel	125	0	35
Overburden	122	0	27
Shale Bedrock	120	100	30
Weathered Shale	120	50	15

The Ditullio slope liner design was modeled with a critical section developed from the most conservative conditions encountered at the site, more conservative than those utilized for Veldman property, including 4 feet of overburden overlying a 14.4 foot thick layer of sand and gravel. Beneath the sand and gravel, a 2.5 foot thick layer of weathered, residual strength bedrock. Beneath this layer of residual strength bedrock we modelled undisturbed shale bedrock.

The closest structure to mine excavation limits is listed in **Table 2**. Only the closest structure was modeled, per DRMS suggestion. It is assumed any structure beyond this distance will have a higher factor of safety. Thus, this closest permanent structure is the critical, lowest stability value. The critical cross-section is shown on **Figure 5**.

Table 2: Closest Structure within 200 Feet of Excavation Limits

Structure	Structure Owner	Distance to Structure
Power line pole	Poudre Valley REA	29 feet from excavation

Stability analyses were run on randomly generated circles generated through the mine excavation and highwall intersecting the location of only the configuration of the closest permanent structure. The Slope/W program calculated the Factors of Safety (FOS) using the ordinary, Bishop, Janbu, and Spencer Methods. The Spencer FOS correlates more closely with observations of actual slope failure, providing a realistic and more rigorous FOS. On the annotated cross sections (**Attachment A**), the Spencer FOS is listed. The results of the analyses are listed in **Table 3**.

Table 3: Stability Results for Excavation in Proximity to Utilities

Structure	Distance to Structure	Factor of Safety
Power line pole	29 feet	1.3

Figures

LEGEND

- 4880 — MAJOR CONTOUR
- STRUCTURE BOUNDARY
- PROPOSED SLOPE LINER TOE
- LIMIT OF EXCAVATION
- PERMIT BOUNDARY
- PROPOSED BACKFILL LOCATIONS
- PROPOSED SLOPE LINERS

0 400 800
SCALE, FEET

M-1979-191 Reclamation Permit Amendment
Application: Three Bells Mine
Larimer County, Colorado

Martin Marietta Materials
Fort Collins, CO

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Project 140521-0

THREE BELLS MINE: GEOTECHNICAL STABILITY EXHIBIT SITE PLAN

January 2015 Figure 1

P:\133252 - MMM Ditullio Slope Liner\Civil\Production Drawings\Working Drawings\ DRMS Stability.dwg Jan 2015

LEGEND

- 4880 — MAJOR CONTOUR
- STRUCTURE BOUNDARY
- PROPOSED SLOPE LINER TOE
- LIMIT OF EXCAVATION
- PERMIT BOUNDARY
- PROPOSED BACKFILL LOCATIONS
- PROPOSED SLOPE LINERS

DETAIL 1/1
DITULLIO STRUCTURES

0 100 200
SCALE, FEET

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Larimer County, Colorado

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THREE BELLS MINE:
GEOTECHNICAL STABILITY
EXHIBIT - DETAIL 1

January 2015 Figure 2

P:\133252 - MMM Ditullio Slope Liner\Civil\Production Drawings\Working Drawings\ DRMS Stability.dwg Jan 2015

DETAIL 3/1
DITULLIO STRUCTURES

0 100 200
SCALE, FEET

LEGEND

- 4880 — MAJOR CONTOUR
- STRUCTURE BOUNDARY
- PROPOSED SLOPE LINER TOE
- LIMIT OF EXCAVATION
- PERMIT BOUNDARY
- PROPOSED BACKFILL LOCATIONS
- PROPOSED SLOPE LINERS

DETAIL 2/1
VELDMAN STRUCTURES

0 100 200
SCALE, FEET

M-1979-191 Reclamation Permit Amendment
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THREE BELLS MINE:
GEOTECHNICAL STABILITY
EXHIBIT - DETAIL 2

January 2015 Figure 3

P:\133252 - MMM Ditullio Slope Liner\Civil\Production Drawings\Working Drawings\ DRMS Stability.dwg Jan 2015

LEGEND

- 4880 — MAJOR CONTOUR
- STRUCTURE BOUNDARY
- PROPOSED SLOPE LINER TOE
- LIMIT OF EXCAVATION
- PERMIT BOUNDARY
- PROPOSED BACKFILL LOCATIONS
- PROPOSED SLOPE LINERS

DETAIL 4/1
VELDMAN STRUCTURES

0 100 200
SCALE, FEET

M-1979-191 Reclamation Permit Amendment
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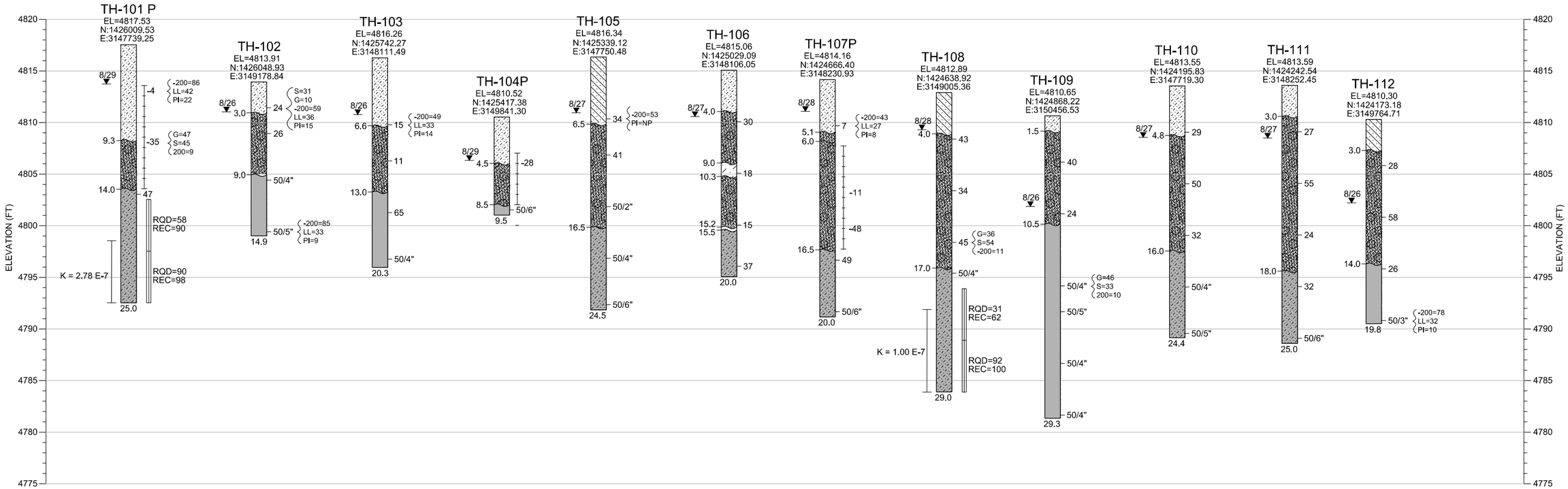
THREE BELLS MINE:
GEOTECHNICAL STABILITY
EXHIBIT - DETAIL 3

Project 140521-0 | January 2015 | Figure 4

P:\133252 - MMM Ditullio Slope Liner\Civil\Production Drawings\Working Drawings\ DRMS Stability.dwg Jan 2015



LEGEND:

- CLAY: MEDIUM STIFF, SILTY, LOCALLY SANDY, FINE TO MEDIUM GRAINED, MOIST TO WET, GRAY TO DARK BROWN TO BLACK, MODERATELY PLASTIC TO PLASTIC, LOCALLY ROOTS
- CLAYEY SAND: LOOSE TO MEDIUM DENSE, SILTY, FINE TO MEDIUM GRAINED, LOCAL SMALL GRAVEL, DRY TO WET, LIGHT BROWN TO DARK BROWN, LOW TO MODERATELY PLASTIC, LOCAL PLANT ROOTS (SC)
- SILTY SAND: LOOSE TO MEDIUM DENSE, CLAYEY, BROWN, DRY, NON TO VERY LOW PLASTIC, LOCAL ROOTS PRESENT
- SAND: LOOSE, POORLY GRADED, FINE TO MEDIUM GRAINED, MOIST, GRAYISH BROWN
- SAND & GRAVEL: MEDIUM DENSE TO VERY DENSE, SANDY GRAVEL TO GRAVELLY SAND, LOCAL COBBLES, WELL GRADED, FINE TO COARSE GRAINED SAND, SMALL GRAVEL UP TO 8 INCH GRAVEL, ROUNDED GRAVEL AND COBBLES, DRY TO WET, PINKISH BROWN TO LIGHT BROWN TO TANISH BROWN (SW, GW, GM)
- WEATHERED CLAYSTONE: STIFF (SOILS), VERY LOW TO LOW STRENGTH BEDROCK, DRY TO SLIGHTLY MOIST, VERY FINE SAND, MOTTLED BROWN TO BROWNISH TAN, LOCAL IRON STAINING, MIXTURE OF BEDROCK COLORS, MODERATELY PLASTIC, BLOCKY
- CLAYSTONE: HARD TO VERY HARD (SOILS), VERY LOW TO LOW STRENGTH BEDROCK, DRY TO SLIGHTLY MOIST, SANDY, VERY FINE SAND, GRAY TO DARK GRAY, LOW TO MODERATELY PLASTIC, LOCAL SHALE THINLY BEDDED, BLOCKY
- SANDSTONE: HARD (SOILS), LOW TO MODERATE STRENGTH BEDROCK, DRY TO SLIGHTLY MOIST, CLAYEY, VERY FINE SAND, LIGHT GRAY TO GRAY, LOCAL SHALE THINLY BEDDED, BLOCKY, FRESH, LOCAL FOSSIL

TH-101 P P STANDS FOR PIEZOMETER
EL=4817.53
N:1426009.53
E:3147739.25

9.3 APPROXIMATE DEPTH OF GEOLOGIC CONTACT

8/29 WATER ENCOUNTERED DURING DRILLING AND DATE MEASURED

35 STANDARD SPLITSPOON BLOW COUNTS. NUMBER ("N" VALUE) INDICATES THE NUMBER OF BLOWS OF A 140 LB. HAMMER FREE FALLING 30 INCHES REQUIRED TO DRIVE THE SAMPLER 1 FOOT OR THE INDICATED INTERVAL. "WT" INDICATES THE SAMPLER ADVANCED WITH RESTING WEIGHT OF THE HAMMER

PIEZOMETER SCREENED PIPE INTERVAL

PACKER TEST INTERVAL
CALCULATED PERMEABILITY
K (CM/S), TL=TOO LOW TO MEASURE

CORE INTERVALS (HQ)
RQD=ROCK QUALITY DESIGNATION (%)
REC=RECOVERED CORE (%)

25.0 DEPTH OF BORING (FT)

NOTES:

1. EXPLORATORY BORINGS WERE DRILLED 8-26-13 THROUGH 8-29-13 USING A TRUCK-MOUNTED CME 55 DRILL RIG. BORINGS WERE DRILLED WITH 4.25-INCH I.D. HOLLOW STEM AUGERS.
2. EXPLORATORY TEST PITS WERE EXCAVATED ON 10-2-13 USING A 310k JOHN DEERE BACKHOE & ON 10-2-13 USING A 310K JOHN DEERE BACKHOE.
3. ALL EXPLORATORY LOCATIONS AND ELEVATIONS WERE SURVEYED BY INTERMILL LAND SURVEYING ON 8-26-13 THROUGH 8-30-13 FOR THE GEOTECHNICAL INVESTIGATION. LOCATIONS FOR TP-204 THROUGH TP-206 WERE FOUND USING A GPS AND ELEVATIONS WERE INTERPOLATED FROM THE SURVEYED GROUND SURFACE.
4. LINES BETWEEN MATERIALS REPRESENT APPROXIMATE BOUNDARIES BETWEEN TYPES AND TRANSITIONS MAY BE GRADUAL.
5. GROUNDWATER LEVELS WERE MEASURED AT THE TIME OF DRILLING & ON 8/23 /13 FOR COMPLETED PIEZOMETER. GROUNDWATER LEVELS MAY FLUCTUATE SEASONALLY AND DUE TO SITE MINING AND DEWATERING OPERATIONS.
6. LAB TESTING:
   - G = % GRAVEL BY WEIGHT
   - S = % SAND BY WEIGHT
   - -200 = % BY WEIGHT PASSING THE #200 SIEVE
   - LL = LIQUID LIMIT
   - PI = PLASTICITY INDEX
   - NP = NON PLASTIC MATERIAL

GEI NOTE:

LOGS RECREATED FROM INFORMATION PROVIDED BY MARTIN MARIETTA MATERIALS. BORINGS AND TEST PITS EXCAVATED BY DEERE AND AULT CONSULTANTS, INC. IN 2013. MATERIAL DESCRIPTIONS AND NOTES CREATED BY DEERE AND AULT (WATER STORAGE FEASIBILITY STUDY, JANUARY 2014).

Attention:
0 1"
If this scale bar does not measure 1" then drawing is not original scale.

NO.	DATE	ISSUE/REVISION	APP
0	06/27/14	90% SUBMITTAL	JDD

Designed: J. DEUTO
Checked: C. MASCHING
Drawn: C. NIEMELA
Approved By: J. DEUTO
Approval Date:

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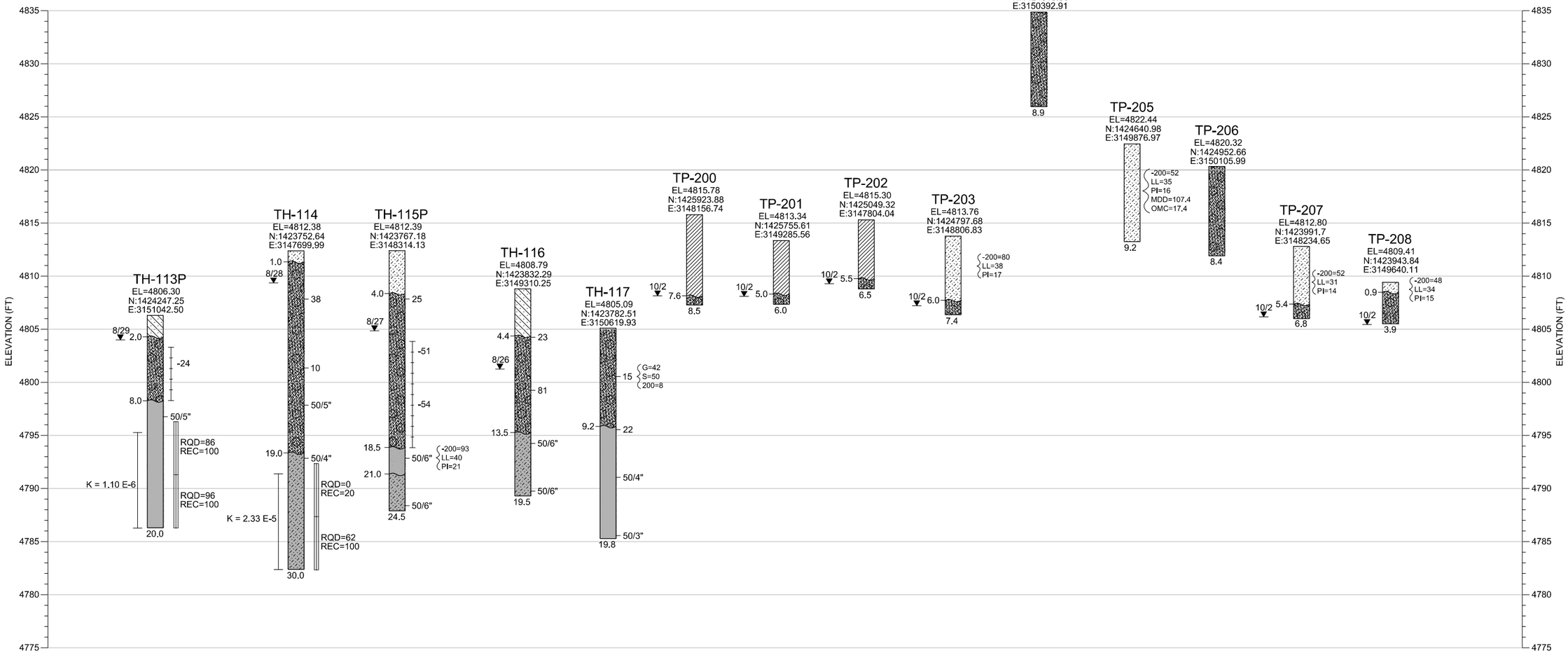
GEI Project 133252

Three Bells-Ditullio Property
Ponds 1, 3, and 4 Slope Liners
Windsor, Colorado

SUMMARY LOGS OF BORING AND TEST PITS (1 OF 2)

DWG. NO. 5



NOTES:

1. BORING LEGEND SHOWN ON SHEET 6.
2. EXPLORATORY BORINGS WERE DRILLED 8-26-13 THROUGH 8-29-13 USING A TRUCK MOUNTED CME 55 DRILL RIG. BORINGS WERE DRILLED WITH A4.25 INCH I.D. HOLLOW STEM AUGERS.
3. EXPLORATORY TEST PITS WERE EXCAVATED ON 10-2-13 USING A 310K JOHN DEERE BACKHOE.
4. ALL EXPLORATORY LOCATIONS AND ELEVATIONS WERE SURVEYED BY INTERMILL LAND SURVEYING ON 8-26-13 THROUGH 8-30-13 FOR THE GEOTECHNICAL INVESTIGATION. LOCATIONS FOR TP-204 THROUGH TP-206 WERE FOUND USING A GPS AND ELEVATIONS WERE INTERPOLATED FROM THE SURVEYED GROUND SURFACE.
5. LINES BETWEEN MATERIALS REPRESENT APPROXIMATE BOUNDARIES BETWEEN TYPES AND TRANSITIONS MAY BE GRADUAL.
6. GROUNDWATER LEVELS WERE MEASURED AT THE TIME OF DRILLING. GROUNDWATER LEVELS MAY FLUCTUATE SEASONALLY AND DUE TO SITE MINING AND DEWATERING OPERATIONS.
7. TP-204 THROUGH TP-206 WERE DONE IN TOP OF EXISTING STOCKPILES AND LOCATED BY GPS.
8. LAB TESTING:
   - G = % GRAVEL BY WEIGHT
   - S = % SAND BY WEIGHT
   - -200 = % BY WEIGHT PASSING THE #200 SIEVE
   - LL = LIQUID LIMIT
   - PI = PLASTICITY INDEX
   - NP = NON PLASTIC MATERIAL

GEI NOTE:

LOGS RECREATED FROM INFORMATION PROVIDED BY MARTIN MARIETTA MATERIALS. BORINGS AND TEST PITS EXCAVATED BY DEERE AND AULT CONSULTANTS, INC. IN 2013. MATERIAL DESCRIPTIONS AND NOTES CREATED BY DEERE AND AULT (WATER STORAGE FEASIBILITY STUDY, JANUARY 2014).

Attention:

0 1"

If this scale bar does not measure 1" then drawing is not original scale.

NO.	DATE	ISSUE/REVISION	APP
0	06/27/14	90% SUBMITTAL	JDD

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Approved By:	J. DEUTO
Approval Date:	

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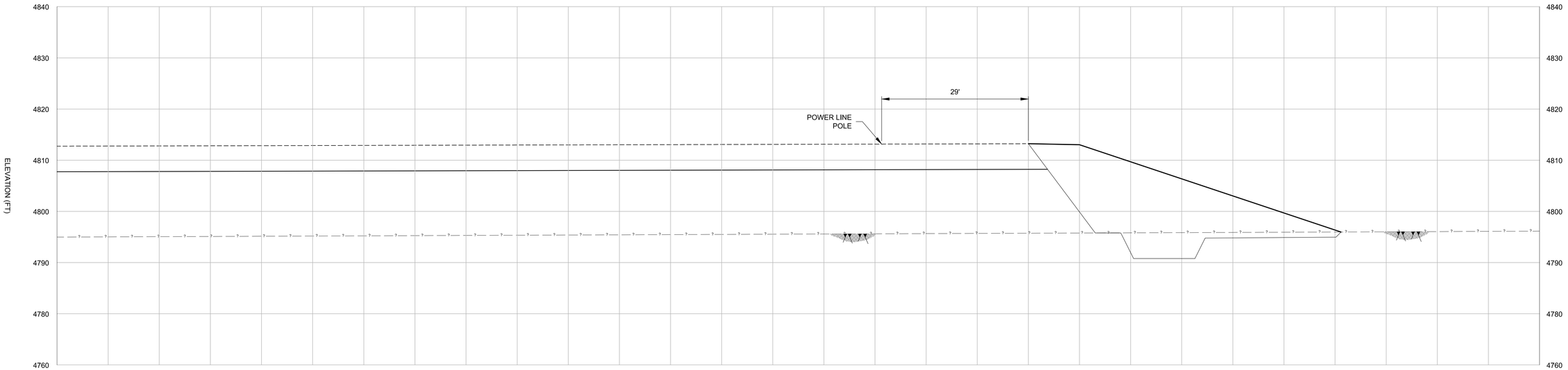
Three Bells-Ditullio Property
Ponds 1, 3, and 4 Slope Liners
Windsor, Colorado

SUMMARY LOGS
OF BORING AND TEST PITS
(2 OF 2)

DWG. NO. 6

P:\133252 - MMM Ditullio Slope Liner\Civil\Production Drawings\Working Drawings\ Sheet 6 & Sheet 7 - Test Pits and Boring Logs.dwg Jun 24, 2014 smickell

CRITICAL SECTION



0 10 20
SCALE, FEET

LEGEND

- EXISTING GROUND
- SLOPE LINER EXCAVATION LIMITS
- PROPOSED SLOPE LINER
- ASSUMED PIT RUN
- ASSUMED BEDROCK

M-1979-191 Reclamation Permit Amendment
Application: Three Bells Mine
Larimer County, Colorado

Martin Marietta Materials
Fort Collins, CO

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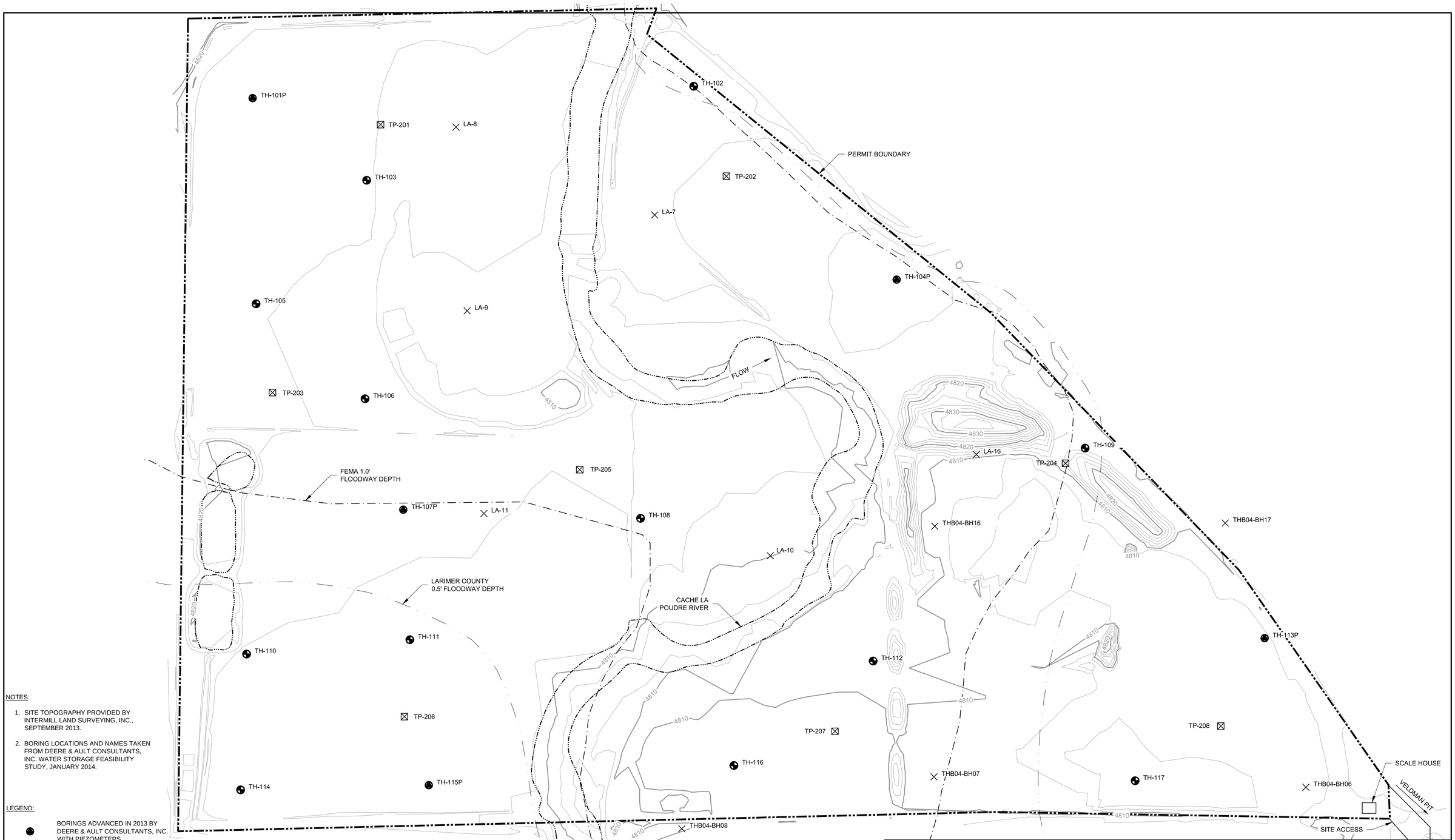
THREE BELLS MINE:
GEOTECHNICAL STABILITY
EXHIBIT - SECTION

January 2015 Figure 7

P:\133252 - MMM Ditullio Slope Liner\Civil\Production Drawings\Working Drawings\ DRMS Stability.dwg Jan 2015



NOTES:

1. SITE TOPOGRAPHY PROVIDED BY INTERMILL LAND SURVEYING, INC., SEPTEMBER 2013.
2. BORING LOCATIONS AND NAMES TAKEN FROM DEERE & AULT CONSULTANTS, INC. WATER STORAGE FEASIBILITY STUDY, JANUARY 2014.

LEGEND:

- BORINGS ADVANCED IN 2013 BY DEERE & AULT CONSULTANTS, INC. WITH PIEZOMETERS
- BORINGS ADVANCED IN 2013 BY DEERE & AULT CONSULTANTS, INC.
- TEST PITS EXCAVATED IN 2013 BY DEERE & AULT CONSULTANTS, INC.
- BORINGS ADVANCED BY LAFARGE (LOCATIONS APPROXIMATE AND DATES UNKNOWN)

M-1979-191 Reclamation Permit Amendment
Application: Three Bells Mine
Larimer County, Colorado

Martin Marietta Materials
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EXISTING CONDITIONS AND GEOTECHNICAL EXPLORATION PLAN

Project 140521-0 | January 2015 | Figure 8

P:\133252 - MMM Ditullio Slope Liner\Civil\Production Drawings\Working Drawings\ Stability Figure 8.dwg Jan 2015

Attachment A

Project: Three Bells Mine
Project Number: 1332520
Location: Critical Section, Worst Case Scenario
By: M. Khan
Date: 1/21/2015

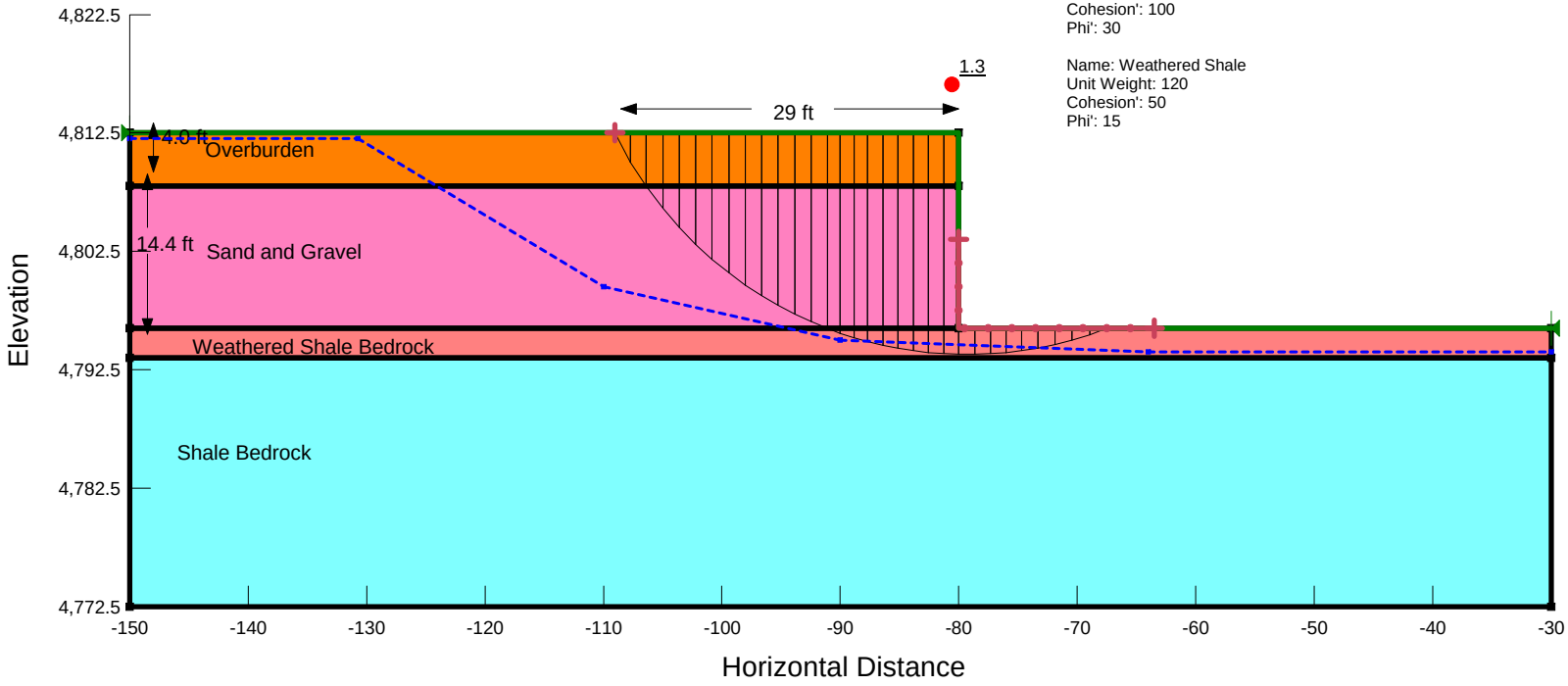
Three Bells Mine-Empty Power Line 29.0 ft back

Name: Overburden
Unit Weight: 122
Cohesion': 0
Phi': 27

Name: Sand and Gravel
Unit Weight: 125
Cohesion': 0
Phi': 35

Name: Shale Bedrock
Unit Weight: 120
Cohesion': 100
Phi': 30

Name: Weathered Shale
Unit Weight: 120
Cohesion': 50
Phi': 15



Project: Three Bells Mine
Project Number: 1332520
Location: Maximum Section, Post Reclamation
By: M. Khan
Date: 1/21/2015

Three Bells Mine-Empty

Name: Slope Liner
Unit Weight: 122
Cohesion': 100
Phi': 27

Name: Overburden
Unit Weight: 122
Cohesion': 0
Phi': 27

Name: Sand and Gravel
Unit Weight: 125
Cohesion': 0
Phi': 35

Name: Shale Bedrock
Unit Weight: 120
Cohesion': 100
Phi': 30